

E-TENDER SPECIFICATION

BHE/PW/PUR/BWT6-CVL/BAL-CHP-AHP/2468

**Balance Civil, Structural & Architectural work of AHP MCC
Cum Compressor Building, ERH, ERH Tunnel, CHP MCC-1, CHP
MCC-2 & Ash Slurry Pump House at 1x660 MW Bhusawal
Thermal Power Station, Unit-6, Maharashtra.**

VOLUME I E- Technical Specifications and Plot Plan (Part-01 of 03)

THIS TENDER SPECIFICATION CONSISTS OF:

Notice Inviting Tender	
Volume-IA	Technical Conditions of Contract
Volume-IB	Special conditions of Contract
Volume-IC	General conditions of Contract
Volume-ID	Forms & Procedures
Volume-IE	Technical Specifications and Plot Plan
Volume II	Price Bid



Bharat Heavy Electricals Limited
(A Government of India Undertaking)
Power Sector - Western Region
345-Kingsway, Nagpur-440001

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EARNEST MONEY DEPOSIT: Refer Notice Inviting Tender

LAST DATE FOR TENDER SUBMISSION Refer Notice Inviting Tender

THESE TENDER SPECIFICATION DOCUMENTS CONTAINING VOLUME-I AND VOLUME- II ARE ISSUED TO:

M/s.

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For Bharat Heavy Electricals Limited

AGM (Purchase)

Place: Nagpur
Date:



**TECHNICAL REQUIREMENT FOR CIVIL,
STRUCTURAL & ARCHITECTURAL
WORKS FOR BHUSAWAL T.P.S. UNIT-6 :
1X660MW PROJECT**

SPECIFICATION NO. PE-TS-415-600-C001			
VOLUME - II B			
SECTION - D		SUB-SECTION	
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MAHARASHTRA STATE POWER GENERATION CO. LTD.

**BHUSAWAL T.P.S. UNIT-6 : 1x660 MW PROJECT
BHUSAWAL, MAHARASHTRA**

VOLUME: II B

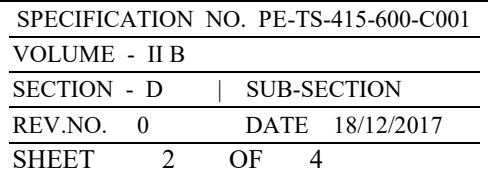
SECTION - D

STANDARD SPECIFICATION

SPECIFICATION NO. PE-TS-999-600-C001



**Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301**





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C O N T E N T

SUB-SECTION	DESCRIPTION
D1	Earthwork in excavation and backfilling
D2	Cement concrete (Plain and reinforced) and formwork
D3	Carpentry and joinery
D4	Roof and underground structures water proofing, insulation and allied works
D5	Metal doors, windows, ventilators, louvers etc.
D6	Glass and Glazing
D7	Rolling Steel Shutter and Grills
D8	Miscellaneous Metal
D9	Masonry and allied works
D10	Finish to masonry and concrete
D11	Painting, Whitewashing, polishing
D12	Floor finish and allied works
D13	Sheet work in roof and siding
D14	Suspended ceiling
D15	Water supply, drainage & sanitation
D16	Road & drainage
D17	Fabrication of structural steelwork
D18	Erection of structural steelwork
D19	Roof decking
D20	False flooring
D21	Bored cast-in-situ RCC piles
D22	Site levelling & grading works
D23	Anti-termite treatment



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GENERAL

Section C & Section D of this specification cover design, preparation of general arrangement drawings, construction and fabrication drawings, supply of materials and construction of all civil, structural and architectural works.

Section-C covers specific technical & functional requirements of contract and should be read in conjunction with BOQ, Section-D and other sections of the contract. In case of any conflict between the contents of BOQ and Section-C, BOQ will prevail over Section-C. In case of any conflict between Section-C and Section-D, Section-C will prevail over Section-D. Further contract document and clarifications given by BHEL to Bidder will prevail over Section C and D in case of any conflict. During the detailed engineering if there is some change in requirements, which is agreed by customer, consultant and BHEL, the same shall prevail over all.



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EARTHWORK IN EXCAVATION AND BACKFILLING

SPECIFICATION NO. PE-TS-999-600-C001



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
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**STANDARD TECHNICAL SPECIFICATION FOR EARTHWORK IN
EXCAVATION AND BACKFILLING**

1.0.0 SCOPE

This specification covers earth work excavation in all types of soil, soft rock and hard rock including setting out, clearing and grubbing, shoring, dewatering, back filling around foundations/pipelines to grade, watering, compaction of fills, testing, approaches, disposal of surplus earth, protective fencing, lighting etc relevant to the structures and locations covered under this contract.

2.0.0 GENERAL

2.1.0 Work to be provided for by the Contractor

The work to be provided for by the contractor unless specified otherwise shall include but not be limited to the following.

a) Supplying and providing all labour, supervision services, earth moving machineries, surveying instruments including facilities as required under statutory labour regulations, materials, scaffolds, equipment, tools and plants, transportation, etc. required for the work.

b) Preparation and submission of working drawings showing the approaches, slopes, berms, shoring, sumps for dewatering including drainage, space for temporary stacking of soils, disposal area, fencing etc and all other details as may be required by the engineer.

c) To carry tests and submit to the Engineer, test results of fill materials and degree of soil compaction of fill whenever required by the Engineer to assess the quality of fill.

d) Design, construction and maintenance of Magazine of proper capacity for storage of explosives for blasting work and removal of the same after completion of the work etc. including procurement of necessary licenses from proper authorities.

2.2.0 Work to be provided by others

No work under this specification will be provided by any agency other than the contractor unless specifically mentioned elsewhere in the contract.



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2.3.0 Codes and Standards

All works shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes unless specified otherwise.

IS-1200	Method of measurement of building and civil engineering works, Part-I: Earthwork
IS-2720	Method of test for soils (Relevant parts)
IS-3764	Excavation work - Code of safety
IS-4081	Safety code for blasting and related drilling operations
IS-4701	Indian Standard Code of Practice for earthwork on Canals
IS:6922	Criteria for safety and design of structures subject to underground blasts
IS: 3764	Excavation work – code of safety

In case of conflict between this specification and those (IS Codes) referred to herein, the former shall prevail. In case any particular aspect of work is not covered specifically by this specification/IS Codes, any other standard practice as may be specified by the engineer shall be followed.

2.4.0 Conformity with Designs

The contractor shall carry out the work as per the approved drawings, specification and as directed by the engineer.

2.5.0 Materials

2.5.1 General

All materials required for the work shall be of the best commercial variety and approved by the engineer.

2.5.2 Material for Excavation

For the purpose of identifying the various strata encountered during the course of excavation, refer clause no. 3.4.0 for the classification of earth strata.

2.5.3 Material for Filling

Material to be used for back filling shall be free from vegetations, roots, salts, rubbish, lumps, organic matter and any other harmful chemicals etc and shall be got approved by the engineer. Normally excavated earth shall be used for back filling. In case such earth contains deleterious salts, the same shall not be used. All clods of earth shall be broken or removed. Where the excavated



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material is mostly rock and if filling with the same is permitted by the engineer in writing, then the filling with rock shall be done in the following manner. The boulders shall be broken into pieces not exceeding 150mm size in any direction and mixed with fine materials consisting of decomposed rock, moorum or any approved earth to fill the voids as far as possible and the mixture shall then be used for filling.

In case the earth required for backfilling is over and above the earth available from the compulsory excavations within the project area, then borrow areas for obtaining suitable fill material shall be arranged by the contractor himself from outside the plant boundary limits and all expenses including royalties, taxes, duties etc shall be borne by him. The selected earth from the borrow areas shall be got approved by the engineer. The borrowed material shall be free from roots, vegetations, decayed organic matter, harmful salts and chemicals, free from lumps and clods etc. The contractor shall obtain and submit necessary clearances/permissions from the concerned authorities for the borrow areas/materials acquired to the engineer.

If specified, the back filling shall be done with clean well graded sand from approved quarries free from harmful and deleterious materials.

2.6.0 Quality Control

All works shall confirm to the lines, levels, grades, cross sections and dimensions shown on the approved drawings and/or as directed by the engineer. The contractor shall establish and maintain quality control for the various aspects of the work, method of construction, materials and equipments used etc. The quality control operation shall include but not be limited to the following.

Sl. No.	Activity	Check
1	Lines, levels & grades	a) By periodic surveys b) By establishing markers, boards etc
2	Back filling	(a) On quality of fill material (b) On moisture content of back fill (c) On degree of compaction achieved

2.7.0 Information regarding site conditions

Surface and Sub-surface data regarding the nature of soil, rock, sub-soil water etc. shown on drawing or otherwise furnished to the Contractor shall be taken as a guidance only and variation therefrom shall not affect the terms of the contract. The Contractor must satisfy himself regarding the character and volume of all work under this contract and expected surface, sub-surface and /



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or sub-soil water to be encountered. He must also satisfy himself about the general conditions of site and ascertain the existing and future construction likely to come up during the execution of the contract so that he may evolve a realistic programme of execution.

3.0.0 EXECUTION

The contractor shall prepare and submit the detailed drawings/schemes for excavation and back filling works as proposed to be executed by him showing the dimensions as per the construction drawings and specification adding his proposal of slopes, shoring, approaches, dewatering, drainage, berms etc. for the approval of engineer.

3.1.0 Setting out

On receiving the approval from the engineer with modifications and corrections if any, the contractor shall set out the work from the control points furnished by the engineer and fix permanent points and markers for ease of periodic checking as the work proceeds. These permanent points and markers shall be fixed at the interval as prescribed by the engineer and shall be got checked and certified by the engineer after whom the contractor shall proceed with the work. It should be noted that this checking by the engineer prior to the start of the work will in no way relieve the contractor of his responsibility of carrying out the work to true lines, levels and grades as per the drawings and specification. If any errors are noticed in the contractor's work at any stage, the same shall be rectified by the contractor at his own risk and cost.

3.2.0 Initial Levels

Initial levels of the ground either in a definite grid pattern or as directed by the Engineer will be taken by the Contractor jointly with the Engineer over the original ground prior to starting actual excavation work and after setting out. These initial levels will be used for preparing cross-sections for volume measurement or for cross-checking the depths obtained from tape measurements. All records of levels, measurements etc. and also any drawing, cross-section etc. made therefrom, shall be jointly signed by the authorised representative of the contractor and the Engineer before the commencement of work and they shall form the basis of all payments in future.

3.3.0 Clearing and Grubbing

The area to be excavated shall be cleared out of fences, trees, logs, stumps, bushes, vegetation, rubbish, slush etc. Trees upto 300mm girth shall be uprooted. Trees above 300mm girth to be cut shall be approved by the engineer and marked. Cutting of trees shall include removing roots as well.



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After the tree is cut and roots taken out, the pot holes formed shall be filled with good earth in 250mm layers and compacted unless directed otherwise by the engineer. The trees shall be cut in to suitable pieces as instructed by the engineer. Before earthwork is started, all the spoils, unserviceable materials and rubbish shall be burnt or removed and disposed to the approved disposal area(s) as specified by the engineer. Useful materials, saleable timber, fire woods etc shall be the property of the owner and shall be stacked properly at the worksite in a manner as directed by the engineer.

3.4.0

Classification

All earthwork shall be classified under the following categories:

No distinction will be made whether the material is dry or wet.

a) **Ordinary Soil**

This shall comprise vegetable or organic soil, turf, sand, silt, loam, clay, mud, peat, black cotton soil, soft shale or loose moorum, a mixture of these and similar material which yields to the ordinary application of pick and shovel, rake or other ordinary digging implement. Removal of gravel or any other nodular material having diameter in any one direction not exceeding 75 mm occurring in such strata shall be deemed to be covered under this category.

b) **Hard Soil**

This shall include :

- i) stiff heavy clay, hard shale, or compact moorum requiring grafting tool or pick or both and shovel, closely applied ;
- ii) gravel and cobble stone having maximum diameter in any one direction between 75 and 300 mm ;
- iii) soling of roads, paths, etc., and hard core ;
- iv) macadam surfaces such as water bound, and bitumen/tar bound;
- v) lime concrete, stone masonry in lime mortar and brick work in lime/cement mortar, below ground level ;
- vi) soft conglomerate, where the stones may be detached from the matrix with picks ; and
- vii) generally any material which requires the close application of picks, or scarifiers to loosen and not affording resistance to digging greater than the hardest of any soil mentioned in (i) and (vi) above.

c) **Soft and Decomposed Rock**

This shall include :

- i) limestone, sandstone, laterite, hard conglomerate or other soft or disintegrated rock which may be quarried or split with crowbars ;



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- ii) unreinforced cement concrete which may be broken up with crowbars or picks and stone masonry in cement mortar below ground level ;
- iii) boulders which do not require blasting having maximum diameter in any direction of more than 300 mm, found lying loose on the surface or embedded in river bed, soil, talus, slope wash and terrace material of dissimilar origin ; and
- iv) any rock which in dry state may be hard, requiring blasting, but which when wet becomes soft and manageable by means other than blasting.

d) Hard Rock (requiring blasting)

This shall include :

- i) any rock or cement concrete for the excavation of which the use of mechanical plant or blasting is required ;
- ii) reinforced cement concrete (reinforcement cut through but not separated from the concrete) below ground level; and
- iii) boulders requiring blasting.

e) Hard Rock (blasting prohibited)

Hard rock requiring blasting as described under (d) but where blasting is prohibited for any reason and excavation has to be carried out by chiselling, wedging or any other agreed method.

In case of any dispute regarding classification, the decision of the Engineer shall be final.

3.5.0 Excavation for Foundations and Trenches

3.5.1 General

All excavation shall be done to the minimum dimensions as required for the safety and working facility. In each individual case, the contractor shall obtain prior approval of the engineer for the method he proposes to adopt for the excavation including dimensions, side slopes, shoring, dewatering, drainage and disposal etc. This approval however shall not in any way make the engineer responsible for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. All excavation in open cuts shall be made true to the line, slopes and grades as shown on the drawings and/or as directed by the engineer. No material shall project within the dimension of minimum excavation lines marked. Boulders (if any) projecting out of the excavated surfaces shall be removed if they are likely to be a hindrance to the work/workers in the opinion of the engineer.

Method of excavation shall in every case be subject to the approval of the engineer. The contractor shall ensure the stability and safety of the excavation, adjacent structures, services and works etc including the safety of the



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workmen. If any slip occurs, the contractor shall remove all the slipped materials from the excavated pit without any extra cost to the engineer/owner. All loose boulders and semi detached rocks which are not inside but so close to the area to be excavated and may liable to fall or otherwise endanger the workmen, equipment of the work etc during excavation in the opinion of the engineer shall be stripped off and removed away from the area of excavation. The method to be used for removal shall be such that it should not shatter or render unstable or unsafe the portion which was originally sound and safe. In case any material not required to be removed initially but later to become loose or unstable in the opinion of the engineer shall also be promptly and satisfactorily removed.

The rough excavation may be carried out upto a maximum depth of 150 mm above the final level. The balance shall be excavated with special care. If directed by the engineer, soft and undesirable spots shall be removed even below the final level. The extra excavation shall be filled up as instructed by the engineer. If the excavation (in all types of soil and rock) is done to a depth greater than that shown on the drawing or as directed by the engineer, the excess depth up to the required level shall be filled with cement concrete not leaner than 1:4:8 or richer as directed by the engineer at the own risk and cost of the contractor. In case where excavation in soil, soft rock (including weathered rock) and hard rock are involved, the excavation in each stratum shall be carried out separately with the approved methodology and as per the instructions of the engineer.

All excavated materials such as rock, boulders, bricks, dismantled concrete blocks etc shall be the property of the owner and shall be stacked separately as directed by the engineer. All gold, silver, oil, minerals, archeological and other findings of importance, trees cut or other materials of any description and all precious stones, coins, treasures, relics, antiquities and other similar things which may be found in or upon the site shall be the property of the owner and the contractor shall duly preserve the same to the satisfaction of the engineer/owner. The contractor shall deliver the same to such person or persons as may be authorized or appointed from time to time by the owner to receive the same.

Prior to starting the excavation, the ground level at the location shall be checked jointly with the engineer.

3.5.2

Excavation in All Type of Soil and in Soft Rock

The excavation in all type of soil, soft rock including decomposed rock etc shall be carried out as per the approved proposal and as directed by the engineer. The work shall be carried out in a workmanlike manner without endangering the safety of nearby structures/services or works and without causing hindrance to any other activities in the area. Foundation pits shall not



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be excavated to the full depth unless construction is imminent. The last 150mm depth shall be excavated once concreting work is imminent. At the discretion of the engineer, the full depth may be excavated and the bed be covered with lean concrete as specified after watering and compacting the bed. As the excavation reaches the required dimensions, lines, levels and grades etc, the work shall be got checked and approved by the engineer. In cases where deterioration of the ground, upheaval, slips etc are expected, the engineer may order to suspend the work at any stage and instruct the contractor to carry out the protection works before the excavation will be restarted.

3.5.3 Excavation in Hard Rock

Hard rocks shall normally be excavated by means of blasting. In case where blasting is prohibited for any reasons, the excavation shall be carried out by chiselling or any other approved method as directed by the engineer. Personnel deployed for rock excavation shall be protected from all hazards such as loose rock/boulder rolling down and from general slips of excavated surfaces. Where the excavated surface is not stable against sliding, necessary supports such as props, bracings or bulkheads shall be provided and maintained during the period of construction. Where the danger of falling loose rock/boulder from the excavated surfaces deeper than 2m exist, steel mesh anchored to the lower edge of the excavation and extending over and above the rock face adequate to retain the dislodged material shall be provided and maintained.

3.5.4 Blasting

Storage, handing and use of explosives shall be governed by the current explosive rules/regulations laid down by the Central and the State Governments. The contractor shall ensure that these rules/regulations are strictly adhere to. The following instructions are also to be strictly followed and the instructions wherever found in variance with the above said rules/regulations, the former (instructions) shall be superseded with the later (above said rules/regulations).

No child under the age of 16 and no person who is in a state of intoxication shall be allowed to enter the premises where explosives are stored nor they shall be allowed to handle the explosives. The contractor shall obtain licence from the District Authorities for undertaking the blasting work as well as for obtaining and storing the explosives as per Explosives Rules, 1940 corrected upto date. The contractor shall purchase the explosives, fuses, detonators etc only from a licensed dealer and shall be responsible for the safe custody and proper accounting of the explosive materials. The engineer or his authorized representative shall have the access to check the contractor's store of explosives and his accounts at any time. It is the full responsibility of the contractor to transport the explosives as and when required for the work in a safe manner to the work spot.



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Further, the engineer may issue modifications, alterations and new instructions to the contractor from time to time. The contractor shall comply with the same without these being made a cause for any extra claim.

3.5.4.1 Materials

All materials such as explosives, detonators, fuses, tamping materials etc proposed to be used in the blasting operation shall have the prior approval of the engineer. Only explosives of approved make and strength are to be used. The fuses known as instantaneous fuse must not be used. The issue of fuse with only one protective coat is prohibited. The fuse shall be sufficiently water resistant as to be unaffected when immersed in water for 30 minutes. The rate of burning of the fuse shall be uniform and shall be not less than 4 seconds per inch of length with 10% tolerance on either side. Before use, the fuse shall be inspected. Moist, damaged or broken ones shall be discarded. When the fuses are in stock for long, the rate of burning of fuses shall be tested before use. The detonators shall be capable of giving an effective blasting of the explosives. Moist and damaged detonators shall be discarded.

3.5.4.2 Storage of Explosives

The current Explosive Rules shall govern the storage of explosives. Explosives shall be stored in a clean, dry and well ventilated magazine to be specially built for the purpose. Under no circumstances should a magazine be erected within 400m of the actual work site or any source of fire. The space surrounding the magazine shall be fenced and the ground inside shall be kept clear and free from trees, bushes etc. The admission to this fenced space shall be through a single gate only and no person shall be allowed without the permission of the officer-in-charge. The clear space between the fence and the magazine shall not be less than 90m. The magazine shall be well drained. Two lightning conductors, one at each end shall be provided to the magazine. The lightning conductors shall be tested once in every year.

Explosives, fuses and detonators shall each be separately stored. Cases of explosives must be kept clear of the walls and floors for free circulation of air on all sides. Special care shall be taken to keep the floor free from any grains of explosives. Cases containing explosives shall not be opened inside the magazine and the explosives in open cases shall not be received into a magazine. Explosives which appear to be in a damaged or dangerous condition are not to be kept in any magazine but must be removed without delay to a safe distance and be destroyed.

Artificial light, matches, inflammable materials, oily cotton, rag waste and articles liable to spontaneous ignition shall not be allowed inside the magazine. Illumination shall be obtained from an electric storage battery



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lantern. No smoking shall be allowed within 100m distance from any magazine.

Magazine shoes without nails shall be used while entering the magazine. The persons entering the magazine must put on the magazine shoes which shall be provided at the magazine for this purpose and should be careful

- * not to put their feet on the clean floor unless the magazine shoes on.
- * not to touch the magazine shoes on ground outside the clean floor.
- * not to allow any dirt or grit to fall on the clean floor.

Persons with bare feet shall dip their feet in water before entering the magazine and then step directly from the tub to the clean floor. No person having article of steel or iron with/on him shall be allowed to enter the magazine. Workmen shall be examined before entering the magazine to check none of the prohibited articles are with them. A brush broom shall be kept in the lobby of the magazine for cleaning the magazine. Cleaning shall be done immediately after each occasion whenever the magazine is opened for receipt, delivery or inspection of the explosives.

The mallets, levers, wedges etc for opening the barrels or cases shall be of wood. The cases of explosives are to be carried by hand and shall not be rolled or dragged inside the magazine. Explosives which have been issued and returned to the magazine are to be issued first; otherwise those which have been stored long in the store are to be issued first. Neither the magazine shall be opened nor any person shall be allowed in the vicinity of the magazine during any dust storm or thunderstorm. All magazines shall be officially inspected at definite intervals and a record of such inspections shall be kept.

3.5.4.3 Carriage of Explosives

Detonators and explosives shall be transported separately to the blast site. Explosives shall be kept dry and away from direct rays of the sun, artificial lights, steam pipes or heated metal and other sources of heat. Before explosives are removed, each case or package shall be carefully examined to ascertain that it is properly closed and shows no sign of leakage.

No person except the driver shall be allowed to travel on the vehicle conveying explosives. No explosive shall be transported in a carriage or vessel unless all iron or steel therein the carriage or vessel which are likely to contact the package containing explosives are effectually covered with lead, leather, wood, cloth or any other suitable material. No light shall be carried on the vehicle carrying explosives and no operation connected with the loading, unloading and handling of explosives shall be conducted after sunset.



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3.5.4.4 Use of Explosives

The contractor shall appoint an agent who shall personally superintend the firing and all operations connected therewith. The contractor shall satisfy himself that the person so appointed is fully acquainted with his responsibilities.

Holes for charging the explosives shall be drilled with pneumatic drills and the drilling pattern shall be so planned that the rock pieces after blasting will be suitable for handling. The hole diameter shall be of such a size that the cartridges can easily pass down through them and any undue force is not required during charging. Charging operation shall be carried out by or under the personal supervision of the shot firer. Wrappings shall never be removed from the explosive cartridges. Only one cartridge at a time shall be inserted in a hole and wooden rods shall only be used for loading and stemming the shot holes. Only such quantities of explosives as are required for a particular work shall be brought to the work site. Should any surplus remain when all the holes have been charged shall be carefully removed to a point at least 300m away from the firing point.

The authorized shot firer himself shall make all the connections. The shot firing cable shall not be dragged along the ground to avoid any damage to the insulation. The shot firing cable shall be tested each time for its continuity and possible short circuiting. The shot firer shall always carry the exploder handle with him until he is ready to fire shots. The number of shots fired at a time shall not exceed the permissible limits. Before any blasting is carried out it shall be ensured that all workmen, vehicles and equipment on the site are cleared from an area of minimum 300m radius from the firing point or as required by the statutory regulations at least 10 minutes before the time of firing by sounding a warning siren and the area shall be encircled by red flags.

The explosives shall be fired by means of an electric detonator placed inside the cartridge. For simultaneous firing of a number of charges, the electric detonators shall be connected with the exploder through the shot firing cable in a simple series circuit. Due precautions shall be taken to keep the firing circuit insulated from the ground, bare wires, rails, pipes or any other path of stray current etc and keep the lead wires short circuited until it is ready to fire. Any kink in the detonator leading wire shall be avoided. For simultaneous firing of a large number of shot holes, use of cordtex may be done. An electric detonator attached to its side with adhesive tape shall initiate cordtex connecting wire or string. Blasting shall only be carried out at certain specified times to be agreed jointly by the contractor and the engineer.

At least five minutes after the blast has been fired in case of electric firing or as stipulated in the regulations, the authorized shot firer shall return to the



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blast area and inspect carefully the work and satisfy himself that all the charged holes have exploded. Cases of misfired unexploded charges shall be exploded by drilling a parallel fresh hole at a distance of not less than 600mm from the misfired hole and by exploding a new charge. The authorized shot firer shall be present during the removal of debris as it may contain unexploded explosives near the misfired hole. The workmen shall not return to the site of firing until at least half an hour after firing.

Where blasting is to be carried out in proximity of other structures, controlled blasting by drilling shallow shot holes and proper muffling arrangements with steel plates loaded with sand bags etc shall be used on top of the blast holes to prevent the rock fragments from causing any damage to the adjacent structures and other properties. Adequate safety precautions as per building byelaws, safety codes, statutory regulations etc shall be taken during blasting operations.

3.5.4.5 Restrictions in Blasting

- a) Blasting which may disturb or endanger the stability, safety or quality of the adjacent structures/foundations shall not be permitted.
- b) Blasting within 200m of a permanent structure or construction work in progress shall not be permitted.
- c) Progressive blasting shall be limited to two third of the total remaining depth of excavation.
- d) No large scale blasting operations will be resorted to when the excavation reaches the last one metre and only small charge preferably black powder may be allowed so as not to shatter the parent rock.
- e) The last blast shall not be more than 0.50 m in depth.
- f) In rocky formations, at locations where specifically indicated or ordered in writing by the engineer, the use of explosives shall be discontinued and excavation shall be completed by chiselling or any other suitable method as approved by the engineer.

3.5.5 Disposal

The excavated spoils shall be disposed of in any (or all) of the following manner as directed by the engineer.

- a) By using it straightway for backfilling.
- b) By stacking it temporarily to use for backfilling at a later date during execution of the contract.
- c) i) By either spreading
or
ii) By spreading and compacting at designated disposal areas.



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a) By selecting the useful material and stacking it neatly in designated areas as indicated by the engineer for use in backfilling by some other agency.

3.5.6 Disposal of Surplus Materials

All surplus material from excavation shall be removed and disposed of from the excavation site to the designated disposal area indicated by the engineer. All good and sound rocks obtained from excavations and all assorted materials of dismantled structures are the property of the owner and if the contractor wants to use it, he shall have to obtain it from the engineer at a mutually agreed rate. All sound rocks and other assorted materials like excavated bricks etc shall be stacked separately.

3.5.7 Protection

The contractor shall notify the engineer as soon as the excavation is expected to be completed within a day so that he shall inspect it at the earliest. Immediately after approval of the engineer, the excavation must be covered up in a shortest possible time. But in no case the excavation shall be covered up or worked on before approval by the engineer. Excavated material shall be placed 1.5m or half the depth (of excavation) whichever is more from the edge of the excavation or further away if directed by the engineer. Excavation shall not be carried out below the foundation level of the structure close by until the required precautions are taken. Adequate fencing is to be made enclosing the excavation. The contractor shall protect all the underground services exposed during excavation. All existing surface drains in the work area shall be suitably diverted by the contractor before taking up excavation to maintain the working area neat and clean.

3.5.8 Dealing with Surface Water

All working areas shall be kept free of surface water as far as reasonably practicable. Works in the vicinity of cut areas shall be controlled to prevent the ingress of surface water.

No works shall commence until surface water streams have been properly intercepted , redirected or otherwise dealt with.

Where works are undertaken in the monsoon period, the Contractor may need to construct temporary drainage systems to drain surface water from working areas.

3.5.9 Dewatering

All excavation shall be kept free of water and slush. Grading in the vicinity shall be controlled to prevent the surface water running into the excavations.



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The contractor shall remove any water inclusive of rain water and subsoil water etc accumulated in the excavation by pumping or other means as approved by the engineer and keep the excavations dewatered and/or lower the subsoil water level to 300mm below the founding level until the construction of foundation and backfilling are completed in all respects.

Sumps made for dewatering must be kept clear of the foundations. The engineer's prior approval on the method of pumping to be adopted shall be taken; but in any case, the pumping arrangement shall be such that there shall be no movement or blowing in of subsoil due to the differential head of water during pumping.

3.5.10 Timber Shoring

Close or open type timber shoring as approved by the engineer depending on the nature of sub-soil, depth of pit or trench and the type of timbering shall be adopted. Timbers made out of approved quality shall only be used. It shall be the responsibility of the contractor to take all necessary steps to prevent the sides of trenches and pits from collapsing.

3.5.10.1 Close Timbering

Close timbering shall be done by completely covering the sides of the trenches and pits generally with short, upright members called "polling boards". These shall be of 250mm wide(min.) and 40mm thick(min.) sections as directed by the engineer. The boards shall generally be placed vertically in pairs, one on each side of the cut and shall be kept apart (maximum spacing is limited to 1.20m) by horizontal walers of strong wood cross strutted with wooden struts or as directed by the engineer. The length of wooden struts shall depend on the width of the trench or pit.

In case where the soil is very soft and loose, the boards shall be placed horizontally against the sides of excavation and supported by vertical walers which shall be strutted to similar timber pieces on the opposite face of the trench or pit. The lowest board supporting the sides shall be taken into the ground. No portion of the vertical side of the trench or pit shall remain exposed to avoid any slipping out of earth.

The withdrawal of the timber shall be done very carefully to prevent the collapse of the pit or trench. It shall be started from one end and proceeded systematically to the other end. Concrete or masonry shall not be damaged during the removal of the timber. No claim shall be entertained for any timber which cannot be withdrawn and is lost or buried.

3.5.10.2 Open Timbering



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In case of open timbering, vertical board of 250mm wide(min.) and 40mm thick(min.) shall be spaced sufficiently apart to leave unsupported strips of maximum 500mm average width. The detailed arrangement, size of timber and the spacing etc shall be subjected to the approval of the engineer. In all other respects, the specification for close timbering shall apply to open timbering as well.

3.6.0 Treatment of Slips

The contractor shall take all precautions to avoid high surcharges and provide proper surface drainage to prevent flow of water over the sides of the excavations. These precautions along with proper slopes, berms, shoring and control of ground water should cause no slips to occur. If however slips still occur, the same shall be removed by the contractor with his own risk and cost.

3.7.0 Backfilling

3.7.1 General

The material to be used for backfilling shall be approved by the engineer which shall be obtained directly from the excavation, from the nearby areas where excavation work by the same agency is in progress, from the temporary stacks of excavated spoils or from the borrow pits as directed by the engineer. The material shall be free from lumps and clods, roots and vegetations, harmful salts and chemicals, organic materials etc.

In locations where sand filling is required, the sand used should be clean, well graded and be of the quality normally acceptable for use in concrete.

3.7.2 Filling and Compaction in Pits and Trenches all Around the Structures

As soon as the work in foundation has been accepted, the spaces around the foundation in pits and trenches shall be cleared of all debris, brick bats, mortar droppings etc and filled with approved earth in layers not exceeding 250mm (in loose thickness). Each layer(loose) shall be watered, rammed and properly compacted to the required degree to the satisfaction of the engineer. Earth shall be compacted with approved mechanized compaction machine. Usually, no manual compaction shall be allowed unless specifically permitted by the engineer. The moisture content of the fill material during compaction shall be controlled near to its optimum moisture content so as to obtain the required degree of compaction. The final surface shall be trimmed and levelled to proper profile as desired by the engineer.

3.7.3 Plinth Filling



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The plinth shall be filled with earth in layers not exceeding 250mm (in loose thickness) and each layer shall be watered and compacted to the required degree with approved compaction machine or manually if specifically permitted by the engineer. When the filling reaches the finished level, the surface shall be flooded with water for at least 24 hours, allowed to dry and then rammed and compacted in order to avoid any settlement at a later stage. The finished surface of fill shall be trimmed to the slope intended to be provided for the floor.

3.7.4 Filling in Trenches for Water Pipes and Drains

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed. Where the trenches are excavated in soil, the filling shall be done with earth on the sides and top of pipes in layers not exceeding 150mm, watered, rammed and compacted taking care that no damage is caused to the pipe below.

In case of trenches excavated in rock, the filling upto a height of 300mm or the diameter of the pipe whichever is more above the crown of the pipe or barrel shall be done with fine material such as earth, moorum, disintegrated rock or ash as per the availability at site and shall be filled in compacted layers not exceeding 150mm. The remaining filling shall be done in layers with the mixture of boulders (of size not exceeding 150mm) and fine material as specified elsewhere in the specification. Each layer shall be watered, rammed and compacted to the required degree and to the satisfaction of the engineer.

3.7.5 Filling in Disposal Area

Surplus materials from excavation which are not required for backfilling shall be disposed of in the designated disposal areas. The spoils shall not be dumped haphazardly but should be spread in layers approximately 250mm thick when loose, watered and compacted with the help of a compacting equipment as per the directions of the engineer. In wide areas, rollers shall be employed and compaction shall be done to the satisfaction of the engineer at the optimum moisture content which shall be checked and controlled by the contractor. In certain cases the engineer may direct the contractor to dispose the surplus materials without compaction which can be done by tipping the spoils from a high bench neatly maintaining a proper level and grade of the bench.

3.8.0 Approaches and Fencing

The contractor should provide and maintain proper approaches for the workmen and inspection. The roads and approaches around the excavation



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should be kept clear at all times so that there is no hindrance to the movement of men, material and equipment of various agencies connected with the project. Sturdy and elegant fencing is to be provided around the top edge of the excavation as well as around the bottom of the fill at the surplus disposal area where dumping from a high bench is in progress.

3.9.0 Lighting

Full scale area lighting is to be provided if night work is permitted or directed by the engineer. If no night work is in progress, red warning lights should be provided at the corners of the excavated pit and the edges of the fill.

4.0.0 TESTING AND ACCEPTANCE CRITERIA

4.1.0 Excavation

On completion of excavation, the dimension of the pits will be checked as per the drawings after the pits are completely dewatered. The work will be accepted after all undercuts have been set right and all over excavations are filled back to the required lines, levels and grades by placing ordinary cement concrete of 1:4:8 proportion and/or richer and/or by compacted earth as directed by the engineer. The choice of the grade of concrete will be a matter of unfettered discretion of the engineer. Over excavation of the sides shall be made good by the contractor while carrying out the backfilling. The excavation work will be accepted after the above requirements are fulfilled and all the temporary approaches encroaching inside the excavation have been removed.

4.2.0 Backfilling

The degree of compaction required will be as per the stipulation laid down in IS: 4701 and the actual method of measuring the degree of compaction will be as decided by the engineer. The work of back filling will be accepted after the engineer is satisfied with the degree of compaction achieved.

5.0.0 RATES AND MEASUREMENTS

5.1.0 Rates

a) The item of work in the schedule of quantities describe the work very briefly. The various items of the schedule of quantities shall be read in conjunction with the corresponding section in the technical specification including amendments and additions if any. For each item in the schedule of quantities, the bidder's rate shall include all the activities covered in the description of the items as well as for all necessary operations in detail as described in the technical specification.



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b) No claims shall be entertained if the details shown on the released for construction drawings differ in any way from those shown on the tender drawings.

c) The unit rate quoted shall include minor details which are obviously and fairly intended and which may not have been included in these documents but are essential for the satisfactory completion of the work.

d) The bidder's quoted rate shall be inclusive of supplying and providing all labour, men, materials, equipments, tools and plants, supervision, services, approaches, schemes etc.

f) In case blasting in hard rock is envisaged, the unit rate quoted for earth work shall include the cost of storage and safety arrangements for the materials required for blasting. No separate payment will be made on this account.

5.2.0 Measurements

Method of measurements are specified as below:

a) The length, breadth and depth shall be measured correct to the nearest centimeter if measurements are taken by tape. Rounding of numerical shall be as per relevant IS Codes. If the measurements are taken with staff and level, the levels shall be recorded correct to 5mm. The area and volume shall be worked out in square meter and cubic meter respectively correct to the nearest of two decimal places.

b) For earth work in excavation, the ground levels shall be taken before and after completion of the work in the actually excavated area. The quantity of earth work in excavation shall be computed from these levels in cubic meter.

c) In case of open footings (rafts/ pilecaps/ drains/ cable trench/ pipe trench/ sub soil beams etc.) up to the depth of 2.0 metres from ground level, around excavation of 30 cm beyond the outer dimension of footing (not the PCC dimension below footing) shall be measured for payment to make allowances for centering and shuttering. Any additional/excess excavation beyond this limit shall be at the risk and cost of the contractor and shall not be measured for payment for item of work on excavation, backfilling, carriage, dewatering etc. Required shoring & strutting, side slopes, benching, dewatering sump pits, approaches to the excavated pit etc. are deemed to be included in the quoted rates in the schedule of quantities.

d) In case of open footings (Rafts/ pilecaps / drains/ cable trench/ pipe trench/ sub soil beams etc.) at a depth of more than 2.0 metre from ground level,



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around excavation of 75 cm beyond the outer dimension of footing (not the PCC dimension below footing) shall be measured for payment to make allowances for centering and shuttering. Any additional/excess excavation beyond this limit shall be at the risk and cost of the contractor and shall not be measured for payment for item of work on excavation, backfilling, carriage, dewatering etc. Required shoring & strutting, side slopes, benching, dewatering sump pits, approaches to the excavated pit etc. are deemed to be included in the quoted rates in the schedule of quantities.

e) Where soft rock and hard rock are mixed, the measurement shall be done as follows. The two types of rock shall be stacked separately and measured in stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in the stacks. If the sum of net quantity of the two types of rock so arrived exceeds the total quantity of excavation, then the quantity of each type of rock shall be worked out from the total quantity (from excavation) in the ratio of net quantities in stack measurements of the two types of rock. If stacking is not feasible, the method as suggested by the engineer shall be followed.

f) Where soil, soft rock and hard rock are mixed, the measurement shall be done as follows. The soft and hard rock shall be removed from the excavated material and stacked separately and measured in stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in stacks. The difference between the entire excavation and the sum of the quantities of soft and hard rock so arrived shall be taken as soil.

g) The authorized quantity (calculated on the basis of authorized width/working space under clause no. 5.2.0 c & 5.2.0 d) or those actually excavated, whichever, are less, shall be measured for payment.

h) Tree cutting having girth more than 300mm shall be measured in number and are separately payable as deemed not covered in excavation items of work in the schedule of quantities.

6.0.0 INFORMATION TO BE SUBMITTED BY THE BIDDER

6.1.0 With Tender

Detail of equipments and machineries proposed to be used for excavation, backfilling and compaction shall be submitted along with the tender.



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6.2.0

After Award

After award of the contract the successful bidder shall submit the following for approval.

a) Within 30 days of the award of contract, the contractor shall submit a detailed programme of the work as proposed to be executed giving completion dates of excavation for the various foundations and the time required for backfilling and compaction after completion of foundation for the structures. The earthwork programme shall be planned in accordance with the foundation programme. The programme should also show how the excavation and backfilling quantities will be balanced minimizing the temporary stacking of spoils. It is to be noted that the engineer even after initial approval of the programme may instruct the contractor to enhance or to retard the progress of work during the actual execution in order to match with the progress of foundations. The initial programme being submitted by the contractor should have sufficient flexibility to take care of such reasonable variations.

b) Within 15 days of the award of contract, the contractor shall submit the drawings for earth work in excavation and backfilling showing detail of slopes, shoring, approaches, sump pits, dewatering lines, fencing etc for the approval of the engineer.



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**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-999-600-C002

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GENERAL TECHNICAL SPECIFICATION

CEMENT CONCRETE (PLAIN & REINFORCED)



**Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301**



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SUB-SECTION – D2

CEMENT CONCRETE (PLAIN & REINFORCED)

1.00.00 SCOPE

1.01.00 General

This specification covers all the requirements, described hereinafter for general use of Plain and Reinforced Cement Concrete work in Structures and locations, cast-in-situ or precast, and shall include all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work. Special requirements for structures such as reinforced concrete chimney, cooling towers, etc. have been covered under the respective specifications. Those specifications shall be used in conjunction with this specification.

1.02.00 IS: 456 shall form a part of this specification and shall be complied with unless permitted otherwise. For any particular aspect not covered by this Code, appropriate Code, specifications and/or replacement by any International code of practice as may be specified by the Engineer shall be followed. All codes and Standards shall conform to its latest revisions. A list of IS codes and Standards is enclosed hereinafter for reference. However, should the list be not exhaustive and does not cover any aspect of the work, then relevant Indian and, in its absence, relevant International code shall apply.

2.00.00 General

2.01.00 Work to be provided for by the Contractor

The work to be provided for by the Contractor, unless otherwise specified shall include but not be limited to the following

- a) Furnish all labour, supervision, services including facilities as may be required under statutory labour regulations, materials, forms, templates, supports, scaffolds, approaches, aids, construction equipment, tools and plants, transportations, etc. required for the work.
- b) Prepare Bar bending Schedules for reinforcement bars showing the positions and details of spacers, supports, chairs, hangers etc.
- c) Prepare working drawings of formworks, scaffolds, supports, etc.
- d) Prepare shop drawings for various inserts, anchors, anchor bolts, pipe sleeves, embedments, hangers, openings, frames etc.
- e) Prepare detailed drawings of supports, templates, hangers, etc. required for



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installation of various embedments like inserts, anchor bolts, pipe sleeves, frames, joint seals, frames, openings etc.

As decided by the Engineer some or all of the drawings & schedules prepared under item (b) to (e) above will have to be submitted for approval.

- f) Submit for approval detailed schemes of all operations required for executing the work, e.g. material handling, Concrete mixing, Placement of concrete, Compaction, curing, services, Approaches, etc.
- g) Design and submit for approval concrete mix designs required to be adopted on the job.

Furnish samples and submit for approval results of tests of various properties of the following:

- i) The various ingredients of concrete
- ii) Concrete
- iii) Embedments
- iv) Joint seals
- i) Provide all incidental items not shown or specified in particular but reasonably implied or necessary for successful completion of the work in accordance with the drawings and specifications.
- j) For supply of certain materials normally manufactured by specialist firms, the Contractor may have to produce, if directed by the Engineer, a guarantee in approved Performa for satisfactory performance for a reasonable period as may be specified, binding both the manufacturers and the Contractor, jointly and severally.

2.02.00 Work by others

No work under this specification will be provided by any agency other than the Contractor unless specifically mentioned elsewhere in the contract.

2.03.00 Information to be submitted by the Tenderer

2.03.01 With Tender

The following technical information's are required with the tender:

- a) Source and arrangement of processing of aggregates proposed to be

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adopted.

- b) Type of plant and equipment proposed to be used.
- c) Names of firms with which association is sought for to execute the special items of work in the contract.
- d) Types of formwork proposed to be used.

2.03.02

After Award

The Contractor shall submit the following information and data including samples where necessary, progressively during the execution of the contract.

a) Programme of Execution

Within 30 days of the award of contract, the Contractor will submit a Master Programme for completion of the work.

This Master Programme may have to be reviewed and updated by the Contractor, quarterly or at more frequent intervals as may be directed by the Engineer depending on the exigencies of the work.

Detailed day-to-day Programme of every month is to be submitted by the Contractor before the end of the previous month.

b) Samples

Samples of the following materials and any other materials proposed to be used shall be submitted as directed by the Engineer, in sufficient quantities free of cost, for approval. The Engineer for future reference will preserve approved samples. The approval of the Engineer shall not, in any way, relieve the Contractor of his responsibility of supplying materials of specified qualities:

- i) Coarse and fine aggregates.
- ii) Admixtures.
- iii) Plywood for Formwork.
- iv) Embedded and anchorage materials as may be desired by the Engineer.
- v) Joint sealing strips and other*waterproofing materials.
- vi) Joint filling compounds.

vii) Foundation quality Rubber Pads.

c) Design Mix

Design mix as per specification giving proportions of the ingredients, sources of aggregates and cement, along with test results of trial mixes as per relevant I.S., is to be submitted to the Engineer for his approval before it can be used on the works.

d) Bar Bending Schedules

Bar Bending Schedules in accordance with Clause 2.01.00 (b) and 3.16.01 of this specification.

e) Detailed Drawings and Designs of Formworks to be used

Detailed design data and drawings of standard formworks to be used as per clause 2.01.00 (c).

f) Detailed Drawings for Templates & Temporary Supports for embedment
As per Clause 2.01.00 (e).

g) Mill Test Reports for Cement & Reinforcing Steel.

h) Inspection Reports

The Engineer in accordance with Clause 2.04.00 of this specification may desire inspection Reports in respect of Formwork and Reinforcement and any other item of work as.

i) Test Reports

Reports of tests of various materials and concrete as required under Clause 4.0: SAMPLING & TESTING of this specification or as directed by the Engineer.

j) Any other data, which may be required as per this specification or as directed by the Engineer.

2.04.00 Conformity with Design

The Contractor will prepare checklists in approved Performa, which will be called "Pour Cards". These Pour Cards will list out all items of work involved. The Contractor will inform the Engineer, sufficiently in advance, whenever any particular pour is ready for concreting. He shall accord all

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necessary help and assistance to the Engineer for all checking required in the pour. On satisfying himself that all details are in accordance to the drawings and specifications, the engineer will give written permission on the same Pour Cards allowing the contractor to commence placement of concrete. Details of all instructions issued by the Engineer and the records of compliance by the Contractor, deviations allowed by the Engineer and any other relevant information will be written on accompanying sheets attached to the Pour Cards. The Pour Cards along with accompaniments will be handed over to the Engineer before starting placement of concrete. One of the mix designs developed by the Contractor as per the I.S. Specifications and established to the satisfaction of the Engineer by trial mixes shall be permitted to be used by the Engineer, the choice being dictated by the requirements of designs and workability. The methods of mixing, conveyance, placement, vibration, finishing, curing, protection and testing of concrete will be as approved or directed by the Engineer.

2.05.00 Materials to be used

2.05.01 General Requirement

All materials whether to be incorporated in the work or used temporarily for the construction shall conform to the relevant IS Specifications unless-stated otherwise and be of best approved quality.

2.05.02 Cement

Ordinary Portland cement of grade-43 as per IS:8112/fly ash based Portland puzzolona cement conforming to IS:1489 (Part-1) shall preferably be used in reinforced/plain cement concrete works for all areas other than for the critical structures identified below. However, other types of cement such as ordinary Portland cement conforming to IS:269, Portland slag cement conforming to IS:455 respectively can be used under special circumstances. Cement used in all concrete mixes shall be in general of grade 33/43 unless design requires a higher grade. Ordinary Portland cement shall be used for following structure.

- a) TG foundation top deck and sub structures including raft.
- b) Spring Supporting decks of all machine foundations.
- c) Structures requiring grade of concrete of M30 and above.

In special cases, Rapid Hardening Portland Cement, Low Heat Cement, Sulphate resistant cement, high strength Ordinary Portland Cement etc. may be permitted or directed to be used by the Engineer.

For Brickwork, plaster, flooring and other finishing works, ordinary Portland cement of 33/43 grade shall be used.

2.05.03 Coarse Aggregate

Aggregate of sizes ranging between 4.75 mm and 150 mm will be termed as Coarse Aggregate. Coarse aggregate for concrete shall be chemically inert, hard, strong durable against weathering, of limited porosity, and free from deleterious materials. It shall be properly graded. Coarse aggregates shall be either crushed gravel or stone. All aggregates shall meet the requirement of IS:383:1970. Only Coarse Aggregate from, approved quarries and conforming to IS-383 will be allowed to be used on the works. Petrographic test shall be carried out by the contractor free of cost for checking the quality of rock from quarry. This test shall be repeated by the Contractor free of cost for change in quarry or as directed by the Engineer. The results shall be checked for reactivity of silica in aggregate with alkalis of cement.

2.05.04 Fine Aggregate

Aggregate smaller than 4.75 mm and within the grading limits and other requirements set in IS: 383 are termed as Fine Aggregate or Sand. Only Fine Aggregate from approved sources and conforming to the above IS Specification will be allowed to be used in works. Sand shall be hard, durable, clean and free from adherent coatings or organic matter and clay balls or pellets. Sand when used as fine aggregate in concrete shall conform to IS:383. For plaster, it shall conform to IS:1542 and for masonry work to IS:2116.

2.05.05 Water

Water for use in Concrete shall be clear and free from injurious oils, acids, alkalis, organic matter, salt, silts, or other impurities. Generally, IS: 3550 will be followed for routine tests. Acceptance of water shall be as per IS: 456.

2.05.06 Admixture

Only admixtures of approved quality will be used when directed or permitted by the Engineer. The different types of admixtures, which may be necessary to satisfy the concrete mix and the design requirement, shall be as per IS-9103 and may be one of the followings:

- a) Accelerating admixture
- b) Retarding admixture
- c) Water reducing admixture
- d) Air entraining admixture



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e) Water proofing admixture

The contractor shall inform the Engineer about the type of admixture which he is planning to use in different areas within the scope of work for the approval of the Engineer. The admixture shall be of proven make and from a reputed manufacturer. It should not have any adverse effect on strength, durability of concrete and reinforcement. Super plasticizers conforming to IS: 9103 or ASTM C-494 shall only be used as admixture having the above properties either individually or in a combination as per the direction of the Engineer.

2.05.07 Reinforcement

Reinforcement shall be as per relevant IS Specification as mentioned in the Contract/Drawing/Instructions. All bars shall be of tested quality.

2.06.00 Storage of Materials

2.06.01 General

All materials shall be stored so as to prevent deterioration or intrusion of foreign matter and to ensure the preservation of their quality and fitness for the work. Any material, which has deteriorated or has been damaged or is otherwise considered defective by the Engineer, shall not be used for concrete and shall be removed from site immediately, failing which, the Engineer shall be at liberty to get the materials removed and the cost incurred thereof shall be realised from the Contractor's dues. The Contractor shall maintain upto-date accounts of receipt, issue and balance (stack wise) of all materials. Storage of materials shall conform to IS: 4082.

2.06.02 Cement

Sufficient space for storage, with open passages between stacks, shall be arranged by the Contractor to the satisfaction of the Engineer.

Cement shall be stored off the ground in dry, leak proof, well-ventilated warehouses at the works in such a manner as to prevent deterioration due to moisture or intrusion of foreign matter.

Cement shall be stored in easily countable stacks with consignment identification marks. Consignments shall be used in the order of their receipts at site. Sub-standard or partly set cement shall not be used and shall be removed from the site, with the knowledge of the Engineer, as soon as it is detected.

2.06.03 Aggregates

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Aggregates shall be stored on raised surface constructed by providing planks or steel plates or on concrete or brick masonry pavement. Each size shall be kept separated with wooden or steel or concrete or masonry bulkheads or in separate stacks and sufficient care shall be taken to prevent the material at the edges of the stock piles from getting intermixed. Stacks of fine and coarse aggregates shall be kept sufficiently apart with proper arrangement of drainage. The aggregates shall be stored in easily measurable stacks of suitable depths as may be directed by the Engineer.

2.06.04 Reinforcement

Reinforcing steel shall be stored consignment-wise and size-wise off the ground and under cover, if desired by the Engineer. It shall be protected from rusting, oil, grease, and distortions.

If necessary, the reinforcing steel may be coated with cement wash before stacking to prevent scale and rust at no extra cost to the Owner. The stacks shall be easily measurable. Steel needed for immediate use shall only be removed from storage.

2.07.00 Quality Control

Contractor shall establish and maintain quality control for different items of work and materials as may be directed by the Engineer to assure compliance with contract requirements and maintain and submit to the Engineer records of the same. The quality control operation shall include but not be limited to the following items of work:

a) Admixture:	Type, quantity, physical, and chemical properties that affects strength, workability, and durability of concrete. For air entraining admixtures, dosage to be adjusted to maintain air contents within desirable limits.
b) Aggregate:	Physical, chemical and mineralogical qualities. Grading, moisture content and impurities.
c) Water:	Impurities tests.
d) Cement:	Tests to satisfy relevant IS Specifications.
e) Formwork:	Material, shapes, dimensions, lines, elevations, surface finish, adequacy of form, ties, bracing



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and shoring and coating.

f) Reinforcement:	Shapes, dimensions, length of splices, clearances, ties and supports. Quality and requirement of welded splices.
	Material tests or Certificates to satisfy relevant IS Specification.
g) Grades of Concrete:	Usage and mix design, testing of all properties.
h) Batching & Mixing:	Types and capacity of plant, concrete mixers and transportation equipment.
i) Joints:	Locations of joints, water stops and filler materials. Dimension of joints, quality, and shape of joint material and splices.
j) Embedded and Anchorage Items:	Material, shape, location, setting.
k) Placing:	Preparation, rate of pouring, weather limitations, time intervals between mixing and placing and between two successive lifts, covering over dry or wet surfaces, cleaning and preparation of surfaces on which concrete is to be placed, application of mortar/slurry for proper bond, prevention of cold joint, types of chutes or conveyors.
l) Compaction:	Number of vibrators, their prime mover, frequency and amplitude of vibration, diameter and weight of vibrators, duration of vibration, hand-spreading, rodding and tamping.
m) Setting of base & Bearing plates:	Lines, elevations, and bedding mortar.
n) Concrete Finishes:	Repairs of surface defects, screening, floating, steel trowelling and brooming, special finishes.
o) Curing:	Methods and length of time.

Copies of records and tests for the items noted above, as well as, records of corrective action taken shall be submitted to the Engineer for approval as may be desired.



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3.00.00 INSTALLATION

All installation requirements shall be in accordance with IS: 456 and as supplemented or modified herein or by other best possible standards where the specific requirements mentioned in this section of the specification do not cover all the aspects to the full satisfaction of the Engineer.

3.01.00 Washing and Screening of Aggregates

Washing and screening of coarse and fine aggregates to remove fines, dirt, or other deleterious materials shall be carried out by approved means as desired by the Engineer.

3.02.00 Admixture

All concrete shall be designed for normal rate of setting and hardening at normal temperature. Variations in temperature and humidity under different climatic conditions will affect the rate of setting and hardening, which will, in turn, affect the workability and quality of the concrete. Admixtures including plasticisers of approved make may be used with the Engineer's approval in accordance with IS-456 to modify the rate of hardening, to improve workability or as an aid to control concrete quality. The Engineer reserves the right to require laboratory test or use test data, or owner satisfactory reference before granting approval. The admixture shall be used strictly in accordance with the manufacturer's directions and/or as directed by the Engineer.

3.03.00 Grades of Concrete

Concrete shall be in one of the grades designated in IS: 456. Grade of concrete to be used in different parts of work shall be as shown on the drawing. In case of liquid retaining structures, IS: 3370 will be followed. Minimum cement content shall be as per IS: 456.

3.04.00 Proportioning and Works Control

3.04.01 General

“Design Mix Concrete” and “Nominal Mix Design” is defined as follows for use in this specification:

- a) Proportioning of ingredients of concrete made with preliminary tests by designing the concrete mix. Such concrete shall be called "Design Mix Concrete".
- b) Proportioning of ingredients of concrete made without preliminary tests

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adopting nominal concrete mix. Such concrete shall be called "Nominal Mix Concrete".

As far as possible, design mix concrete shall be used on all concrete works. Nominal mix concrete, in grades M-15 or lower only may be used if shown on drawings or approved by the Engineer. In all cases the Proportioning of ingredients and works control shall be in accordance with IS: 456 and shall be adopted for use after the Engineer is satisfied regarding its adequacy and after obtaining his approval in writing.

3.04.02 Mix Design Criteria

Concrete mixes will be designed by the Contractor to achieve the strength, durability, and workability necessary for the job, by the most economical use of the various ingredients. In general, the design will keep in view the following considerations

- a) Consistent with the various other requirements of the mix, the quantity of water should be kept at the lowest possible level.
- b) The nominal maximum size of coarse aggregate shall be as large as possible within the limits specified.
- c) The various fractions of coarse and fine aggregates should be mixed in such a proportion as to produce the best possible combined internal grading giving the densest and most workable mix.
- d) The finished concrete should have adequate durability in all condition, to withstand satisfactorily the weather and other destruction agencies, which it is expected to be subjected to in actual service.
- e) The mix design shall have required workability and characteristic strength as per IS: 456. The quantity of cement, aggregates, and admixtures shall be determined by mass.

The requirement of adequate structural strength is catered for by the choice of proper grade of concrete in structural design. The Contractor will strictly abide by the same in his design of concrete mix installation. Various trials shall be given by the contractor with specific cement content on each trial. In some cases, plasticizers and other admixtures may be necessary to achieve the desired results.

3.05.00 Strength Requirements

The strength requirements of both design mix and nominal mix concrete where ordinary Portland Cement or Portland Blast furnace slag cement is used, shall

be as per IS:456. All other relevant clauses of IS:456 shall also apply.

3.06.00 Minimum Cement Content

The minimum cement content for each grade of concrete shall be as per IS: 456. Contractor has to consider actual environmental exposure condition at site. Based on various tests results and as per Engineer, the environment condition shall be adopted for which minimum cement content shall be considered. No extra payment shall be made on account of any variation in environment condition.

- a) Sufficient number of trial mixes (to be decided by the Engineer) will be taken at the laboratory for the various designs and graphs of w/c ratio Vs crushing strengths at various ages will be plotted.
- b) All tests will be done in presence of the Engineer who shall be the final authority to decide upon the adoption of any revised minimum cement content. The Contractor will always be responsible to produce quality concrete of the required grade as per the acceptance criteria of IS: 456.
- c) The Engineer will always have the unquestionable right to revise the minimum cement content as decided above, if, in his opinion, there is any chance of deterioration of quality on account of use of lower cement content or any other reason.

3.07.00 Water-Cement Ratio

The choice of water-cement ratio in designing a concrete mix will depend on:-

- a) The requirement of strength.
- b) The requirement of durability.

3.07.01 Strength Requirement

In case of "Design Mix Concrete" the water-cement ratio of such value as to give acceptable test results as per IS: 456, will be selected by trial and error. The values of water-cement ratios for different grade and mix designs will have to be established after conducting sufficiently large number of preliminary tests in the laboratory to the satisfaction of the Engineer. Frequent checks on test will have to be carried out and the water-cement ratios will be revised if the tests produce unsatisfactory results. Notwithstanding anything stated above the Contractor's responsibility to produce satisfactory test results and to bear all the consequences in case of default remains unaltered.



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In case of nominal mix concrete, the maximum water-cement ratio for different grades of concrete is specified in Table-5 of IS: 456 and no tests are necessary. The acceptance test criterion for nominal mix concrete shall be as per IS: 456.

3.07.02 Durability Requirement

Tables 4 & 5 of IS: 456 give the maximum water-cement ratio permissible from the point of view of durability of concrete subjected to adverse exposure to weather, sulphate attacks, and contact with harmful chemicals. Impermeability may also be an important consideration.

Whenever the water-cement ratio dictated by Durability consideration is lower than that required from strength criteria, the former should be adopted.

In general the water cement ratio between 0.4 and 0.45 will be desirable to satisfy the durability requirement and from the consideration of impermeability of concrete. The contractor may propose lower water cement ratio as mentioned above by addition of a suitable plasticizer/super-plasticizer. Trial mix shall be carried out accordingly. However, the contractor has to propose specifically along with field trials in the event of lower cement content if found suitable along with a plasticizer.

3.08.00 Workability

The degree of workability necessary to allow the concrete to be well consolidated and to be worked into the corners of formwork and around the reinforcement and embedments and to give the required surface finish shall depend*on the type and nature of structure and shall be based on experience and tests. The usual limits of consistency for various types of structures are given below:

TABLE-V

LIMITS OF CONSISTENCY

Degree of workability	Slump in mm with Standard Cone as per IS: 1199		Use for which concrete is suitable
	Min.	Max.	
Very low	0	25	Large Mass concrete structure with heavy compaction equipments, roads
Low	25	50	Uncongested wide and shallow R.C.C. structures
Medium	50	100	Deep but wide R.C.C. structures with congestion of reinforcement and inserts
High	100	150	Very narrow and deep R.C.C. structures with congestion due to reinforcement and inserts.

Note: Notwithstanding anything mentioned above, the slump to be obtained for work in progress shall be as per direction of the Engineer.

With the permission of the Engineer, for any grade of concrete, if the water has to be increased in special cases, cement shall also be increased proportionately to keep the ratio of water to cement same as adopted in trial mix design for each grade of concrete. No extra payment will be made for this additional cement.

The workability of concrete shall be checked at frequent intervals by slump tests.

3.09.00 Size of coarse Aggregates

The maximum size of coarse aggregates for different locations shall be as follows unless otherwise directed by the Engineer

Very narrow space

- 12 mm

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Reinforced concrete
Except foundation - 20 mm

Ordinary Plain concrete and Reinforced
concrete foundations - 40 mm

Mass concrete - 80 mm

Lean concrete - 40 mm

Grading of coarse aggregates for a particular size shall conform to relevant I.S. Codes and shall also be such as to produce a dense concrete of the specified proportions, strength and consistency that will work readily into position without segregation.

Coarse aggregate will normally be separated into the following sizes and stacked separately in properly designed stockpiles

80 mm to 40 mm, 40 mm to 20 mm and 20 mm to 5 mm. In certain cases it may be necessary to further split the 20 mm to 5 mm fraction into 20 mm to 10 mm and 10 mm to 5 mm fractions.

This separation of aggregates in different size fractions is necessary so that they may be remixed in the desired proportion to arrive at a correct internal grading to produce the best mix.

3.09.01 Temperature control of concrete in top decks of machine foundations (i.e. of TGs, BFPs, Fans and Mills) as extra payable over RCC item of BOQ:

The temperature of fresh concrete shall not exceed 23°C when placed. A suitable measuring device for measuring the temperature of concrete as approved by the Engineer shall be used. For maintaining the limiting temperature of the 23°C, crushed ice shall be used as mixing water. The ice shall be formed of water conforming IS: 456. The Contractor shall establish the quantity of crushed ice to be mixed in order to achieve the limiting temperature of 23°C.

3.09.02 Base raft of Turbo Generator foundations and top decks of all machine foundations shall be cast in a continuous operation without any construction joint.

3.10.00 **Mixing of Concrete**

Ingredients of the concrete mix shall be measured by weight. Concrete shall always be mixed in mechanical mixer. Water shall not normally be charged

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into the drum of the mixer until all the cement and aggregates constituting the batch are already in the drum and mixed for at least one minute. Mixing of each batch shall be continued until there is a uniform distribution of the materials and the mass is uniform in colour and consistency, but in no case shall mixing be done for less than 2 (two) minutes and at least 40 (forty) revolutions after all the materials and water are in the drum. When absorbent Aggregates are used or when the mix is very dry, the mixing time shall be extended as may be directed by the Engineer. Mixers shall not be loaded above their rated capacity as this prevents thorough mixing.

The entire contents of the drum shall be discharged before the ingredients for the next batch are fed into the drum. No partly set or remixed or excessively wet concrete shall be used. Such concrete shall be immediately removed from site. Each time the work stops, the mixer shall be thoroughly cleaned & when the next mixing commences, the first batch shall have 10% additional cement at no extra cost to the Owner to allow for loss in the drum.

Regular checks on mixer efficiency shall be carried out as directed by the Engineer as per IS: 4634 on all mixers employed at site only those mixers whose efficiencies are within the tolerances specified in IS: 1791 will be allowed to be employed.

Batching Plant shall conform to IS: 4925. The measuring gauges of batching plant shall be periodically calibrated for which the contractor shall provide standard weights. The accuracy of all gauges shall be within limits prescribed by the Engineer.

When hand mixing is permitted by the Engineer, for unimportant out of the way locations in small quantities, it shall be carried out on a water-tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. In case of hand-mixing, 10% extra cement shall be added to each batch at no extra cost to the owner.

3.11.00

Conveying Concrete

Concrete shall be handled and conveyed from the place of mixing to the place of laying as rapidly as practicable by approved means and placed and compacted in the final position before the initial setting of the cement starts. Concrete should be conveyed in such a way as will prevent segregation or loss of any of the ingredients. For long distance haulage, agitator cars of approved design will be used. If, in spite of all precautions, segregations does occur during transport, the concrete shall be properly re-mixed before placement. During very hot or cold weather, if directed by the Engineer, concrete shall be transported in deep containers, which will reduce the rate of loss of water, by evaporation or loss of heat. If necessary, the container may have to be covered and insulated. Conveying equipments for concrete shall be well maintained

and thoroughly cleaned before, commencement of concrete mixing. Such equipments shall be kept free from set concrete.

3.12.00 Placing and Compacting Concrete

Where specifically covered, the relevant I.S. Code will be followed for the procedure of surface preparation, placement, consolidation, curing, finishes, repairs and maintenance of concrete. If, however, there is no specific provision in relevant I.S. code for any particular aspect of work, any other standard code of practice, as may be specified by the Engineer, will be adopted. Concrete may have to be placed against the following types of surfaces:

- a) Earth foundation
- b) Rock foundation
- c) Formwork
- d) Construction joint in concrete or masonry

The surface on or against which concrete is to be placed has to be cleaned thoroughly. Rock or old construction joint has to be roughened by wire brushing, chipping, sand blasting or any other approved means for proper bond. All cuttings, dirt, oil, foreign and deleterious material, laitance, etc. are to be removed by air water jetting or water at high pressure. Earth foundation on which direct placement of concrete is allowed, will be consolidated as directed by the Engineer such that it does not crumble and get mixed up with the concrete during or after placement, before it has sufficiently set and hardened.

Formwork, reinforcement, preparation of surface, embedments, joint seals etc., shall be approved in writing by the Engineer before concrete is placed. As far as possible, concrete shall be placed in the formwork by means approved by the Engineer and shall not be dropped from a height or handled in a manner which may cause segregation. Any drop over 1500 mm shall have to be approved by the Engineer.

Rock foundation or construction joint will be kept moist for at least 72 hours prior to placement. Concrete will be placed always against moist surface but never on pools of water. In case the foundation cannot be dewatered completely, special procedure and precaution, as directed by the Engineer will have to be adopted.

Formwork will be cleaned thoroughly and smeared lightly with form oil or grease of approved quality just prior to placement.

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A layer of mortar of thickness 12 mm of the same or less w/c ratio and the same proportion as that of the concrete being placed or cement slurry will be spread thoroughly on the rock Foundation or construction joint just prior to placement of concrete.

After concrete has been placed, it shall be spread, if necessary & thoroughly compacted by approved mechanical vibration to maximum, subsidence without segregation and thoroughly worked around shape. Vibrators shall not be used for pushing concrete into adjoining areas. Vibrators must be operated by experienced workmen and the work carried out as per relevant IS Code of Practice: In thin members with heavy congestion of reinforcement or other embedments, where effective use of internal vibrator is, in the opinion of the Engineer, doubtful, in addition to immersion vibrators the contractor may have to employ form vibrators conforming to IS: 4656. For slabs and other similar structures, the contractor will additionally employ screed vibrator as per IS: 2506. Hand tamping may be allowed in rare cases, subject to the approval of the Engineer. Care must be taken to ensure that the inserts, fixtures, reinforcement, and formwork are not displaced or distorted during placing & consolidation of concrete.

The rate of placement of concrete shall be such that no cold joint is formed and fresh concrete is placed always against green Concrete, which is still plastic and workable. No concrete shall be placed in open, during rains. During rainy season, no placement in the open is to be attempted unless sufficient tarpaulins or other similar protective arrangement for completely covering the still green concrete from rain is kept at the site of placement. If there has been any sign of washing of cement and sand, the entire affected concrete shall be removed immediately. Suitable precautions shall be taken in advance to guard against rains before leaving the fresh concrete unattended. No accumulation of water shall be permitted on or around freshly laid concrete.

Slabs, beams, and similar members shall be poured in one operation, unless otherwise instructed by the Engineer. Mouldings, throating, drip course, etc., shall be poured as shown on the drawings or as directed by the Engineer. Holes shall be provided and bolts, sleeves, anchors, fastenings, or other fixtures shall be embedded in concrete as shown on the drawings or as directed by the Engineer. Any deviation there from shall be set right by the Contractor at his own expense as instructed by the Engineer.

In case the forms or supports get displaced during or immediately after the placement and bring the concrete surface out of alignment beyond tolerance limits, the Engineer may direct to remove the portion and reconstruct or repair the same -at the Contractor's expense.

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The Engineer shall decide upon the time interval between two placements of concrete of different ages coming in contact with each other, taking in consideration the degree of maturity of the older concrete, shrinkage, heat dissipation and the ability of the older concrete to withstand the load imposed upon it by the fresh placement.

Once the concrete is deposited, consolidated and finished in its final position, it shall not be distributed.

3.13.00 Construction Joints and Cold Joints

3.13.01 Construction Joints

It is always desirable to complete any concrete structure by continuous pouring in one operation. However, due to practical limitation of methods and equipment and certain design considerations, construction joints are formed by discontinuing concrete certain predetermined stages. These joints will be formed in a manner specified in the drawings/Instruction.

Vertical construction joints will be made with rigid stop-board forms having slots for allowing passage of reinforcement rods and any other embedments and fixtures that may be shown. Next stage concrete shall be placed against construction joint as per clause 3.12.

Where the location of the joints are not specified, it will be in accordance with the following:

- a) In a column, the joint shall be formed 75 mm below the lowest soffit of the beam framing into it.
- b) Concrete in a beam shall preferably be placed without a joint, but if Provision of a joint is unavoidable, the joint shall be vertical and at the middle of the span.
- c) A joint in a suspended floor slab shall be vertical and at the middle of the span and at right angles to the principal reinforcement.
- d) Feather-edges in concrete shall be avoided while forming a joint.
- e) A construction joint should preferably be placed in a low-stress zone and at right angles to the direction of the principal stress.
- f) In case the Contractor proposes to have a construction joint anywhere to facilitate his work, the proposal should be submitted well in advance to the Engineer for study and approval without which no construction joint will be allowed.

3.13.02 Cold Joint

An advancing face of a concrete pour, which could not be covered by fresh concrete before expiry of initial setting time (due to an unscheduled stoppage or delay on account of breakdown in plant, inclement weather, low rate of placement or any other reason), is called a cold joint. The Contractor should always remain vigilant to avoid cold joints.

If, however, a cold joint is formed due to unavoidable reasons, the following procedure shall be adopted for treating it:

- a) If the concrete is so green that it can be removed manually and if vibrators can penetrate the surface without much effort, fresh concrete can be placed directly against the old surface. The old concrete should be covered by fresh concrete as quickly as possible and the joint thoroughly and systematically vibrated.
- b) In case concrete has hardened a bit more than (a) but can still be easily removed by a light hand pick, the surface will be raked thoroughly and the loose concrete removed completely without disturbing the rest of the concrete in depth. A rich mortar layer 12 mm in thickness, will be placed on the cold joint fresh concrete shall be placed on the mortar layer and the joint will be thoroughly and systematically vibrated penetrating the vibrator deep into the old layer of concrete.
- c) In case the concrete at the joint has become so stiff that it cannot be remoulded and mortar or slurry does not raise inspite of extensive vibration, the joint, will be left to harden for at least 12 - 24 hrs. It Will then be treated as a regular construction joint, after cutting the concrete to required shape and preparing the surface as described under clause 3.12.

3.14.00 Repairs, Finishes, and Treatment of Concrete surfaces

3.14.01 Adequate and sound concrete surfaces, whether formed or unformed, can be obtained by employing a concrete mix of proper design, competent formwork, appropriate methods of handling, placing, and consolidation by experienced workmen.

Unsound concrete resulting from improper mix design, incompetent methods, equipment and formwork, poor workmanship and protection will not be accepted and will have to be dismantled, removed and replaced by sound concrete at the Contractor's cost. The Engineer may, at his sole discretion, allow to retain concrete with minor defects provided the Contractor is able to repair it by approved methods at no extra cost to the Owner, All concrete work shall be inspected by the Contractor immediately after the forms are removed

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& he will promptly report occurrence of any defects to the Engineer. All repair works will be carried out as per the instructions and in the presence of the Engineer or his representative. Generally, repair work will consist of any or all of the following operations:

- a) Sack rubbing with mortar and stoning with carborundum stone.
- b) Cutting away the defective concrete to the required depth shape.
- c) Cleaning of reinforcement & embedments. It may be necessary to provide an anti-corrosive coating on the reinforcement.
- d) Roughening by sand blasting or chipping.
- e) Installing additional reinforcement/welded mesh fabric.
- f) Dry packing with stiff mortar.
- g) Plastering, guniting, shotcreting etc.
- h) Placing and compacting concrete in the void left by cutting out defective concrete.
- i) Grouting with cement sand slurry of 1:1 mix.
- j) Repairing with a suitable mortar either cement or resin modified mortars.
- k) Polymer modified patching and adhesive repair& mortar for beams & columns.

3.14.02 Finishing unformed Surface

The contractor shall provide normal finishes in unformed surfaces which can be achieved by screeding, floating, trowelling etc. A few typical and common cases of treatment of concrete surface are cited below

a) Floor

Whenever a non-integral floor finish is indicated, the surface of reinforced concrete slab shall be struck off at the specified levels and slopes and shall be finished with a wooden float fairly smooth removing all laitance. No over trowelling, to obtain a very smooth surface, shall be done, as it will prevent adequate bond with the subsequent finish. If desired by the Engineer, the surface shall be scored and marked to provide better bond.

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Where monolithic finish is specified or required, concrete shall be compacted and struck off at the specified levels and slopes with a screed, preferably a vibrating type and then floated with a wooden float. Steel trowelling is then started after the moisture film and shine have disappeared from the surface and after the concrete has hardened enough to prevent excess of fines and water to rise to the surface but not hard enough to prevent proper finishing of aberrations. Steel trowelling properly done will flatten and smoothen sandy surface left by wooden floats and produce a dense surface free from blemishes, ripples, and trowel marks.

A fine textured surface that is not slick and can be used where there is likelihood of spillage of oil or water can be obtained by trowelling the surface lightly with a circular motion after initial trowelling keeping the steel trowel flat on the surface.

To provide a better grip the Engineer may instruct marking the floor in a regular geometric pattern after initial trowelling.

b) Beans, Columns & Walls

If on such or any other concrete structure it is intended to apply plaster or such concrete surfaces against which brickwork or other allied works are to be built, the Contractor shall hack the surface adequately as soon as the form is stripped off so that proper bond can develop. Pattern, adequacy, and details of such hacking shall meet with the approval of the Engineer, who shall be informed to inspect such surfaces before they are covered up.

3.15.00 Protection and Curing of concrete

Newly placed concrete shall be protected by approved means from rain, sun, and wind. Concrete placed below the ground level shall be protected against contamination from falling earth during and after placing. Concrete placed in ground containing deleterious substances, shall be protected from contact with such ground, or with water draining from such ground, during placing of concrete and for a period of at least three days, or as otherwise instructed by the Engineer. The ground water around newly poured concrete shall be kept to an approved level by pumping out or other adequate means of drainage to prevent floatation or flooding. Steps, as approved by the Engineer, shall be taken to protect immature concrete from damage by debris, excessive 'Loadings, vibration, abrasion, mixing with earth or other deleterious materials, etc. that may impair the strength and durability of the concrete.

As soon as the concrete has hardened sufficiently, it shall be covered either with sand, hessian, canvas, or similar materials and kept continuously wet for at least 14 (fourteen) days after final setting. Curing by continuous sprinkling of water will be allowed if the Engineer is satisfied with the adequacy of the

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arrangements made by the Contractor. Quality of water for curing shall be as per IS: 456.

If permitted by the Engineer, liquid curing compound may be used for prevention of premature water loss in concrete and thereby effecting curing of concrete. This type of curing compound shall be sprayed on newly laid concrete surfaces to form a thin film barrier against premature water loss without disturbances to normal setting action. The curing compound shall be emulsified paraffin based and shall comply with ASTM requirements for acceptance.

The curing compound shall be applied following the final finishing operation and immediately after disappearance of water from concrete surface. It is important not to apply the curing compound when standing water is still present on concrete.

The contractor shall arrange for the manufacturer's supervision at no extra cost.

The Contractor shall remain extremely vigilant and employ proper equipment and workmen under able supervision for curing. The Engineer's decision regarding the adequacy of curing is final. In case the Engineer notices any lapse on the part of the Contractor, he will inform the Contractor or his supervisor verbally or in writing to correct the deficiency in curing. If no satisfactory action is taken by the Contractor within 3 (three) hours of issuance of such instruction, the Engineer will be at liberty either to employ sufficient means through any agency to make good the deficiency and recover the cost thereof from the Contractor, or deduct certain amount from contractor's payment for the part where inadequate curing was noticed entirely at the discretion of the Engineer.

3.16.00 Reinforcement

Mild steel round bars, TMT bars, Hot rolled deformed bars or cold twisted deformed bars as medium tensile or high yield strength steel, plain hard drawn steel wire fabric etc, will be used as reinforcement as per drawings and directions. In an aggressive environment an anti-corrosive coating on the reinforcement may be provided as per IS: 9077, as shown on the drawing or as directed by the Engineer.

3.16.01 Bar Bending Schedules

The Contractor shall prepare Bar Bending Schedules showing clearly the arrangements proposed by the Contractor to match available stock of reinforcing steel, progressively, starting within one week of receipt of approval on corresponding design of RCC structure. As decided by the Engineer, some

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or all the detailed drawings and schedules will have to be submitted for approval. Approval of such detailed drawings by the Engineer shall not relieve the Contractor of his responsibility for correctness nor of any of his obligations to meet the other requirements of the contract. The contractor for record and distribution shall submit six prints of the final drawings & schedules with one reproducible print.

3.16.02 Cleaning

All steel for reinforcement shall be free from loose scales, oil, grease, paint or other harmful matters immediately before placing the concrete.

3.16.03 Bending

Unless otherwise specified, reinforcing steel shall be bent in accordance with the procedure specified in IS: 2502 or as approved by the Engineer. Bends and shapes shall comply strictly with the dimensions corresponding with the final Bar Bending Schedules. Bar Bending Schedules shall be rechecked by the Contractor before any cutting, bending is done.

No reinforcement shall be bent when already in position in the work, without approval of the Engineer, whether or not it is partially embedded in concrete. Bars shall not be straightened in a manner that will injure the material. Rebending can be done only if approved by the Engineer. Reinforcing bars shall be bent by machine or other approved means producing a gradual and even motion. All the bars shall be cold bent unless otherwise approved. Bending hot at a cherry-red heat (not exceeding 845°C) may be allowed under very exceptional circumstances except for bars whose strength depends on cold working. Bars bent hot shall not be cooled by quenching.

3.16.04 Placing in Position

All reinforcements shall be accurately fixed and maintained in position as shown on the drawings by such approved and adequate means like mild steel chairs and/or concrete spacer blocks. Bars intended to be in contact at crossing points, shall be securely tied together at all such points by No. 20 G annealed soft iron wire or by tack welding in case of Bar larger than 25 mm dia., as may be directed by the Engineer. Binders shall tightly embrace the bars with which they are intended to be in contact and shall be securely held. The vertical distance between successive layers of bars shall be maintained by provision of mild steel spacer bars. They should be spaced such that the main bars do not sag perceptibly between adjacent spacers. Before actual placing, the Contractor shall study the drawings thoroughly and inform the Engineer in case he feels that placement of certain bars is not possible due to congestion. In such cases he should not start placing any bar before obtaining clearance from the Engineer.

3.16.05 Welding / Coupler for Splicing

Lapping shall normally do splicing of reinforcement. For M.S. reinforcement bars, butt-welding may be done, if permitted by the Engineer, under certain conditions. The work should be done with suitable safeguards in accordance with relevant Indian Standards for welding of mild steel bars used in reinforced concrete construction as per IS: 2751 and IS: 456. For High yield strength deformed bars, lap welding may be done, if permitted by the Engineer, under certain conditions. The work should be done with suitable safeguards in accordance with relevant Indian Standards as per IS: 9417. Welding of High yield strength deformed bar shall not be allowed.

Splicing of reinforcement using mechanical coupler may be done, if permitted by the Engineer, under certain conditions. The work should be done with suitable safeguards in accordance with relevant Indian standards for "Reinforcement couplers for mechanical splices of bars in concrete" as per IS: 16172. Corrosion test in the coupler-bar connections exposed to marine or severe environmental conditions to rule out any risk of galvanic corrosion will be done by the contractor at no extra cost. Proper fitting & fixing of mechanical coupler to rebar shall be ensured at site for each coupled joint as per inspection testing plan developed at site in consultation with manufacturer of coupler. If so required at site, coupler/ threading on rebar shall be such that two bars can be coupled by moving couplers not rebar (as being heavy reinforcement weight and L shaped, it is not feasible to rotate the rebar for fixing up the coupler) at no extra cost.

3.16.06 Control

The placing of reinforcements shall be completed well in advance of concrete pouring. Immediately before pouring, the reinforcement shall be examined by the Engineer for accuracy of placement and cleanliness. Necessary corrections as directed by him shall be carried out. Laps and anchorage lengths of reinforcing bars shall be in accordance with IS: 456, unless otherwise specified. The laps shall be staggered as far as practicable and as directed by the Engineer. Arrangements for placing concrete shall be such that reinforcement in position does not have to bear extra load and get disturbed. The cover for concrete over the reinforcements shall be as shown on the approved drawings unless otherwise directed by the Engineer. Where concrete blocks are used for ensuring the cover and positioning reinforcement, they shall be made of mortar not leaner than 1 (one) part cement to 2 (two) parts sand by –volume and cured in a pond for at least 14 (fourteen) days. The type, shape, size and location of the concrete blocks shall be as approved by the Engineer.



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3.17.00 Cold Weather Concreting

When conditions are such that the ambient temperature may be expected to be 5°C or below during the placing and curing period, the work shall conform to the requirement of IS: 456 and IS: 7861.

3.18.00 Hot Weather Concreting

When depositing concrete in very hot weather, the Contractor shall take all precautions as per IS: 7861 and stagger the work to the cooler parts of the day to ensure that the temperature of wet concrete used in massive structures does not exceed 38°C while placing. Positive temperature control by precooling, post cooling or any other method, if required, will have to be done by the contractor at no extra cost.

3.19.00 Concreting under water

When it is necessary to deposit concrete under water it shall be done in accordance with the requirements of IS: 456.

3.20.00 Form Work

3.20.01 General

If it is so desired by the Engineer, the contractor shall prepare, before commencement of actual work, designs and working drawings for formwork and centring and get them approved by the Engineer. The formwork shall conform to the shape, grade, lines, levels and dimensions as shown on the drawings.

Materials used for the formwork inclusive of the supports and centring shall be capable of withstanding the working load and remain undistorted throughout the period it is left in service. All supports and scaffolds should be manufactured from structural or tubular steel except when specifically permitted otherwise by the Engineer.

The centring shall be true to vertical, rigid and thoroughly braced both horizontally and diagonally. Rakers are to be used where forms are to support inclined members. The forms shall be sufficiently strong to carry without undue deformation, the dead weight and horizontal pressure of the concrete as a liquid as well as the working load. In case the contractor wishes to adopt any other design criteria, he has to convince the Engineer about its acceptability before adopting it. Where the concrete is vibrated, the formwork shall be strong enough to withstand the effects of vibration without appreciable deflection, bulging, distortion or loosening of its components. The joints in the formwork shall be sufficiently tight to prevent any leakage of slurry or

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mortar.

To achieve the desired rigidity, tie bolts, spacer blocks, tie wires and clamps as approved by the Engineer shall be used but they must in no way impair the strength of concrete or cause stains or marks on the finished surface. Where there are chances of these fixtures being embedded, only mild steel and concrete of adequate strength shall be used. Bolts passing completely through liquid retaining walls/slabs for the purpose of securing and aligning the formwork shall not be used.

The formwork shall be such as to ensure a smooth uniform surface free from honeycombs, air bubbles, bulges, fins and other blemishes. Any blemish or defect found on the surface of the concrete must be brought to the notice of the Engineer immediately and rectified as directed by him.

For exposed interior and exterior concrete surfaces of beams, columns and wall, plywood or other approved form shall be thoroughly cleaned and tied together with approved corrosion-resistant devices. Rigid care shall be exercised in ensuring that all column forms are in true plumb and thoroughly cross-braced to keep them so. All floor and beam centring shall be crowned not less than 8 mm in all directions for every 5 metres span. The formwork should lap and be secured sufficiently at the lift joints to prevent bulges and offsets.

Temporary openings for cleaning, inspection and for pouring concrete shall be provided at the base vertical forms and at other places, where they are necessary and as may be directed by the Engineer. The temporary openings shall be so formed that they can be conveniently closed when required, during pouring operations without leaving any mark on the concrete.

3.20.02 Cleaning and Treatment of Forms

All parts of the forms shall be thoroughly cleaned of old concrete, wood shavings, saw dust, dirt and dust sticking to them before they are fixed in position. All rubbish, loose concrete, chippings, shavings, sawdust etc. shall be scrupulously removed from the interior of the forms before concrete is poured. Compressed air jet and/or water jet along with wire brushes brooms etc. shall be used for cleaning. The inside surface of the formwork shall be treated with approved non-staining oil or other compound before it is placed in position. Care shall be taken that oil or other compound does not come in contact with reinforcing steel or construction joint surfaces. They shall not be allowed to accumulate at the bottom of the formwork. The oiling of the formwork will be inspected just prior to placement of concrete and redone wherever necessary.

3.20.03 Design

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The formwork shall be so designed and erected that the forms for slabs and the sides of beams, columns, and walls are independent of the soffits of beams and can be removed without any strain to the concrete already placed or affecting the remaining formwork.

Removing any props or repropping shall not be done except with the specific approval of the Engineer. If formwork for column is erected for the full height of the column, one side shall be left open and built up in sections, as placing of concrete progress. Wedges, spacer bolts, clamps or other suitable means shall be provided to allow accurate adjustment and alignment of the formwork and to allow it to be removed gradually without jarring the concrete.

3.20.04 Inspection of Forms

Casting of Concrete shall start only after the formwork has been inspected and approved by the Engineer. The concreting shall start as early as possible within 3 (three) days after the approval of the formwork and during this period the formwork shall be kept under constant vigilance against any interference. In case of delay beyond three days, a fresh approval from the Engineer shall be obtained.

3.20.05 Removal of Forms

Formwork shall be kept in position after casting of concrete for a minimum period as mentioned in IS: 456, however the period of retaining form in position can be extended as per drawing, instruction of Engineer or as required for satisfactory completion of work without any extra cost. Before removing any formwork, the Contractor must notify the Engineer well in advance to enable him to inspect the concrete if the Engineer so desires.

The Contractor shall record on the drawing or in any other approved manner, the date on which concrete is placed in each part of the work and the date on which the formwork is removed there from and have this record checked and countersigned by the Engineer regularly. The Contractor shall be responsible for the safe removal of the formwork and any work showing signs of damage through premature removal of formwork or loading shall be rejected and entirely reconstructed by him without any extra cost to the Owner, The Engineer may, however, instruct to postpone the removal of formwork if he considers it necessary.

If any other type of cement other than ordinary Portland cement and Rapid hardening cement is used, the time of removal of forms shall be revised such that the strength of this cement at the time of removal of forms match with strength of Portland cement at the time of removal of form.

3.20.06 Tolerance

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The formwork shall be so made as to produce a finished concrete, true to shape, lines, levels, plumb and dimensions as shown on the drawings subject to the following tolerances unless otherwise specified in this specification or drawings or directed by the Engineer:-

- For -
- a) Sectional dimension - ± 5 mm
 - b) Plumb - 1 in 1000 of height
 - c) Levels - ± 3 mm before any deflection has taken place

The tolerance given above are specified for local aberrations in the finished concrete surface & should not be taken as tolerances for the entire structure taken as a whole or for the setting and alignment of formwork, which should be as accurate as possible to the entire satisfaction of the Engineer. Any error, within the above tolerance limits or any other as may be specially set up by the Engineer, if noticed in any lift of the structure after stripping of forms, shall be corrected in the subsequent work to bring back the surface of the structure to its true alignment.

3.20.07 Re-use of Forms

Before re-use, all forms shall be thoroughly scraped, cleaned, joints and planes examined and when necessary repaired, and inside surface treated as specified hereinbefore. Formwork shall not be used/re-used if declared unfit or unserviceable by the Engineer.

3.20.08 Classification

Generally, the "ordinary" class formwork shall be used unless otherwise specified.

- a) **Ordinary:** These shall be used in places where ordinary surface finish is required and shall be composed of steel and/or approved good quality partially seasoned timber.
- b) **Plywood:** These shall be used in exposed surfaces, where specially good finish is required and shall be made of approved brand of heavy quality plywood to produce a perfectly uniform and smooth surface conforming to the shape described in the drawing with required grain texture on the concrete. Re-use may only be permitted after special inspection and approval by the Engineer. He may also permit utilization of used plywood for the "ordinary" class, if it is still in good condition.
- c) **Ornamental:** These shall be used where ornamental and curved surface are required and shall be made of selected best quality well seasoned

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timbers or of plywood, which can be shaped correctly.

3.21.00 Opening, Chases, Grooves, Rebates, Blockouts etc.

The Contractor shall leave all openings, grooves, chases, etc. in concrete work as shown on the drawings or as specified by the Engineer.

3.22.00 Anchor Bolts, Anchors, Sleeves, Inserts, Hangers/Conduits/Pipe and other misc. Embedded Fixtures

The Contractor shall build into concrete work all the items noted below and shall embed them partly or fully as shown on drawings and secure the same as may be required. The materials shall be as specified and be of best quality available according to relevant Indian Standards of approved manufacture and to the satisfaction of the Engineer. Exposed surfaces of embedded materials are to paint with one coat of approved anti- corrosive paint and/or bituminous paint without any extra cost to the Owner. If welding is to be done subsequently on the exposed surface of embedded material, the paint shall be cleaned off the member to a minimum length of 50 mm beyond each side of the weld line.

Necessary templates, jigs, fixtures, supports etc. shall be used as may be required or directed by the Engineer.

Items to be embedded

- a) Inserts, hangers, anchors, frame around openings, manhole covers, frames, floor clips, sleeves conduits and pipes.
- b) Anchor bolts and plates for machinery, equipment and for structural steel work.
- c) Steel structurals to be left embedded for future extension, special connection etc.
- d) Dowel bars, etc. for concrete work falling under the scope of other contractors.
- e) Lugs or plugs for door and window frames occurring in concrete work.
- f) Flashing and jointing in concrete work.
- g) Any misc. embedments and fixture as may be required.

Correct location and alignment, as per drawings/instruction of all these



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embedded items shall be entirely the responsibility of the Contractor.

3.23.00 Expansion and Isolation Joints

3.23.01 General

Expansion and isolation joints in concrete structures shall be provided at specific places as per details indicated on the drawings. The materials and types of joints shall be as specified hereinafter. In case of liquid retaining structures, additional precautions shall be taken to prevent leakage of liquids as may be specified on the drawings or as directed by the Engineer. All materials are to be procured from reliable manufacturers and must have the approval of the Engineer. Where it is the responsibility of the Contractor to supply the material, the Engineer may demand test certificates for the materials and/or instruct the Contractor to get them tested in an approved laboratory free of cost to the Owner. Joints shall be formed true to line, level, shape, dimension, and quality as per drawings and specifications. Prior approval of the method of forming the joints should be obtained from the Engineer before starting the work.

3.23.02 Bitumen Board/ Expanded Polystyrene Board

a) Bitumen Board

Bitumen impregnated fibreboard of approved manufacturer as per IS: 1838 may be used as fillers for expansion joints. It must be durable and waterproof. It shall be compressible and possess a high degree of rebound. The dimensions of the board should be equal to that of the joint being formed. It should, preferably be manufactured in one piece, matching the dimension of the joint and not prepared by cutting to size smaller pieces from larger boards at site. At the exposed end, the joint shall be sealed with approved sealing compound to a depth of at least 25 mm after application of an approved primer. The sealing compound and the primer shall be applied as specified by the manufacturer.

b) Expanded Polystyrene Boards

If required, commercial quality of expanded polystyrene products commonly used for thermal insulations may also be used as filler material in expansion joints. The thickness may vary from 12 mm to 50 mm. The material will have to be procured from reliable manufacturers as approved by the Engineer. The method of installations will be similar to that recommended by the manufacturers for fixing on cold storage walls. A coat of Bitumen paint may have to be applied on the board against which concrete will be placed.

3.23.03

Joint sealing strips

Joint sealing strips may be provided at the construction, expansion, and isolation joints as a continuous diaphragm to contain the filler material and/or to exclude passage of water or any other material into or out of the structure. The sealing strips will be either metallic like G.I., Aluminums, or Copper, or non-metallic like rubber or P.V.C.

Sealing strips will not have any longitudinal joint and will be procured and installed in largest practicable lengths having a minimum number of transverse joints. The material is to be procured from reputed manufacturers having proven records of satisfactory supply of joint strips of similar make and shape for other jobs. The jointing procedure shall be as per the manufacturer's recommendations, revised if necessary, by the Engineer. The Contractor is to supply all labour and material for installation -including the material and tools required for jointing, testing, protection, etc. If desired by the Engineer, joints in rubber seals may have to be vulcanized.

a) Metal Sealing Strips

Metal sealing strips shall be either G.I., Aluminium or Copper and formed straight, U shaped, Z shaped or any other shape and of thickness as indicated in the drawing. The transverse joints will be gas welded using brass rods and approved flux and will be tested by an approved method to establish that it is leak proof. If required, longer lap lengths and different method of brazing which will render it leak proof, will be adopted by the Contractor. The edges shall be neatly crimped and bent to ensure proper bond with the concrete.

i) G.I. Strips

G.I. strips shall be minimum 1.5 mm thick and 150 mm in width unless specified otherwise. The standard of Galvanizing shall be as per relevant Indian Standards for heavy-duty work. At the joints, the overlapping should be for a minimum length of 50 mm.

ii) Aluminium Strips

Aluminium strips shall be minimum 18 SWG thick and 300 mm wide unless specified otherwise and shall conform to IS: 737 of 19000 grades or 31000 grade (Designation as per IS: 6051). A minimum lap of 50 mm length is required at the joints.

iii) Copper Strips

The Copper strips shall be minimum 18 SWC in thickness and 300 mm



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width unless specified otherwise and shall conform to the relevant Indian Standards. It should be cleaned thoroughly before use to expose fresh surface, without any reduction in gauge. A minimum lap of 50 mm in length is required at the joints.

b) Non-metallic Sealing Strips

These will be normally in Rubber or P.V.C. Rubber or P.V.C. joint seals can be of shape having any combination of the following features:

- i) Plain
- ii) Central bulb
- iii) Dumb-bell or flattened ends
- iv) Ribbed and Corrugated Wings
- v) V shaped

As these types of seals can be easily handled in very large lengths unlike metal strips, transverse joints will be allowed only under unavoidable circumstances and with the specific approval of the Engineer. The method of forming these joints, laps etc. shall be as specified by the Manufacturer and/or as approved by the Engineer taking particular care to match the central bulbs & the edges accurately.

c) Rubber Sealing Strips

The minimum thickness of Rubber sealing strips shall be 3 mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings or as directed by the Engineer. The material will be natural rubber and be resistant to corrosion, abrasion, and tear and also to attacks from the acids, alkalis and chemicals normally encountered in service. The physical properties will be generally as follows. The actual requirements may be slightly different as decided by the Engineer:

Specific Gravity	:	1.1 to 1.15
Shore Hardness	:	65A to 75A
Tensile Strength	:	25 - 30 N/Sq.mm
Maximum Safe Continuous Temperature	:	75°C



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Ultimate Elongation : Not less than 350%

b) P.V.C., Sealing Strips

The minimum thickness of P.V.C. sealing strips will be 3 mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings or as directed by the Engineer. The material should be of good quality Polyvinyl Chloride highly resistant to tearing, abrasion, and corrosion as well as to chemicals likely to come in contact with during use. The physical properties will generally be as follows. The actual requirements, which will be directed by the Engineer, may vary slightly

Specific Gravity : 1.3 to 1.35

Shore Hardness : 60A to SOA

Tensile Strength : 10 - 15 N/Sq.mm

Maximum Safe Continuous
Temperature : 70 Deg.C

Ultimate Elongation : Not less than 275%

3.23.04 Bitumen Compound

When shown in drawing or directed, the gap in expansion joints shall be thoroughly cleaned and bitumen compound laid as per manufacturer's specifications. The compound to be used shall be of approved manufacture and shall conform to the requirements of IS: 1834.

3.23.05 Isolation Joints

Strong and tough alkathene sheet or equivalent, about 1 mm in thickness and as approved by the Engineer shall be used in isolation joints. It shall be fixed by an approved adhesive compound on the cleaned surface of the already set concrete to cover it fully. Fresh concrete shall be laid against the sheet, care being taken not to damage the sheet in any way.

3.23.06 Pad

Hard foundation quality rubber pads of required thickness and shapes shall be put below machine or other foundations as shown on the drawings. The rubber shall have a unit weight of 1500 Kg/Cu.m, a shore hardness - 65A to 70A and be of best quality of approved manufacture, durable, capable of absorbing vibration and must be chemically inert in contact with moist or dry earth or any other deleterious material expected under normal conditions.

3.24.00

Grouting under Machinery or Structural Steel Bases

If required, grouting under base plates of machines or structural steel etc. shall be carried out by the Contractor. In general, the mix shall be 1 (one) part cement and 1 (one) part sand and just enough water to make it flow as required. The areas to be grouted shall be cleaned thoroughly with compressed air jet and/or with water in locations where accumulated surplus water can be removed. Where directed by the Engineer, 6 mm down stone chips may have to be used in the mix. Surface to be grouted shall be kept moist for at least 24 hours in advance. The grout shall be placed under expert supervision, so that there is no locked up air. Edges shall be finished properly. If specified on drawings, admixtures like Aluminium powder, "Ironite" etc. may have to be added with the grout in required proportions. Premixed non-shrink grout of approved manufacture having proper strength shall be used with Engineer's approval for important machineries.

3.25.00

Precast Concrete

The Specification for precast concrete will be similar as for the cast-in-place concrete described herein and as supplemented in this section. All precast work shall be carried out in a yard made for the purpose. This yard shall be dry, properly levelled and having a hard and even surface. If the ground is to be used as a soffit former of the units, it shall be paved with concrete or masonry and provided with a layer of plaster (1:2 proportion) with smooth neat cement finish or a layer of M.S. sheeting. Where directed by the Engineer, casting will have to be done on suitable vibrating table. The yard, lifting equipment, curing tank, finished material storage space etc. shall be designed such that the units are not lifted from the mould before 7 (seven) days of curing and can be removed for erection after 28 (twenty-eight) days of curing. The moulds shall preferably be of steel or of timber lined with G.I. sheet metal. The yard shall preferably be fenced.

Lifting hooks, where necessary or as directed by the Engineer, shall be embedded in correct position of the units to facilitate erection, even though they may not be shown on the drawings, and shall be burnt off and finished after erection.

Precast concrete units, when ready, shall be transported to site by suitable means approved by the Engineer. Care shall be taken to ensure that no damage occurs during transportation. All adjustments, levelling, and plumbing shall be done as per instructions of the Engineer. The Contractor shall render all help with instruments, materials, and men to the Engineer for checking the proper erection of the precast units.

After erection and alignment, the joints shall be filled with grout or concrete as

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per drawings. If centrings have to be used for supporting the precast units, they shall not be removed until the joints have attained sufficient strength and in no case before 14 (fourteen) days. The joint between precast roof planks shall be pointed with 1:2 cement: sand mortar where called for in the drawings.

3.26.00 Waterproofing of Concrete Structure

3.26.01 General

Where required, waterproofing of concrete structures shall be ensured internally by suitable design of the concrete mix, addition of suitable admixtures in the concrete or mortar at the time of mixing and/or installing water bars at the joints. In addition to the above measures, the structures shall be made watertight by adopting "structural waterproofing" as per specification. The design, material, and workmanship shall conform to the relevant I.S. Codes where applicable. The Engineer's approval of the materials shall be obtained by the Contractor before procurement. If desired by the Engineer, test certificates for the materials and samples shall be submitted by the Contractor free of charge. The materials shall be of best quality available indigenously, fresh clean and suitable for the duties called upon.

3.26.02 Water Bar/Seal/Special Treatment of Construction Joint

Water bearing structures and underground structures may have water bar/seals installed at the joints. They may be metallic, rubber, or P.V.C. The materials and installation will be as described under Clause 3.23.3. Construction joint shall be provided as per clause 3.13.1 with or without water bar/seal as shown on the drawing. In case of water bars being used at the construction joint, fixing of the same has to be done carefully, so that the water bar is not disturbed during concreting. The construction joint shall also be treated by any one of the following methods.

Method 1: A surface retarder in the form of a thixotropic gel shall be applied on the joint surface of the previous pour in case of joint on the wall and in case of floor the same shall be applied on the formwork against which previous pour of concreting shall be done. The retarder may be liquid or paste form depending on the type of formwork. The formwork shall be removed within 24 hours after concreting. Within 2 hours of striking of the formwork the retarder shall be washed off with strong water jet to make surface rough and clean. Then a rich cement mortar using cement, sand and aggregates (maximum size 8 mm) along with synthetic rubber emulsion type water resistant bonding agent shall be applied for a depth of 50 mm just before pouring the next stage of concreting. In case of walls, the above bonding agent will be mixed with water, which will be used for making the cement mortar. The proportion of mixing of this bonding agent with water shall be as per manufacturer's specification. In case of floor joint, however, after washing of retarder a

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solvent free two-component epoxy resin-bonding agent will be used at the joint before the next pour of concrete. The above bonding agent shall have the following properties after 28 days

Compressive strength	-	55 to 60 N/Sq.mm
Flexural strength	-	5 to 30 N/sq.mm
Tensile strength	-	15 N/Sq.mm (approx.)
Bonding strength to concrete	-	3 N/Sq.mm (approx.)
Bonding strength to steel	-	20 N/Sq.m (approx.)

The whole operation shall be done as per manufacturers specification. The contractor shall provide manufacturer's supervision at no extra cost to the owner.

Method 2: One row of threaded nozzles at regular intervals not exceeding 1.5 m centre to centre shall be placed in concrete along the construction joint during casting. Injection of cement water together with a suitable waterproof expanding grouting admixture of approved quality shall be done through the nozzles after the concrete has set to seal the voids in concrete near the construction joint in walls and slabs. The injection shall be done under pressure of approximately 2 to 4 kg/sq.cm. The nozzles shall be sealed off with suitable admixture after the injection is over. The whole operation shall be carried out as per manufacturer's specification and supervision. The cost of such manufacturer's supervision shall be borne by the contractor.

3.26.03 Waterproofing Admixtures

The waterproofing admixture for concrete and cement mortar/plaster shall conform to IS: 2645. The admixture shall not cause decrease of strength of concrete/plaster at any stage and it shall be free from chlorides and sulphates. The admixture shall not affect the setting time by more than 5%. The maximum permissible dosage of admixture will be 3% (three percent) by weight of cement, but a lower dosage will always be preferred. The product shall be stored in strong moisture proof packings. However, in case of important structures where M25 or higher grade concrete is specified, the use of melamine based, high range water reducing concrete admixture shall be used to provide a waterproof concrete, For achieving high strength concrete having cement content around 400 kg/cu.m. a melamine based super plasticizer will be preferable.

- In concrete: The admixtures shall be procured from reliable and reputed manufacturers and approved by the Engineer. The method of application

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and other details shall conform to the manufacturer's specification and/or as instructed by the Engineer. The Contractor shall have the services of the manufacturer's supervisor at no extra cost to supervise the work, if desired by the Engineer.

- b) In Plaster: The concrete surface, to be plastered, shall be hacked to Engineer's satisfaction, cleaned thoroughly and kept wetted for 24 hours. The plaster shall be in cement sand mortar mixed in proportion varying from 1:1 to 1:4 by volume along with the approved waterproofing admixture and laid in appropriate thickness and in layers not exceeding 15 mm/layer or as per manufacturer's specification. The additive shall be of quality and type approved by the Engineer. If desired by the Engineer, the Contractor shall have the work supervised by the manufacturer's supervisor at no extra cost. On completion, the Plastered surface shall be cured continuously for a minimum period of 14 days like concrete.

3.26.04 Structural waterproofing

- a) Nozzles spaced as required after the concrete is completed shall be drilled into surfaces to be rendered watertight. Non-shrink cement grout with waterproofing compound as per manufacturers specifications shall be injected under pressure to seal all voids. Special care shall be taken at joints by providing additional nozzles. The pressure grouting shall be done on the internal surface.

- b) External Treatment

Two layers of (1:4) plaster of 12 mm thick each with waterproofing compound as per manufacturer's specification shall be provided on outer surface of concrete underground structures.

3.26.05 Protective coating on Inside Surface.

Two coats of cement based two components polymer modified flexible protective and waterproofing slurry having 1 mm thick for each coat shall be applied on the walls/floor after proper surface preparation as mentioned above. The slurry shall be applied by brush.

3.26.06 Bitumen Felt: Application for Tanking

This specification shall cover laying the waterproof course on the outside and inside of the walls and bases of structures.

The materials shall conform to IS: 1322, and the workmanship to IS: 1609. The bitumen felt should be hessian base and/or fibre base as specified in Drawing. If required by the Engineer, tests as specified in relevant IS Codes

shall be arranged by the Contractor without charging any extra to the Owner.

The Contractor shall execute this work in direct collaboration with one of the well-known specialized firm approved by the Engineer.

Cleaning the surface, keeping it dry, providing, necessary corner fillets and cement rendering and cutting chases, etc. shall be done as per drawings and/or instructions. If any protective brickwork on/against concrete sub-bases or walls are required, the same shall be provided. A twenty (20) years guarantee for satisfactory performances shall be given by the Contractor as well as his specialist sub-contractor jointly and severally, for this work. Free rectification of any defects noted in the work within this guarantee period will be carried out by the Contractor even if it is beyond the specified maintenance period of the contract as a whole.

3.26.07 Polyethylene Films: Application in Walls or base of structures

Waterproof treatment shall be applied as outlined and as per sequence given hereunder

- i) the concrete surface shall be made smooth with 12 mm cement plaster 1:6.
- ii) apply hot bitumen 80/100 grade (IS: 73-1961) at the rate of 1.0 Kg/Sq.m minimum
- iii) lay black polyethylene film 250-micron (IS: 2508-1977) with cut back bitumen adhesive in overlaps over hot bitumen surface, gently pressed, taking care not to puncture the film.

Alternatively, the overlaps shall be heat sealed by an electric iron having three parallel sealing bars. A long piece of plywood is to be placed below the polyethylene film to be heat-sealed. On the plywood a rubber gasket is to be laid to provide a cushion for better welding of the film. On the rubber padding, a cellophane tape is to be spread and on this the LDPE film, with 100 mm overlap, is to be stretched. On the overlapped film another cellophane tape is to be placed to prevent the heat sealer from sticking to the LDPE film. After this, the electric iron is to be pressed on the overlap joint for sufficient time so as to allow perfect welding. The operation is to be repeated for subsequent lengths of joints. After heat-sealing, the cellophane tape is to be removed and the joints are to be tested for leaks.

- iv) Lay 100 gm brown craft paper laminated with a layer of straight run bitumen,
- v) Lay hot bitumen 80/100 grade (IS: 73-1961) at 1.0 Kg/Sq.m minimum.



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- vi) Lay 250-micron polyethylene film as second layer similar to (iii) above.
- viii) Lay second layer of 100 gm. brown craft paper laminated similar to (iv) above.
- ix) Apply hot bitumen (straight run grade) to IS: 73-1961 at 1.0 Kg/Sq.m dusted with fine sand.
- x) Protecting with a layer of 75 mm plain cement concrete M-10, or a layer of brick laid in cement mortar 1:6 in case of wall apply a 12 mm thick plaster as shown on the drawing or a protective brick wall in 1:6 cement mortar as shown on the drawing.

3.27.00 Protective Coating on Concrete Surface

3.27.01 On Foundation

The outside faces of foundation of important structures will be protected from adverse effect of soil/underground water, if shown on drawing by using rubber/bitumen emulsion protective coating of approved manufacturer.

4.00.00 SAMPLING AND TESTING

4.01.00 General

The Contractor shall carry out all sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own cost unless otherwise specified in this specification. The Contractor shall get the specimens tested in a laboratory approved by the Engineer and submit to the Engineer the test results in triplicate within 3 (three) days after completion of the test.

4.02.00 Cement

Representative samples will be taken from each consignment of cement received from the manufacturer/supplier for carrying out the tests for fineness (by hand sieving), setting time and compressive strengths as per guidelines of IS: 269. Soundness Tests may also be required to be carried out if required by the Engineer. The Contractor shall carry out the tests without any expense to BHEL. No cement from a particular consignment/batch will be used on the works unless satisfactory 3 (three) days and 7 (seven) days test results for compressive strength are known. The Engineer and Contractor will jointly associate themselves with the tests irrespective of whether they are carried out by the BHEL or the Contractor. These tests are of great importance, as their results will have a bearing on the acceptance of concrete or otherwise as per the terms and conditions of the Contract.



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4.03.00 Aggregates

The contractor shall carry out any or all the tests on aggregates as may be required by the Engineer in accordance with IS: 2386 PARTS-I to VIII. The acceptance criteria of the samples tested shall be in accordance with the requirements of the relevant Indian Standards.

4.04.00 Water

Sampling and Testing of water being used for concrete works as per IS: 3550 will be carried out by the Contractor at regular intervals and whenever directed by the Engineer. The acceptance criteria will be as per IS: 456.

4.05.00 Admixture

4.05.01 Air Entraining Agents

Initially, before starting to use A.E.A., relationship between the percentage of air entrained and the cylinder cube crushing strength vis-a-vis quantity of A.E.A. used for all types of concrete will be established by the Contractor by carrying out sufficiently large number of tests. After that, at regular intervals and whenever directed by the Engineer, the Contractor will check up the actual percentages of air entrained and corresponding crushing strengths to correlate with the earlier test results.

4.05.02 Other Admixtures

Tests for establishing the various properties of any other admixtures, which may be required to be added, shall be carried out by the Contractor.

4.06.00 Concrete

The sampling of concrete, making the test specimens, curing and testing procedure etc. shall be in accordance with IS: 516 and IS: 1199, the size of specimen being 15 cm cubes. Normally, only compression tests shall be performed but under special circumstances the Engineer may require other tests to be performed in accordance with IS: 516. Sampling procedure, frequency of sampling and test specimen shall conform to IS: 456. To control the consistency of concrete from every mixing plant, slump tests shall be carried out by the Contractor every two hours or as directed by the Engineer. Slumps corresponding to the test specimens shall be recorded for reference. The acceptance criteria of concrete shall be in accordance with IS: 456. Concrete work found unsuitable for acceptance shall have to be dismantled and replacement is to be done as per specification by the Contractor at his own cost. In the course of dismantling, if any damage is done to the embedded



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items or adjacent structures, the same shall be made good, free of charge by the Contractor, to the satisfaction of the Engineer.

5.00.00 ACCEPTANCE CRITERIA

5.01.00 Standard Deviation

Standard deviation shall be based on test results and determination of Standard deviation shall conform to IS: 456.

5.02.00 Acceptance Criteria

The strength requirements and acceptance criteria shall conform to IS: 456.

5.03.00 Inspection and Core Tests

Inspection of concrete work immediately after stripping the formwork and core test of structures shall conform to IS: 456.

5.04.00 Load Test

Load tests of structural members as per IS:456 may be required by the Engineer, when the strength of test specimen results falls below the required strength.

If the member shows evident failure, the Contractor shall make the structure adequately strong free of cost to BHEL.

The entire cost of load testing shall be borne by the Contractor. If a portion of the structure is found to be unacceptable, it shall be dismantled and replaced by a new structure as per specification. The entire cost of dismantling and replacement and restoration of the site being borne by the Contractor.

If, in the course of dismantling, any damage is done to the embedded items and or other adjacent structures, the same will be made good, free of charge by the Contractor to the satisfaction of the Engineer.

6.00.00 RATES AND MEASUREMENTS

6.01.00 Cast-in-situ Concrete

6.01.01 Rates

- a) The unit rates shall include the cost of labour, materials, equipment, handling, transporting, botching, mixing, placing in position, vibrating, compacting, finishing, curing, testing, etc. at all elevations. This shall include the cost of curing by regular wetting or by using curing compound.

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- b) The unit rates shall include for all working conditions including at locations under water, liquid, mud, in or under foul positions and extreme weather conditions.
 - c) The unit rates for exposed concrete works (including machine foundations) shall include all incidentals, rendering, smoothening with carborandum stone, finishing with a paste of cement sand mortar, curing, etc.
 - d) The unit rates shall include all arrangement for maintaining stability of structure during execution.
 - e) Nothing extra shall be payable for the handling/mixing of extra cement on account of any reason or pouring of second stage concrete.
 - f) Nothing shall be payable to the Contractor on account of facilities and arrangement provided by him for conducting ultrasonic pulse velocity (UPV) tests or other relevant tests to ascertain grade and quality, etc. of the concrete in case the concrete quality is in doubt and contractor has to establish the quality by further tests. In case of any defects, the Contractor shall rectify the same by cement/epoxy grout at his own cost.
- However, mandatory UPV test as specified in the drawings shall be carried out including arrangement of all its facilities, staging, etc. and shall be payable to the contractor as per BOQ item.
- g) The unit rates for controlling of the temperature of concrete shall include storing and mixing of ice, water, cooling of aggregate etc.
 - h) The quoted rate shall include the cost of MIX design, making of all trial mixes using admixtures and mixing in concrete etc. complete.

6.01.02

Measurements

- a) Actual volume of concrete work as executed or as per drawings issued, whichever is less shall be measured in cubic metres to the nearest two decimals.
- b) No deductions shall be made for the following:
 - i) Ends of dissimilar materials embedded inside for example, beams, posts, girders, rafters, purlins, trusses, corbels and steps upto 500 sqcm in cross section;
 - ii) Opening upto 0.1 sq.m.

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iii) Volume occupied by reinforcement, sleeves, anchor bolts, and similar items.

iv) Volume occupied by pipes, conduits, sheathing, etc. not exceeding 100 sq.cm. each in cross sectional area.

c) The concrete works of different grades; below and above ground floor finished level shall be measured separately, unless otherwise specified in the schedule of items. Accordingly rates shall be applied for concrete in foundation for concrete below ground floor finished level and concrete in superstructure for concrete above ground floor finished level.

d) For temperature control measures, measurement shall be done in terms of quantity of concrete in cum. in concreting of which the ice have been used or cooling of aggregates has been done to keep the temperature of freshly laid concrete to less than 23°C.

6.02.00 Reinforcement

6.02.01 Rates

a) The unit rates shall include for cover block, providing binding wire, welding, separator pieces between two or more layers of reinforcement required for keeping the steel in position, etc. at all elevations.

b) No extra will be paid for transportation from stores, cleaning, straightening of steel, cutting, bending, binding with annealed wire, welding, tack welding, placing the reinforcement modification of already embedded reinforcement, if required, due to faulty fabrication or placement and other cost of tools and plants, materials, labours, return of unused steel to the store, etc.

c) However, lap welding of reinforcement steel if permitted shall be paid under separate item as provided in the BOQ and no deduction for labour and binding wire saved for not providing lap length shall be made. Similarly, splicing of reinforcement bars using mechanical couplers if permitted shall be paid under separate item as provided in the BOQ and no deduction for labour and binding wire saved for not providing lap length shall be made.

d) No extra shall be paid for preparing and getting approved bar bending schedules (including all revisions).

e) Generally members are straight and have straight edges. However, for bending, binding, placing of reinforcement in any curved member in length



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or cross section or both, no extra payment shall be made.

6.02.02 Measurements

- a) Bar or any other type of reinforcement used like hard drawn steel wire fabric etc. for reinforced concrete shall be measured by weight in tonnes. The weight shall be arrived at by multiplying the actual or theoretical length measured alongwith standard hooks, cranks, bends, authorized laps, etc. whichever is less by the sectional weights. Claims for payment for this item shall be submitted with supporting documents giving the schedule of bars with sketches. The sectional weight to be adopted shall be IS Section weight. Nothing extra will be payable to the Contractor on account of, difference in weight, if any, due to different methods adopted for issue and measurement.
- b) Standard hooks, cranks, bends, authorised laps, supports, hangers and chairs which are covered in approved bar bending schedule shall be measured in tonnes.

6.03.00 Formwork and Staging

6.03.01 Rates

- a) The unit rates shall be inclusive of all staging, scaffolding, making the formwork watertight, etc. for all elevations and in all types of works.
- b) No separate payment shall be made for providing fillets, for rounding or chamfering at junctions, comers, etc.
- c) The unit rates shall include the cost of labour, materials etc. and the extra time, which shall be required for the removal of shuttering/ support for satisfactory completion of work.
- d) No extra payment shall be made on account of difficulty, wastage etc. for placement/removal of formwork between the network of closely placed steel beams or for the lacing/bracing portions and ribbed slab constructions.
- e) Payment for curved shuttering shall be made for curved members/wall whose centerline radius in plan is less than 6m.
- f) If the contact surface area in pockets is less than or equal to 0.1 sq.m. in each case, payment shall be done under item for providing formwork in pockets.

6.03.02 Measurements



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a) Formwork for different classes (types) shall be measured separately as the actual surface in contact with the concrete and paid on area basis unless included in the rate for concrete. The unit of measurement shall be in sq.m.

b) Openings upto 0.1 sq.m or boxing left for inserts etc. for facility of Contractor's work, shall be neglected as if nonexistent for the purpose of formwork measurement of surface in which the openings occur.

For suspended floor, no deduction shall be made for flange area of secondary steel beams.

d) No measurement shall be taken for the formwork in pockets, openings, chases, blockouts, etc. in concrete, the contact surface area is less than or equal to 0.1 sq.m. in each case.

e) For pockets, if the contact surface area is less than or equal to 0.1 sq.m. in each case, measurement shall be done under item for providing formwork in pockets.

e) Formwork, if required, for joints shown on drawing or instructed by the Engineer, shall be paid for the 'leading side' only.

6.04.00 Embedded Parts

6.04.01 Rates

a) The unit rate for erection of embedded steel parts, supplied by Engineer shall include transportation from Owner's store to the place of work, erection & installation including setting material in concrete, etc. complete.

b) The unit rate for MS pipe embedments and PVC pipe embedments shall include cutting, welding, fabrication, erection, embedding, and transportation to site. Unit rate shall also include the cost of the pipes.

c) Rate for expansion fasteners shall include cost of fasteners, installation, and fixing including cost of washers and nuts and site testing if required.

6.04.02 Measurements

a) The measurement of the embedded steel parts fabricated and installed by the Contractor shall be based on the calculated weight of steel sections in tonne corrected to second place of decimal.

b) Embedded steel parts supplied by Owner and installed by Contractor Measurement shall be done for the net weight of the embedments installed in tonnes correct to second place of decimal.

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- c) For PVC pipes/conduits, measurements shall be in quintals correct to second place of decimal for the net weight.
- d) For mild steel pipes, measurement shall be in quintals, correct to second place of decimal, for the net weight of the steel pipe supplied, fabricated, and installed.
- e) The lugs shall be measured in Kg. correct to second place decimal for the net weight.
- f) The expansion fasteners shall be measured in number according to tension capacity.
- g) The rails shall not be treated as embedded steel part and the track shall be measured in running metres along the centre line and paid for under separate item of work as specified in schedule of items. Other related civil items associated with the laying of track shall be measured separately and paid under respective items of works.

6.05.00 Groutings

6.05.01 Rates

Rate shall include the cost of surface preparation, admixtures, and curing.

6.05.02 Measurements:

- a) Measurement shall be in cubic decimeters.
- b) Measurement for grouting shall be by volume of the block out, pockets or bolt hole upto the top surface of foundation concrete and shall be calculated from the dimensions shown on the drawings.
- c) Measurement for underpinning shall be by volume between the top surface of the foundation concrete and the underside of the base plate, the plan dimensions being as indicated on the drawings.
- d) No deduction shall be made for shims, bolts, shear keys and such other embedments.
- f) Pressure injection grouting with cement based grout if required as per drawing shall be applied at appropriate spacing to cover the desired surface area and measurement shall be made for the surface area grouted in sqm as per BOQ item. However in water retaining structures, the structural grouting if required to ensure water tightness shall not be payable



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separately as deemed to be covered in water retaining concrete item of BOQ.

6.06.00 Joints

6.06.01 Rates

The unit rate shall include all the activities described in the schedule of items.

6.06.02 Measurements

a) Bitumen Board/Expanded polystyrene.

The measurement for bitumen board shall be based on actual finished surface area in square meters nearest to second decimal, for the specified thickness.

b) Water Stops

The measurement for water stops shall be in running metres of actual length of the joint covered, for specified thickness, width, and shapes. No separate measurement shall be made for laps/splices for cross-joints and mitered joints.

c) Metal Cover Strips

The measurement for Metal Cover Strips shall be based on actual finished surface area in square metres for the specified thickness.

d) Vibration Damping Resilient Pads

The measurement for this item shall be in square metres for the specified thickness, measured correct to the second place of decimal, of the actual finished surface area.

6.07.00 Dismantling/Demolishing Work – RCC and PCC and Chipping of Concrete

6.07.01 Rates

The unit rates shall include the cost of all necessary propping, shoring, underpinning scaffolding, safety measures, temporary enclosures, disposal/stacking of serviceable/unserviceable materials, etc. for all types of work and for all grades of concrete.

In the case of dismantling/demolishing work, the cutting of reinforcement shall also be included in the rate.

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In the case of chipping work, the cutting of reinforcement shall be paid separately.

If the serviceable material including reinforcement steel from dismantled structure is allowed to be used/taken out by bidder, suitable rebate shall be given by bidder.

6.07.02 Measurements

- a) Dismantling of PCC and RCC work shall be measured in cu.m separately. Measurement of all work, except hidden work shall be taken before execution of work and no allowance for increase in bulk shall be allowed. Specifications for deductions of voids, openings etc, shall be done on the same basis as that applied for construction work.
- b) Chipping of concrete, making holes/pockets etc. shall be measured in cubic decimeters (i.e. 0.001 cu.m.).
- c) Cutting of reinforcement in chipping work for making of pockets and openings shall be measured in sq. cm. of cross-sectional area.

6.08.00 Precast Concrete

This clause shall be read in conjunction with relevant provisions specified elsewhere for cast in-situ Concrete.

6.08.01 Rates

- a) The unit rate shall include cost of preparation of casting yard, formwork, concrete and its casting, finishing as specified, setting filling of gaps between adjacent pre-cast concrete units with concrete, or cement mortar, curing, handling, erection, grouting, welding, preparation of supporting surface, etc.

6.08.02 Measurements

The measurement of pre-cast concrete members shall be on the basis of volume of concrete in cubic metres nearest to second place of decimal. No deduction shall be made for volume occupied by reinforcement/inserts/sleeves and for openings up to 0.1 sq.m. The setting of element with cement mortar shall not be measured separately The filling of concrete cement mortar between the gaps of adjacent precast units shall be considered while computing the volume of pre-cast concrete work and shall be paid for under this item itself.



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7.00.00

LIST OF IS CODES AND STANDARDS FOR REFERENCE

All work under this specification shall, unless specified otherwise, conform to the latest revisions and/or replacements of the following or any other Indian Standard Specifications and Codes of Practice. In case any particular aspect of work is not specifically covered by Indian standard Specifications, any other standard practice, as may be specified by the Engineer, shall be followed:-

IS: 73 -Indian Standard Specification for Paving Bitumen

IS: 216 - Indian Standard Specification for Coal Tar Pitch

IS: 383 - Indian Standard Specification for Coarse and Fine Aggregates from Natural Sources for Concrete

IS: 432 - Indian Standard Specification for Mild Steel and Medium Tensile Steel Bars and Hard Drawn Steel Wire for concrete Reinforcement

IS: 455 - Indian Standard Specification for Slag Cement

IS: 456 - Indian Standard Code of Practice for Plain and Reinforced Concrete

IS: 457 - Indian Standard Code of Practice for General Construction of Plain and Reinforced Concrete for Dams and other Massive Structures

IS: 516 - Indian Standard Specification for Methods of Test for Strength of Concrete

IS: 702 - Indian Standard specification for industrial bitumen.

IS: 1199 - Indian Standard Specification for Methods of Sampling and Analysis of Concrete

IS: 1322 - Indian Standard Specification for Bitumen Felts for



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Waterproofing and Damp-proofing

- IS: 1489 - Indian Standard Specification for Portland Pozzolona Cement
- IS: 1566 - Indian Standard Specification for hard drawn steel wire fabric for concrete reinforcement.
- IS: 1609 - Code of Practice for Laying Damp-proof Treatment using Bitumen Felts
- IS: 1786 - Indian Standard Specification for High Strength Deformed Steel Bars and Wires for Concrete Reinforcement.
- IS: 1791 - Indian Standard Specification for Batch Type Concrete Mixers.
- IS: 1838 - Indian Standard Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type).
- IS: 2185 - Indian Standard Specification for Hollow Cement Concrete Blocks
- IS: 2210 - Indian Standard Specification for Design of Reinforced Concrete shell Structures and Folded Plates
- IS: 2386 - Indian Standard Specification for Methods of Test for Aggregates for Concrete - Part-I to VIII
- IS: 2502 - Indian Standard Code of Practice for Bending and Fixing of Bars for Concrete Reinforcement
- IS: 2505 - Indian Standard Specification for Concrete Vibrators, Immersion Type
- IS: 2506 - Indian Standard Specification for Screed Board Concrete Vibrators
- IS: 2514 - Indian Standard Specification for Concrete Vibrating Tables
- IS: 2571 - Code of practice for laying in-situ cement concrete floors.
- IS: 2645 - Integral cement water proofing compound
- IS: 2722 - Indian Standard Specification for Portable Swing Weigh Batcher for Concrete (Single and Double Bucket type)



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IS: 2750 -	Indian Standard Specification for steel scaffoldings.
IS: 2751 -	Code of Practice for Welding of Mild Steel Bars used for Reinforced Concrete Construction
IS: 2770 -	Indian Standard Specification for Method of Testing Bond in Reinforced Concrete
IS: 3025 -	Indian Standard specification for Methods of Sampling and Test (Physical and Chemical) for Water used in Industry
IS: 3067 -	Code of practice for general design details and preparatory work for damp proofing and water proofing of building.
IS: 3201 -	Indian Standard Specification for Design and Construction of Precast Concrete Trusses
IS: 3370 -	Indian Standard Specification for Code of Practice for Concrete Structures for Storage of Liquids
IS: 3414 -	Code of practice for design and installation of joints in buildings.
IS: 3550 -	Indian Standard Specification for Method of Test for Routine Control for Water used in Industry
IS: 3558 -	Code of Practice for use of Immersion vibrators for Consolidating Concrete
IS: 3696 -	Safety Code for Scaffolding and Ladders
IS: 3812 -	Indian Standard Specification for Fly Ash for Use as Admixture for Concrete
IS: 4014 -	Code of practice for steel tubular scaffolding.
IS: 4031 -	Indian Standard Specification for Method of Tests for Hydraulic Cement
IS: 4082 -	Indian Standard Specification for Recommendation on Stacking and Storage of Construction Materials at site
IS: 4090 -	Indian Standard Specification for Design of Reinforced Concrete Arches
IS: 4634 -	Indian Standard Specification for Method of Testing



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Performance of Batch-type Concrete Mixes

- IS: 4656 - Indian Standard Specification for Form Vibrators for Concrete
- IS: 4925 - Indian Standard Specification for Concrete Batching and Mixing Plant
- IS: 4926 - Indian Standard Specification for Ready Mixed Concrete
- IS: 4990 - Indian Standard Specification for Plywood for Concrete Shuttering work
- IS: 4991 - Indian Standard Specification for Blast Resistant Design of structure for Explosion above ground
- IS: 4995 - Indian Standard Specification for Design of Reinforced Part-I & II Reinforced Concrete Bins for the Storage of Granular and Powdery Materials
- IS: 4998 - Indian Standard Specification for Design of Reinforced Concrete Chimneys.
- IS: 5256 - Code of practice for sealing joints in concrete lining on canals.
- IS: 5512 - Indian Standard Specification for Flow Table for use in Tests of Cement and Pozzolan materials
- IS: 5513 - Indian Standard Specification for vacate Apparatus.
- IS: 5515 - Indian Standard Specification for Compaction Factor Apparatus.
- IS: 5525 - Recommendation for detailing of reinforcement in reinforced concrete works.
- IS: 5624 - Indian Standard Specification for foundation bolts.
- IS: 5751 - Indian Standard Specification for Precast Concrete Coping Blocks.
- IS: 5816 - Indian Standard Specification for Method of Test for Splitting Tensile strength of Concrete Cylinders.
- IS: 5891 - Indian Standard Specification for Hand operated Concrete Mixers.
- IS: 5892 - Indian Standard Specification for transit mixer and agitators.



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- IS: 6452 - Indian Standard Specification for High Alumina Cement for Structural Use
- IS: 6909 - Indian Standard Specification for Super sulphated Cement
- IS: 6923 - Indian Standard Specification for Method of Test for Performance of Screed Board Concrete Vibrators.
- IS: 6925 - Indian Standard Specification for Method of Test for Determination of Water Soluble Chloride in Concrete Admixtures.
- IS: 7242 - Indian Standard Specification for Concrete Spreaders.
- IS: 7246 - Indian Standard Specification for Table Vibrators for Consolidating Concrete.
- IS: 7251 - Indian Standard Specification for Concrete Finishers.
- IS: 7293 - Safety code for working with construction machinery.
- IS: 7320 - Indian Standard Specification for Concrete Slump Test Apparatus.
- IS: 7861 - Indian Standard Specification for Recommended Practice Part-I&II for Extreme Weather Concreting.
- IS: 7969 - Safety Code for Storage and Handling of Building Materials.
- IS: 8041 - Indian Standard Specification for Rapid Hardening Portland cement.
- IS: 8112 - Indian Standard Specification for high strength Ordinary Portland Cement.
- IS: 8142 - Indian Standard Specification for Determining Setting time of concrete by Penetration Resistance.
- IS: 8989 - Safety Code for Erection of Concrete Framed Structures.
- IS: 9012 - Recommended method for shortcreting.
- IS: 9013 - Indian Standard Specification for Method of Making, Curing, and determining compressive Strength of Accelerated-cured Concrete Test Specimens.



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- IS: 9077 - Code of Practice for Corrosion Protection of Steel Reinforcement in RB and RCC Construction.
- IS: 9103 - Indian Standard Specification for Admixtures for Concrete.
- IS: 10262 - Recommended Guidelines for Concrete Mix Design.
- IS: 13311 - Non-destructive testing of concrete.
- SP: 34 - Handbook of concrete, reinforcement and detailing.



**TECHNICAL SPECIFICATION
FOR CARPENTRY AND
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CARPENTRY AND JOINERY

SPECIFICATION NO. PE-TS-999-600-C003



**Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301**



**TECHNICAL SPECIFICATION
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CARPENTRY AND JOINERY

1.00.00 SCOPE

This section covers supply, fitting and fixing of timber frames to doors and windows with M S holdfasts, flush doors, windows, shutters, partitions, wall panelling, pelmets, shelves, furniture, etc. as shown in drawings, including a prime coat of approved paint, varnish, or fixing of decorative plastic laminate where called for. This shall also include the supply and fixing of all hardware and fixtures shown in drawing or specified.

2.00.00 INSTALLATION

2.00.01 Materials

a) Timber

Unless otherwise specified, all timber shall be best quality well seasoned CP teakwood free from large or loose knots, cracks or any other defects. All timber shall be treated with approved wood preservative before use, unless specified otherwise. The rough timber shall be approved by the Engineer before incorporating in the works and starting the carpenter's work.

b) Plywood

Plywood shall be of commercial quality or with decorative surface veneer. Unless specifically permitted otherwise, the adhesive used in plywood shall be phenol formaldehyde synthetic resin of BWP grade conforming to IS: 848.

c) Decorative Laminated Plastic Sheets

The colour, pattern, finish and texture shall be approved by the Engineer. The bulk supply shall be procured in full sheet sizes which will ensure the least number of joints in one surface.

d) Flush Doors

Flush doors shall be solid core doors with commercial or decorative faces and hardwood edges conforming to IS: 2202 (Part-1). The core for solid core doors shall be of block board or wood particle board. Manufacturer's literature and test certificates shall be submitted for the approval of the Engineer. The Contractor shall give a guarantee that the adhesive used is BWP grade phenol formaldehyde synthetic resin conforming to IS: 848.

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The thickness shall be as specified.

e) Panel Doors

Panel door shall be of teakwood shutter frame, unless otherwise noted and panels with teakwood/commercial ply/teakwood particle board. Other considerations shall be as mentioned in item (d) above.

f) Windows, Ventilators

Windows and ventilators shall made of teakwood shutter frame, unless specified otherwise and glazing of specified thickness shall be fixed with wooden beadings.

g) Fixtures

Fixtures for doors, windows, furniture etc. shall be as shown on drawing or specified.

2.02.00 Workmanship

2.02.01 General

The work shall be done by skilled carpenters as per details shown on drawing or instructed by the Engineer.

Framing timber and other work shall be close - fitting with proper wood joinery, accurately set to required lines or levels and rigidly secured in place. The surface of frames etc., which will come in contact with masonry after fixing, shall be given two coats of approved paint before fixing. Mastic caulking shall be done after fixing external door and window frames. Special care shall be taken to match the grain of timber or plywood, which will be subsequently polished. Screwing or nailing will not be permitted to the edge of plywood and particle board. The edge of all plywood, blackboard and particle board shall be finished with teakwood lipping unless otherwise shown on drawings.

Fixing to frames and partitions shall generally be with 40 mm x 6 mm x 300 mm long M S holdfasts bifurcated at end and grouted with 1:2:4 cement concrete. The gap between masonry and external door and window frame shall be caulked with polysulphide mastic. M.S. grills or guard bars shall be provided to windows where called for in the drawings.



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2.02.02 Finish

All carpentry work after finishing shall be sand papered smooth. A prime coat paint shall be given after inspection of the Engineer to all surfaces other than those, which shall be subsequently polished or covered with laminated plastic sheet.

2.02.03 Surface Treatment

When shown on drawings or called for, decorative ply or laminated plastic sheets shall be bonded under pressure to the surface to be finished. The adhesive used shall be of brand and brought to site in sealed containers. The rate of application and the length of time for which the pressure is to be applied shall be as per the manufacturer's instructions. The edge of sheets shall be protected by teak lipping or bevelled as shown on drawings.

3.00.00 ACCEPTANCE CRITERIA

3.00.01 Door and Window Frames

All frames shall be square and flat at the time of delivery and shall be checked for dimensions and corner angles. After fixing they shall be on a fine vertical plane. All external door and window frames shall be caulked with mastic.

3.02.00 Door and Window Shutters

All doors and window shutters shall be of proper size, shape, and design and free of warp. When fixed to frames, these shall operate smoothly without jamming and all latching or locking devices shall engage properly without undue pressure.

3.03.00 Partitions, Paneling, Pelmet, Furniture, etc.

3.03.01 General

These shall conform to drawings in all details. No unsightly nail marks etc. shall be permitted. Plywood grains shall be matched to give a uniform and pleasing appearance.

3.03.02 Partition

Shall be checked for rigidity of fixing, plumb and horizontal as well as vertical alignment.



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3.03.03 Pelmets

Shall be checked for rigidity of fixing and adequate clearance of fixture.

3.03.04 Cupboard Shutters

Shall operate smoothly without jamming and locks, bolts and double ball catches shall engage securely. Single ball catches shall not be used.

3.03.05 Drawers

Shall operate smoothly and have backstops to prevent them from being pushed too far. Locks shall engage securely.

3.03.06 Loose Furniture

When placed on a level surface, tables tops etc. shall be horizontal and the pieces stand stably on legs or supports.

4.00.00 IS CODES

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS: 848 - Synthetic resin adhesives for plywood (Phenolic and Aminoplastic)

IS: 1003 - Timber panelled and glazed shutters.

IS: 2191 - Wooden flush door shutter (Cellular and hollow core type).

IS: 2202 - Wooden flush door shutters (solid core type).

IS: 4021 - Timber door, window, and ventilator frames.

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates



**TECHNICAL SPECIFICATION
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Rates shall include of all activities mentioned in “Schedule of Item” for completion of the work. No separate payment shall be made for fixing, caulking, application of primer coat, polishing, providing of butt hinges, holdfasts, sliding/tower bolts, door stoppers, door closers and other fittings and fixtures.

5.02.00 Measurement

Measurement shall be done in Sqm for doors, windows, ventilators, shutters, partitions etc.

Measurement for wooden frame shall be in CuM.

Pelmets shall be measured in RM.



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C004		
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**ROOF AND UNDERGROUND STRUCTURES WATER
PROOFING, INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C004



**Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301**



**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

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ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

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**ROOF AND UNDERGROUND WATER PROOFING,
INSULATION AND ALLIED WORKS**

1.00.00 SCOPE

This section covers furnishing, installation, repairing, finishing, curing, testing, protection, maintenance till handing over of roof and underground water-proofing, insulation and allied works for buildings and at locations covered under the scope of this package.

2.00.00 INSTALLATION

2.01.00 GRADING UNDERBED

The surface to receive the underbed shall be roughened and thoroughly cleaned with wire brush and water. Oil patches if any shall be removed with detergent. The surface shall be soaked with water and all excess water removed just before laying of the underbed.

The underbed shall not be laid under direct hot sun and shall be kept in shade immediately after laying so as to avoid quick loss of water from the mix and separation from the roof surface. The underbed shall be cured under water for at least 7 days.

The underbed shall be laid to provide an ultimate run off gradient not less than 1 in 120 and as directed by the Engineer. Upto an average thickness of 25mm the underbed shall usually be composed of cement and sand plaster. For higher thickness the underbed shall be made with cement concrete. The underbed shall be finished to receive the waterproofing treatment direct or insulation as the case may be.

2.01.01 Cement Mortar Underbed

The underbed grading plaster shall be average 25 mm thick maximum. It shall consist of cement and coarse sand in the ratio 1:4 nominal by volume. The sand and cement shall be thoroughly mixed dry and then water added. Each batch of mix shall be consumed before the initial set starts.

The plaster shall be fully compacted to the desired grade in continuous operation. The surface shall be even and reasonably smooth.

2.01.02 Cement Concrete Underbed

The underbed cement concrete shall be used where the subgrade is more than average 25 mm thick. It shall consist of cement concrete 1:2:4 nominal mix

by volume with 12 mm down stone chips and coarse sand. The aggregate shall be mixed dry and minimum quantity of water shall be added to make the mix workable.

The mix shall be laid to proper grade, fully consolidated and surface shall be smooth and even.

2.02.00 INSULATION

The Tenderer shall, along with the tender, send specifications of insulating materials he proposes to use and the proposed method of laying. Before bulk supply, the contractor shall send samples of insulating material to the Engineer, and after approval of the samples, the Contractor shall procure and transport the bulk material to the site. Whenever asked by the Engineer, the Contractor shall furnish test certificates from testing laboratory on the insulating and other properties of the materials.

After laying the insulation, the surface shall be made ready as required to receive the waterproofing treatment. If any plastering is used it shall be not leaner than 1:4 cement sand by volume and not thinner than 12 mm and it shall be cured for seven days.

2.02.01 Foam Concrete

This shall be of lightweight foam concrete of average 50 mm thickness or as specified or as shown on drawings. This may be laid in situ in suitable panels or precast blocks. The insulating properties shall be such that the thermal conductivity shall not exceed 0.125 Kcl/sq.m. hr degree C. Before starting the laying of foam concrete samples shall be prepared at site and got tested for approval of the Engineer.

The foam concrete laid shall be sufficiently strong to withstand the usual workload and standard loads expected on the roof. Any damaged portion shall be removed and replaced forthwith. Approval of the Engineer shall be taken before laying the waterproofing over the insulation.

While laying the foam concrete, samples from each batch of the mix shall be kept for test if so desired by the Engineer.

2.02.02 Expanded Polystyrene Blocks

The expanded polystyrene block Insulation shall be fire retardant quality and shall have a maximum thermal conductivity of 0.026 Kcl m/sq.m h °C. It must be strong enough to withstand without any deformation under the workload and standard loads expected on the roof.

The Contractor shall lay the expanded polystyrene block as per manufacturer's approved specification. Only specifically experienced workers shall be used for this work. If the Engineer is not satisfied about the efficiency of the workers the Contractor shall secure manufacturers supervision at no extra cost to the Owner.

2.03.00 Fillets

Fillets at Junction of roofs and vertical walls shall be provided with the same insulating material as provided for the main roof insulation. The fillets shall be 150 mm x 150 mm in size unless otherwise shown on drawings or instructed by the Engineer.

Where there is no insulation over roof slab, fillets shall be cast-in-situ cement concrete (1:2:4) nominal mix volume.

2.04.00 Waterproofing Treatment

2.04.01 Bitumen Felt Treatment

Waterproofing treatment shall be laid by a specialist firm with long experience in the particular trade.

The waterproofing treatment for roofs with bitumen felts shall be done following relevant IS: 1346. Bitumen felt shall conform to IS: 1322 and Bitumen primer to IS: 3384.

The bonding materials shall consist of blown type conforming to IS: 702 or residual bitumen conforming to IS: 73 or a mixture of the two to withstand local conditions of prevailing temperature or gradient of roof surface. The Contractor shall convince the Engineer that the bonding material proposed to be used is suitable for the particular job.

The Contractor shall state the source from where he proposed to procure the materials. Samples of the self-finished felt shall be submitted in advance to the Engineer along with test certificates for his review. Test certificates for the bonding materials shall also be submitted and samples, if desired by the Engineer, shall be provided for confirmatory tests. Samples shall be submitted if instructed by the Engineer.

Minimum overlaps of 100 and 75 mm shall be given at the end and sides of strips of felt and properly bonded with bitumen. Joints in successive layers of felt shall be staggered.

Normal treatment with one layer of felt, heavy treatment with two layers of felt

or Extra Heavy treatment with three layers of felt shall be indicated. Brief details of the various treatments shall be as follows:

a) Normal Treatment - Five courses

- 1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.
- 2) Hot applied bitumen at the rate of 1.2 kg/sq.m. (min.)
- 3) Hessian base self finished felt, type 3, grade 1.
- 4) Hot applied bitumen at the rate of 1.2 kg/sq.m. (min.)
- 5) 20 mm thick pressed precast concrete tiles with 15 mm, thick 1:4 cement-sand mortar underbed.

b) Heavy Treatment - Seven Courses

With Hessian base felt

- 1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.
- 2) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)
- 3) Hessian base self-finished felt, type 3, grade 1.
- 4) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)
- 5) Hessian base self-finished felt, type 3, grade I.
- 6) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)
- 7) 20 mm thick pressed precast concrete tiles with 15 mm thick 1:4 cement: sand mortar underbed.

or

With fiber base felt

- 1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.
- 2) Not applied bitumen at the rate of 1.2 kg/sq.m (Min.)
- 3) Fiber base self-finished felt, type 2, grade 2.
- 4) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)

5) Fiber base self-finished felt, type 2, grade 2.

6) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)

7) 20 mm thick pressed precast concrete tiles with 15 mm thick 1:4 cement: sand mortar underbed.

c) Extra Heavy Treatment – Nine courses

With fiber based felt

1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.

2) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)

3) Fiber-base self-finished felt type 2, grade 1.

4) Hot applied bitumen at the rate of 1.2 kg/sq.m (min.)

5) Fibre base self-finished felt type 2, grade 1.

6) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)

7) Fibre base self-finished felt type 2, grade 1.

8) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)

9) 20 mm thick pressed precast concrete tiles with 15 mm thick 1:4 cement: sand mortar underbed.

or

With Hessian base felt

1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.

2) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)

3) Hessian base self-finished felt, type 3, grade 1.

4) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)

5) Hessian base self-finished felt, type 3, grade 1.

6) Hot applied bitumen at the rate of 1.2 kg/sqm. min.

**TECHNICAL SPECIFICATION FOR
ROOF AND UNDERGROUND
STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C004

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7) Hessian base self-finished felt, type 3, grade 1.

8) Hot applied bitumen at the rate of 1.2 kg/sqm. min.

9) 20 mm thick pressed precast concrete tiles with 15 thick 1:4 cement: sand mortar underbed.

However, in special cases, more courses, or a combination of fibre base and hessian base felts may be asked for.

The surface to receive the waterproofing treatment must be cleaned and dried satisfactorily and the Engineer's approval taken before starting the work. If any existing waterproofing treatment is being augmented the existing top course shall be completely removed and all damaged felts or other defects repaired.

The Engineer may instruct the Contractor to lay part of the stipulated courses at the first instant to be followed later on with the balance courses. This interim finish shall be done with a course of hot applied bitumen. While doing the balance again hot bitumen shall be applied to start with after repair of all damages to the already laid course.

After completion the surface shall be cleaned taking care that felt cuttings etc. do not find their way into rainwater down comers.

2.04.02

Elastomeric Membrane

a) Material

The material shall consist of high solid content Polyurethane based cold liquid applied coatings as per ASTM C836-89a comprising of urethane pre-polymers extended with flexible material, which cure by reaction with atmospheric moisture to give a continuous film which is rubbery and elastic or any other equivalent material permitted as per ASTM and approved by the Engineer. The material shall consist of high solid coating designed to give a high-build film. The material shall not be diluted. The coating shall have physical feature like high viscosity, 90% solids, high resistance to impact, abrasion and cracking, superior tensile strength, application limit of 70°C minimum, 300% elongation and forming a perfectly smooth permanently flexible seamless membrane which should have good adhesion to roof substrates (RCC, tiles, brick, and metals), having a minimum life of 10 years. It should also be resistant to acid (mild concentrated), alkalies and have a very low water absorption rate (0.5%) max. at ambient temp. after 7 days.

The pack shall not be older than 9 months after the date of manufacture and packing.

b) Primer coat

It shall consists of polyurethane (P.U.) or any other equivalent material. Primer coat shall be a special blend of moisture curing urethane pre-polymers in solvent. A single coat of this primer shall be applied by brush over the prepared bed as an adhesion coat of an application rate of minimum 6 sq.m per litre.

The primer shall be allowed to dry for minimum of 2hrs. time before the successive finishing coats of P.U. liquid membrane are applied.

c) Finishing coats :

The finishing coats shall consist of two successive liquid coatings of high solids content urethane pre-polymers or equivalent material to form an elastomeric membrane. The overall dry film thickness shall be 1.5mm subject to minimum 500 gm per sq.m per coat application rate.

Each coat shall be allowed to dry for minimum 12 hours before applying the next coat. The surface should be dry and smooth before application.

The coating shall be continued up the parapets/walls for a minimum of 150mm over the finished roof surface. It shall be continued into rain water pipes by atleast 100mm.

The final coat of P.U. liquid when tacky shall be sprinkled with the sand.

For edges, expansion joints and any vulnerable points a later of polyscrim cloth /fabric to be embedded between 2 finishing coats.

d) Surface Finish :

Areas of roof treatment which are vulnerable to accidental damage shall be provided with wearing course consist of minimum 20 mm thick PCC of Grade M15 (using 12.5mm size aggregate) cast in panel of maximum size of 1.20m x 1.20m and reinforced with 0.56mm diameter galvanised chicken wire mesh and sealing of joints using sealant or elastomeric compound.

When the roof surface is subjected to foot traffic or used as a working area, a cement mortar (1:4) shall be applied over the top most layer of roofing treatment. Over this, a layer of chequered cement concrete flooring tiles conforming to IS:13801 shall be provided in place of stone grit and cement painted. The tiles shall be laid as per IS:1443.

2.04.03 Waterproofing By Epoxy Resin Based Application

Exposed surfaces of cement concrete, lime concrete or brickwork to be treated for waterproofing by the resin-based application shall be thoroughly cleaned and the epoxy resin based material to be applied as directed by the manufacturer. The material shall not have any adverse effect on the surface on which it is applied and must stick to it uniformly to make a strong durable bond. It shall not be affected by short duration fire, sun exposure, and light duty traffic. The application shall be resistant to growth of fungus and proof against saltpetre action. If desired by the Engineer, a sample shall be prepared in advance and tested for waterproofness for 48 hours under 300 mm depth of standing water. The Contractor shall arrange the demonstration by providing free the materials and labour for the application as free of cost to Owner. This item shall carry a guarantee as specified.

2.04.02 Flashing

Unless otherwise stated flashing shall be done in the same way as the waterproofing except that the last layer shall be finished with two coats of bituminous primer. The flashing shall be extended up the vertical surfaces as shown on drawing. The flashing shall end in grooves in vertical walls. The grooves shall be at least 65 mm deep and caulked with waterproof mastic cement. The minimum overlap with horizontal roofing felt shall be 100 mm.

Where specified or directed by the Engineer, metal flashing shall be provided. The materials shall be 18 Gage or 22 G G.I. sheets, as specified or as directed by the Engineer.

2.05.00 WATER-PROOFING OF UNDERGROUND STRUCTURES

Basements, ducts, pits, tunnels (excluding tanks) etc below the ground water table and in contact with soil are covered under this. Bonding material shall be blown bitumen of 65/25 grade conforming to IS: 702.

Waterproofing shall be provided on the outside of walls and top of RCC slab and shall be carried out upto 150mm above ground level. The number of layers of bitumen felt to be used for walls and floor unless otherwise shown in the drawing shall be:

- a) 2 layers - for depths up to 5m below ground level
- b) 3 layers - for depths beyond 5m below ground level

2.05.01

Method of laying the bitumen felts and workmanship shall be as per IS: 1609 and IS: 3067. Water proofing work shall be taken in hand only when the sub-soil water level is at its lowest; the site shall be kept dry by adequate arrangements for pumping out water till the work has been completed.

For this purpose drains shall be formed along the edges of the excavation but beyond the building line, with suitable collecting sumps.

In case of large excavation areas where it is necessary to dewater under the floor, additional land drains shall be formed across the excavation, to adequately drain the area.

Adequate arrangement shall be made to protect the sides of excavation from slipping while the work is in progress.

The base concrete or mud-mat shall be rendered smooth by a 20mm thick sand-cement plaster (6:1). Any sharp edges/corners, over which the waterproofing course is to be laid, shall be eased out by means of cement.

The surface must be dry before the next operation is carried out.

Water proofing/damp proofing treatment:

A) Heavy Treatment (Two layers of felt)

- i) Primer (For vertical faces only), as per I.S. 3384.
- ii) Hot applied blown bitumen at the rate of 1.2 Kg/m²
- iii) Hessian base, bitumen felt type 3 grades 2
- iv) Hot applied blown bitumen @ 1.2 Kg/m²
- v) Hessian base, bitumen felt type 3 grade 2
- vi) Hot applied blown bitumen @ 1.2 Kg/m²

B) Extra Heavy treatment (Three layers of felt)

- i) Primer (for vertical faces only) as per I.S. 3384
- ii) Hot applied bitumen at the rate of 1.2 Kg/m²
- iii) Hessian base bitumen felt type 3 grades 2
- iv) Hot applied bitumen at the rate 1.2 Kg/m²

v) Hessian base bitumen felt type 3 grades 2

vi) Hot applied bitumen at the rate of 1.2 Kg/m²

vii) Hessian base bitumen felt type 3 grades 2

viii) Hot applied bitumen at the rate of 1.2 Kg/m²

The surface must be dry before the next operation is carried out at each stage said above.

The laying of felt over the bitumen so applied that it shall always commence on the floor, and shall be carried over to the walls only after treatment of the floor is complete. The minimum over lapping at sides and ends of strips shall be 10cm. Point for subsequent layers completely sealed by blow lamp.

A protective flooring of either brick flat in cement mortar (1:3) or 6cm thick cement concrete (M 15) or a coat of cement plaster (1:3) 4 cm thick shall be constructed over the bitumen layers to prevent damage to the latter during subsequent construction of the structural floor.

The walls shall be treated in a similar way; the bitumen felts joining at the base with the projecting felt laid over the mud-mat. The wall surface shall be made smooth where necessary with a coat of cement plaster (1:3), the felts laid as for the floor, ensuring that the surface to be treated is dry and then a protective brick wall, 12.5 cm nominal thickness shall be built in cement mortar (1:3) over the projecting mud-mat, the space between the wall and felt being grouted with cement.

3.00.00

ACCEPTANCE CRITERIA AND GUARANTEE

The surface level shall be such as to allow quick draining of rains without leaving any pool anywhere. The finishing course shall be fully secured and shall have an even density. There shall not be any bubble formation or crushed or squeezed insulation or underbed.

The contractor shall give a guarantee in writing for all works executed under this specification supplemented by a separate and unilateral guarantee from the specified agency for the roof waterproofing treatment work. The guarantee shall be for materials and workmanship as under:

For Bitumen Felt Treatment under clause no. 2.04.01: 5 years in case of normal treatment, 10 years for heavy treatment and 20 years for extra heavy treatment.

For Elastomeric Membrane under clause no. 2.04.02: 10 (ten) years

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STRUCTURES WATER PROOFING,
INSULATION AND ALLIED WORKS**

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In case guarantee is more stringent in owner specification, more stringent guarantee shall be applicable. The mode of execution of the guarantee shall be such, which shall be acceptable to the Owner.

4.00.00 I.S. CODES AND STANDARDS

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

a)	IS: 73	-	Paving Bitumen
b)	IS: 702	-	Industrial Bitumen
c)	IS: 1203	-	Methods of testing tar and bitumen
d)	IS: 1322	-	Bitumen felts for waterproofing and damp proofing.
e)	IS: 1346	-	Code of practice for waterproofing of roofs with bitumen felts.
f)	IS: 1609	-	Damp-proofing Treatment using Bitumen Felts – Code of Practice
g)	IS: 3067	-	Code of practice for General design details and preparatory work for Damp-proofing and water-proofing of buildings
h)	IS: 3384	-	Bitumen primer for use in waterproofing and damp proofing.

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall be for complete work, including the cost of all materials and labour, as detailed in the specification unless any portion is specifically excluded in the “Schedule of Items”.

No extra shall be paid for finishing around opening, sleeves, pipes, ducts, inserts, etc.



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No separate payments shall be made for cleaning of surface, treating of cracks and surface preparation.

5.02.00

Measurement

The finished work shall be measured in Sqm of actual surface area for the purpose of payment.

No deduction shall be made and no extra shall be paid for openings upto 0.4 sqm.



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METAL DOORS, WINDOWS, VENTILATORS, LOUVERS ETC.

SPECIFICATION NO. PE-TS-999-600-C005



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



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METAL DOORS, WINDOWS, VENTILATORS, LOUVERS ETC.

1.00.00 SCOPE

This section covers supplying and/or erecting and installing of all metal doors, windows, ventilators, louvers, glazed partitions, etc. The scope of work shall also include the assembly and erection of all doors, windows, louvers, glazed partitions, etc. Supplying and/or fixing of all door and window accessories and hardware are also included in the scope.

2.00.00 INSTALLATION

2.01.00 Materials

Steel sections used for fabrication of doors, windows etc. shall be standard rolled steel sections specified in IS: 1038 and IS: 1361 or as specified.

Steel sheets for frames, shutters, louver blades etc. shall be of gauge mentioned in drawings and schedules.

Aluminium sections for fabricating doors, windows, partitions etc. shall be extruded sections conforming to IS:733 or IS:1285 or as manufactured by Indian Aluminium Company Limited or approved equivalent. Aluminium door, windows and ventilator shall be fabricated as per IS:1948 and IS:1949. The alloy used shall conform to IS Designation HE 9-WP of IS: 733.

Hardware and fixtures shall be as specified and the best quality from approved manufacturers shall only be used. The tenderer shall specifically state the particular manufacturer's materials he proposes to use. Improper alignment or faulty operation due to inadequate strength of hardware or fixture shall entirely be the Contractor's responsibility.

All hardware and fixtures shall be able to withstand repeated use. Door closures shall conform to IS: 3564 and shall be suitable for doors weighing 61-80 Kg. unless otherwise stated. Each closer shall be guaranteed against manufacturing defect for one year and any defect found within this period shall be rectified or shall be replaced free of charge. Concealed door closers shall be either floor mounted or transom mounted, suitable for installation with metal doors. It shall conform to the performance Requirements and endurance test stated in IS: 3564 - Appendix-A. The Contractor shall submit samples of each type of hardware to the Engineer. The approved samples shall be retained by the Engineer for comparison of bulk supply. The samples shall be returned to the Contractor towards end for incorporation in the job. The mastic for caulking shall be of best quality from a manufacturer approved by, the Engineer. In general, mastic for fixing of metals frames shall be as per IS:



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1081 or as approved by the Engineer.

2.02.00 Fabrication

2.02.01 Steel Doors, Windows, Ventilators, louvers etc.

a) Door Frames

Frames shall be fabricated from 16 gage(G) sheets. They shall, be mortised, reinforced, drilled, and tapped for hinge lock and bolt strikes. Where necessary, frames shall be reinforced for door closers. Welded construction with mitered Corners shall be used. Rubber door silencers shall be furnished for the striking jamb. Loose "T" masonry anchors shall be provided. Frames shall finish flush with floor and adjustable floor anchors shall be installed. Frames shall be brought to site with floor ties/weather bars installed in, place.

b) Double Plate Flush Door Shutters

Door shutters shall be 45 mm thick, completely flush design and shall comprise of the outer sheets or 18 G steel sheets, rigidly connected and reinforced inside with continuous vertical 20 G stiffeners, spot welded in position at not more than 150 mm on centres.

Both edges of doors shall be joined and reinforced full height by steel channels placed immediately inside and welded to the door faces. Top and bottom of doors shall be reinforced horizontally as shown on drawing by steel channels running full width of door. Doors shall not have more than 2.5 mm clearance at jambs and heads, shall have proper level on lock stiles and rails to operate without binding, and shall be reinforced at corners to prevent sagging or twisting. Pairs or double doors shall have meeting-stile edges bevelled or rebated. Where shown on drawing, or called for in the schedule of items, the doors shall be sound deadened by filling the inside voids with mineral wool or other suitable approved materials.

Doors shall be mortised, reinforced, drilled, and tapped in shop for hinges, locks, and bolts. They shall also be reinforced for closers, push-plates, and other surface hardwares where necessary. Any drilling and tapping required for surface hardware shall be done at site. Where shown drawing, provision shall be made for fixing glazing, vision panels, louvers etc. glazing mouldings shall be of 18 G steel or extruded aluminium sections and suitable for fixing 6 mm. glass. Louvers blades shall be V or Z shaped and made out of 16 G sheets.



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c) Single Sheet Door Shutters

Single sheet doors shall be made from best quality 18 G mild steel sheets, and shall present a flush surface on the outside. The inside shall be stiffened with semi tubular edge and central stiffening rail, which shall convey the lock and other fixture. The frames shall be made from best quality, 16 G mild steel sheets.

Wherever required, provisions for fixing glass panes, louvers etc. shall be made.

The manufacturing shall be done as specified in 2.02.01 (b) "Double Plate Flush Door Shutters."

d) Sliding Door

Sliding doors shall be either double plate or single plate Construction made out of 18 gauge steel sheets with adequate stiffeners. The contractor shall specify the weight of the door in his shop and submit the manufacturer's catalogue of the sliding gear he proposes to use. Where called for the Contractor shall make provision for openings to the door for monorail beams. Doors shall close positively to exclude rainwater from seeping in. When called for, sliding doors shall withstand specified wind loads without buckling or jamming. The door shall slide freely under all ambient conditions.

e) Door Threshold

Door threshold shall be provided. Doors without threshold shall have bottom tie of approved type.

f) Steel Windows, Sashes, and Ventilators etc.

These shall conform in all respects to IS: 1038 and IS: 1361 latest editions. The details as called for in the above codes shall be applicable for coupling mullions, transoms, weather bars, and pivot arrangements for ventilators, etc. or as called for. All welds shall be dressed flush on all exposed and contact surfaces. Where composite unit openings are required the individual window units shall be joined together with requisite transoms and mullions. All windows shall be outside glazed, fixed with putty or metal glazing beads as specified. Where aluminium glazing beads are specified, they shall be extruded aluminium channel 9.5 mm x 9.5 mm x 1.6 mm (Indal Section No. 2209) unless otherwise shown on drawings. Aluminium beads shall be given one coat of zinc chromate primer before fixing to windows.



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2.02.02**Aluminium Door, Windows, and Frames**

Extruded sections shall have a minimum 3 mm wall thickness. All sections shall be approved by the Engineer before fabrication is taken up. Doors frames, mullions, transom etc. shall be anodized in a bath of sulphuric acid to provide a clear coating of minimum 15 micron thickness. The anodized materials shall then be sealed by immersing in boiling water for 15 minutes. A protective transparent Coating shall be applied to the sections before shipment from the factory.

All work shall be fitted and shop assembled to a first class job, and ready for erection. Shop joints shall be made to hair lines and then welded or braced by such method as will produce an uniform colour throughout the work. Work on the above, other than described, shall be carefully fitted and assembled with neat joints with concealed fasteners. Wherever possible, joints shall be made in concealed locations and on edges of doors. Field connections of all work may be made with concealed screws or other approved type of fasteners. Glazing beads shall be snap fit type without visible screws and shall be of sizes to accommodate 6 mm thick glazing. All work shall be adequately braced and reinforced as necessary for strength and rigidity.

2.03.00**Shop Coat or Paint**

The shop Paint for steel doors, windows etc. shall be best lead or zinc chromate primer paint from, approved manufacturer. All surfaces shall be thoroughly cleaned of rust, grease, loose mill scales etc. and given one coat of shop paint. Portions like mullions, transoms etc. that will be inaccessible after assembly of units shall be given an extra coat of paint before assembly.

Where called for, all steel doors, windows, etc. shall be hot dip galvanized to give a coating weight of 1½ - 2 oz. per sqft. One coat zinc chromate primer coat shall then be applied as shop paint.

Portions of aluminium frame, which come in contact with masonry construction shall be (before shipment from workshop) protected with a heavy coat of alkali resistant paint. Aluminium coming in contact with other incompatible metals shall be coated with zinc chromate primer.

2.04.00**Handling & Storage of Fabricated Material**

All metal doors, windows, etc. shall be packed and crated properly before dispatch, to ensure that there will be no damage to the fabricated materials. Loading into wagons and trucks shall be done with all care to ensure safe arrival of materials at site in undamaged condition.



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When taking delivery of items supplied by Owner, the Contractor shall satisfy himself that the items supplied are up to the specified standard. Any defect detected shall promptly be brought to the notice of the Engineer.

All metal doors, windows etc. shall be stored under cover in a way to prevent damage or distortion. Special care shall be taken to prevent staining of aluminium products by rust, mortar etc.

2.05.00

Assembly & Erection at Site

In general, the fixing of steel doors, windows, ventilators, louvers, etc. shall conform to IS: 1081. The Contractor shall assemble and install all steel doors, windows, sashes, fixed metal louvers, etc. including transoms and mullions for composite units in respective places, keening proper "Lines and levels", and in approved workmanlike manner, to give trouble free and leak-proof installations. Installation shall be done according to instructions of the manufacturer, and/or as approved by the Engineer. If required by the Engineer, the installation shall have to be carried out under the supervision of the manufacturer's staff. The Contractor shall take all precaution against damage of the components during installation. Necessary holes, chases, etc. required for fixing shall be made by the Contractor and made good again as per original, after installation, without any extra charge.

After installation of steel doors, windows, etc. all abrasions to shop-coat of paint shall be retouched and made good the same quality of paint used in shop coat.

All coupling mullions, transoms, frames, etc. in contact with adjacent steel and other members, shall be well bedded in mastic. The Contractor shall bring to the site the cement in original sealed containers of manufacturer and shall apply it as per the instruction. For all frames supplied by either the owner or the Contractor, mastic shall be supplied by the Contractor and caulking done properly as per drawings, specifications and as per instructions of the Engineer.

Door shutters, partitions hardware fixtures etc. shall be fixed only after major equipments have been installed in rooms.

Wherever required, nylon cords of approved quality shall be supplied along with pivoted sashes and shall be of adequate length to terminate one metres from the floor. Loose ends of cords shall end in metal or plastic pull as approved by the Engineer.

2.06.0

Fire proof Door



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Fire proof doors shall be provided at all fire exit points as specified and also to restrict the spread of fire within buildings whether from internal fire or from external fire. The construction details of door shall conform to the requirements stipulated in IS:3614(Part-1). Doors shall comply with the testing requirement mentioned in IS:3614 (Part-2). The doors shall be approved by Tariff Advisory Committee and shall have minimum 2 hrs. fire rating.

Metal covered (on both sides) Doors having insulating core filled up with mineral wool shall be used at all fire exit points and shall open out side.

All necessary accessories and hardware shall also be supplied along with doors. Fire proof door shall be provided with zinc silicate primer (minimum DFT 75 micron) after blast cleaning the surface to near white metal surface and shall be finished painted with epoxy based painting.

3.00.00 ACCEPTANCE CRITERIA

3.01.00 For fabricated Items

- a) Overall dimensions shall be within ± 1.5 mm of the size shown on drawings.
- b) Mullions, transoms etc. shall be in one length and permissible deviations from straightness shall be limited to ± 1.5 mm from the axis of the member.
- c) Door and window shutters shall operate without jamming. The clearance at head and jamb for door shutters shall not exceed 1.5 mm for double leaf doors; the gap at the meeting stiles shall not be more than 1.5 mm.
- d) Door leaves shall be undercut where shown on drawings.
- e) Doors, windows, frames, etc. shall be on a true planes, free from warp or buckle.
- f) All welds shall be dressed flush on exposed and contact surfaces.
- g) Correctness of location and smoothness of operations of all shop installed hardware and fixtures
- h) Provision for hardware and fixtures to be installed at site.
- i) Glazing beads shall be cut with mitered corners.
- j) Glazing clips, fixing devices etc. shall be supplied in adequate numbers.
- k) Shop coats shall be properly applied.

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3.02.00	For installed Items 1) Exposed aluminum surfaces shall be free from scratches, stains, and discoloration. Anodized surfaces shall present a uniform and pleasing look. a) Installations shall be at correct location, elevation and in general, on a true vertical plane. b) Fixing details shall be strictly as shown on drawings. c) Assembly of composite units shall be strictly, as per drawings with mastic caulking of transoms and mullions, gaskets, weather strips etc. complete. d) All frames on external walls shall be mastic caulked to prevent leakage through joint between frames and masonry. e) All openable section shall operate smoothly without jamming. f) Locks, fasteners etc. shall be engage positively. Key shall, be non-interchangeable. g) Cutting to concrete or masonry shall be made good and all abrasions to shop paint shall be touched up with paint of same quality as shop paint. h) Aluminium doors, windows, etc. shall be free from scratches stain or discoloration.	
4.00.00	INFORMATION TO BE SUBMITTED	
4.01.00	With Tender	
4.02.00	After Award	
	a) Before starting fabrication of all metal doors, windows, etc. the Contractor shall submit detailed fabrication drawings to the Engineer for approval. The fabrication shall be started only after approval of drawings. b) He shall submit a programme of work to be done for the approval of the Engineer. c) Before bulk supply, he shall submit for the approval of the Engineer samples of all bought out items and samples of each type of fabricated items. The samples shall be retained by the Engineer for comparison of	

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bulk supply and returned to the Contractor towards the end for final incorporation in the job.			
5.00.00	IS CODES		
All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.			
	Specification for Wrought Aluminium and Aluminium Alloy bars, rods and sections (for general engineering purpose)	-	IS: 733
	Specification for Wrought Aluminium and Aluminium Alloy, extruded round tube, hollow section (for general engineering purpose)	-	IS: 1285
	Steel doors, windows, and ventilators	-	IS: 1038
	Steel windows for industrial, building	-	IS: 1361
	Aluminium doors windows, and ventilators	-	IS: 1948
	Aluminium windows for industrial buildings	-	IS: 1949
	Steel doorframes	-	IS: 4351
	Code of practice for fixing and glazing of Metal (steel and aluminium) doors, windows and Ventilators.	-	IS: 1081
	Specification for Fire-check Doors – Part 1: Plate, Metal covered and Rolling type	-	IS: 3614
	Hot Rolled Steel Sections for Doors, Windows and Ventilators – Specification	-	IS: 7452
6.00.00	RATES AND MEASUREMENT		
6.01.00	Rates		
Rates shall be applicable of all elevation. Rates shall include preparation of working drawings (if required), supply of material, fixtures, gaskets, erection			



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FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

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of unit, caulking and jamming of frames, including cutting/drilling/welding, grouting, grinding, making good of the structure for installing the unit etc. complete as per "Schedule of Items".

Rates shall also include cost of surface preparation, application of primer, enamel painting or anodizing as applicable.

Rate for fire proof door is inclusive of providing insulation core, primer, shop painting (epoxy based), all hardware as specified in Schedule of items.

6.02.00

Measurement

Supply and installation of doors, windows, and ventilators shall be measured in Sqm or Kg as per BOQ item. If measured in sqm, it shall be for net outer to outer (excluding frame) area of doors, windows, and ventilators of each type used as described in "Schedule of Items". Frame for steel or aluminium shall be measured in Kgs. Wooden frames shall be measured in Cum. Measurement for aluminium partition frames shall be in Kg. Panelling and glazing shall be paid separately if not covered in BOQ item description.

Measurement for fire proof door shall be in SqM in net area outer to outer of the door.



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ANNEXURE-A

SCHEDULE OF FIXTURES

A. TIMBER DOORS

1. For single leaf panel/flush doors

i) 100 mm brass butt hinges with screws	-	3 Nos.
ii) 150 mm brass tower bolts with screws	-	1 No.
iii) 100 mm x 225 mm clear plastic push Plate with counter sunk brass screws	-	1 No.
iv) 30 mm brass ring pull handle with Plates and screws	-	1 No.
v) 150 mm brass coat hook with screws	-	1 No.
vi) Heavy duty, cylinder locks on active leaf - for flush door. For door- closure, see "Door Schedule".		

B. ALUMINIUM DOORS

1. For double leaf door

i) Concealed hanging arrangement for door leaves.	
ii) Concealed two points bolt encasing simultaneously at head and threshold on inactive leaf, operable from inside.	
iii) Heavy duty, cylinder lock on active leaf.	
iv) Pull handle of approved design on both leaves.	
v) Doors stops for both leaves.	
vi) Overhead door closure for both leaves.	



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ANNEXURE-A

C. STEEL DOORS AND WINDOWS

1. Doors

a) Double leaf doors

i) 100 mm butt hinges	- 3 Nos. on each leaf.
ii) 300 mm aluminum tower bolt	- 2 Nos. (top and bottom) On inside of inactive Leaf. 1. No. (Top only) On inside active leaf.
iii) 200 mm anodized aluminum pull handle	- 1 No. of each leaf.
iv) Door stop of approved design	- 1 No. of each leaf.

NOTE: For locks, door closure and threshold, see "Door Schedule".

b) Single leaf doors

i) 100 mm butt hinges	- 3 Nos.
ii) 300 mm aluminum tower bolt	- 2 Nos. top & bottom of Inside face
iii) 200mm anodised aluminum Pull handle	- 1 No.
iv) Door stop of approved design	- 1 No.

NOTE: For locks, door closures and threshold, see "Door Schedule".

2. Windows, Ventilators, etc.

a) Side Hung Windows

i) Hinges	- As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.
ii) 12" peg stays	- 1 No. per leaf



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ANNEXURE-A

- iii) 2 point handles - 1 No. per leaf
- b) Top Hung Ventilators (Projecting Out)
 - i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.
 - ii) Adjustable sliding fabrication assemblies - 2 Nos. per leaf.
 - iii) 2 point handles - 1 No. per leaf.
- c) Bottom Hung Ventilators (Projecting in)
 - i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.
 - ii) Concealed side arms for opening adjustment. - 2 Nos. per leaf.
 - iii) Spring Catch - 1 No. per leaf.



TITLE:

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FOR METAL DOORS, WINDOWS,
VENTILATORS, LOUVERS ETC.**

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ANNEXURE-A

D. ALUMINIUM WINDOW, VENTILATORS, ETC.

(As per IS-1948 latest editions)

a) Side Hung Windows

- i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.
- ii) 300 mm peg stays - 1 No per leaf
- iii) 2 point handles - 1 No per leaf

b) Top Hung Ventilators (Projecting out)

- i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.
- ii) Adjustable sliding fabrication assemblies - 2 Nos. per leaf
- iii) 2 Point handles - 1 No. per leaf

c) Bottom Hung Ventilation & (Projecting In)

- i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.
- ii) Concealed side arms for opening adjustment - 2 Nos. per leaf
- iii) Spring Catch - 1 No. per leaf



TITLE:

**TECHNICAL SPECIFICATION
FOR GLASS AND GLAZING**

SPECIFICATION NO. PE-TS-999-600-C006

VOLUME - II B

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GLASS AND GLAZING

SPECIFICATION NO. PE-TS-999-600-C006



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

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GLASS AND GLAZING

1.00.00 SCOPE

This section covers supplying and fixing of all glass and glazing including all clips, putty, mastic cement etc. wherever required as per specifications.

2.00.00 INSTALLATION

2.01.00 General

The Contractor shall supply and install all glass and glazing as required for various doors, windows, sashes, ventilators and fixed louvers, miscellaneous glazing and partitions, from approved manufacturer like Hindustan Pilkinton or equivalent, having uniform refractive index and free from flaws, specks, and bubbles. The glass shall be brought to site in the original packing from the manufacturer and cut to size at site.

Materials

- a) Glare reducing or heat absorbing glass shall be "Calorex" of Hindustan Pilkinton or approved equivalent and special care shall be taken to grind smooth and round off the edges before fixing.
- b) Clear glass shall be flat draw sheet glass and shall be at least 4 mm thick. Sheet glass for doors shall be minimum 5.5 mm thick.
- c) Wired glass shall be thick- rolled glass with centrally embedded 42g wire mesh of Georgian type. This may be of clear or coloured glass, as required.
- d) Obscure glasses shall have a cast surface in one side.
- e) Coloured and figured glass shall be as per approved sample.
- f) In general, the putty shall conform to IS: 400 and be of best quality from approved manufacturer. It shall be brought to site in the manufacturer's original packing.
- g) Neoprene gaskets with snap-fit glazing beads shall be fixed as per manufacturer's instructions and shall sit snugly against glass to give a leak proof installation.

2.03.00 Glazing, Setting, and Finish

All glazing clips, bolts, nuts, putty, mastic cement etc. as required shall be supplied by the Contractor.



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All glass shall be thoroughly cleaned before putting in position. Each glass pane shall be held in place by special glazing clips of approved type. As specified in relevant I.S. Codes, four glazing chips shall be provided per glass pane, except for large panes where six or more clips shall be used as per engineer's instructions. All holes that may be necessary for holding the clips glazing heads and all other attachments shall be drilled by, the Contractor.

Glass panes shall be set without springing, and shall be bedded in putty and back puttied, except where mouldings or gasket are specified, putty, mastic cement etc. shall be smoothly finished to the even line and figured glass shall be set with smooth side out.

Where owner will supply glass, the Contractor shall cut it to size and fix them in the same as specified above.

The Contractor shall supply necessary glazing clips, putty, mastic cement etc.

After completion of glazing, the Contractor shall remove all dirt stains, excess putty etc. clean glass panes and leave the work in perfectly acceptable condition. All broken cracked or damaged glass shall be replaced by new ones at the contractor's own cost.

3.00.00

ACCEPTANCE CRITERIA

- a) All installation shall be free from cracked, broken, or damaged glass. Edges of large panes of thicker glass and heat absorbing glass shall be inspected carefully for chipped, cracked, or underground edges.
- b) Glazing shall be carefully done to avoid direct contact with metal frames.
- c) All glass shall be embedded in mastic or fixed by neoprene gaskets to give a leak proof installation.
- d) At completion, the panes shall be free from dirt, stains, excess putty etc. to the complete satisfaction of the Engineer.

4.00.00

I.S. CODES

Following are some of the important I.S.Codes relevant to this Section:

IS: 3548 - Code of practice for glazing in building.

IS: 1081 - Code of practice' for fixing and glazing metal doors, windows ventilators.



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5.00.00

RATES

Rates of glass and glazing if not included in respective items for supply and installation of window, ventilator, and partitions shall be paid separately as per BOQ items provided. No separate payment shall be made for glazing clips, mastic cement, putty, screws; rails, etc. nor for drilling holes in frames for inserting glazing clips.



TITLE:

**TECHNICAL SPECIFICATION FOR
ROLLING STEEL SHUTTERS AND
GRILLS**

SPECIFICATION NO. PE-TS-999-600-C007

VOLUME - II B

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ROLLING STEEL SHUTTERS AND GRILLS

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Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION FOR
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GRILLS**

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ROLLING STEEL SHUTTERS AND GRILLS

1.00.00 SCOPE

This Section covers the design and supply of materials, fabrication, delivery and erection of Rolling Shutters/Grills with motor drive and/or manual operation including all accessories as hereinafter specified.

2.00.00 INSTALLATION

2.01.00 Components

- a) Slats for rolling shutters shall be made from tested bright cold rolled, annealed M.S. strips, not less than 0.9 mm thick for shutters upto 4.5 M wide and not less than 1.25 mm thick for shutters having width more than 4.5 M, wide and above, machine rolled at 75 mm rolling centers, interlocking with each other. The profile will be such as to prevent excessive deflection under specified wind load.
- b) Rolling grills shall be constructed out of 6mm rods at 35 mm on centers running horizontally flexible connected with vertical links spaced not more than 200 centers. Alternatively, rolling grills shall be made from perforated slats of approved design reinforced with 6mm dia rods.
- c) End locks shall be heavy type M.C.I./C.I. and shall be provided at each end of alternate slats unless specified otherwise.
- d) Bottom bars shall be finished with two angles not less than 6 mm thick for external shutters. When shown on drawings, a flexible weather strip shall be applied to make tight contact with the floor.
- e) Guides shall be of such depth as to retain the shutter under a wind pressure of 100 Kg/Sq.m.
- f) Shafts shall be of steel pipe of sufficient size to carry the tensional load with a maximum deflection of 1/360th of span. Grease packed ball bearings or bushings shall be provided for smooth trouble free operation.
- g) Hoods shall be formed of not less than 20 gauge steel, suitable reinforced to prevent sag.
- h) Locks shall be slide bolt and hasp, or cylinder lock operable from one or both sides. Provision securing hand chain with pad-lock, provision for removable handle for hand cranks etc. shall be made as prescribed by the Engineer.



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- i) Power unit shall be suitable for 3 phase, 50 cycles, 400-volt A.C. power supply and be either floor or wall mounted unit. The motor shall be of sufficient capacity, to move the shutter in either direction at a speed of 0.3 metres per second. In addition to the gear motor each standard power unit shall include a magnetic brake, a reversing starter with built-in overload protection, a geared limit switch and one push button station located inside the building unless otherwise stated in drawing.

It is desirable that the bottom bar of motor operated doors shall be provided with a sensitive edge, electrically connected to stop the travel of the door on meeting an obstruction.

- j) Operating chains shall be of tested quality, heavily galvanized and with all ends rounded to assure smooth operation and hand protection.
- k) Reduction gears shall be high strength grey cast iron, machine moulded from machine out patterns.

2.02.00 Manually Operated Shutters/Grills

Manually operated shutters shall be easily operable by one person. The speed of operation shall be about 1.3 metres per second. In general, manually operated shutters shall be push pull type for opening up to 9 Sq. metre in area. Larger shutters shall, be either chain and gear operated or crank and gear operated. The crank handle shall be removable. All shutters shall be lockable from one or both sides as desired by the Engineer.

2.03.00 Power operated Shutters/Grills

These shall be operable from a push button station conveniently located beside the door. One emergency hand chain/crank operation shall also be provided for use in case of failure of the electric system. Where called for, externally mounted shutters shall be operated by control mechanism located inside the building.

2.04.00 Shop Coat

Shutters shall be painted with one coat of red lead or zinc chromate primer. Where specified, doors shall be galvanized and subsequently painted one coat of zinc chromate for adhesion of field coat.

2.05.00 Erection

Door shall be installed by the manufacturer or his authorized representative and all work shall be as per manufacturer's instructions. Any drilling or cutting

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	to concrete, masonry etc. shall be made good after erection of shutters and all abrasion to shop coat shall be touched up. All electrical work shall be in strict accordance with the latest Indian Electricity Rules.	
3.00.00	ACCEPTANCE CRITERIA AND GUARANTEE	
3.01.00	Shop Inspection After completing the manufacture of the different components of the rolling shutter, an arrangement for shop inspection by the Engineer shall be made to check the conformity with approved shop drawings.	
3.02.00	Field Inspection After installing the shutters, the Contractor shall test the performance of the shutter in the presence of the Engineer. The doors shall be smoothly operable under all ambient conditions. All control and locking devices shall give fault free performance.	
3.03.00	Guarantee The Contractor shall give one year's guarantee for the successful operation of the shutters. This shall be supported by a separate and unilateral guarantee from the manufacturer of the shutters.	
4.00.00	I.S. CODE IS: 6248 - Metal rolling shutters and rolling grills.	
5.00.00	RATES AND MEASUREMENT	
5.01.00	Rates Rates for rolling shutters and grill shall include the cost of the locks, guide channels, cost of drive as specified. In case of electrically operated rolling shutters, the rate shall also include the mounting of controls, wire and wiring from the nearest junction box, conduit and other electrical connections and cost of electric motor.	
5.02.00	Measurement Supply and installation of rolling shutter and grill shall be measured in Sqm in net outer to outer (including frame) area of each type used as described in “Schedule of Items”.	



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MISCELLANEOUS METAL

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Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:
TECHNICAL SPECIFICATION FOR
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MISCELLANEOUS METAL

1.00.00 SCOPE

This section covers supply, fabrication and erection of miscellaneous metal items of light nature in gates, balcony and stair hand rails, structural works, ladders, hangers, masonry anchors, anchor bolts, fasteners, chain link fencing, barbed wire fencing etc. as specified or shown on drawing or as instructed by the Engineer. The above items shall be of fabricated or cast of mild steel, aluminium, brass, cast iron, M.S.& galvanized M.S. sheets, aluminium sheets, expanded metal, wire mesh as shown on drawings or specified.

2.00.00 INSTALLATION

2.01.00 Fabrication/casting

2.01.01 General

All work shall be done according to approved shop drawings. All workmanship shall be equal to the best practice in modern structural or foundry shop.

2.01.02 Shop Connections

- a) All shop connections shall be riveted or welded except when noted otherwise on drawings.
- b) Welding of steel shall be done in accordance with IS: 816.
- c) Welding of aluminium shall be done accordance with IS: 2812, "Arc welding of Aluminium and Alloys." Special care shall be taken to grind smooth all welded surface that shall remain exposed to view. Welds shall be electrically continuous if so required by the Engineer.

2.01.03 Shop Coat

Before leaving the shop, all metal work shall be thoroughly cleaned by effective means of all loose mill seals, rust and foreign matter. Except where encased in concrete, all steelwork shall be given one coat of approved metal protective paint, applied by brush thoroughly and evenly, well worked into joints and other open spaces. All paint shall be applied to dry surfaces. When specified steel work shall be galvanised or painted with a coat of zinc chromate primer. Aluminium surfaces, which shall come in contact with masonry, shall be given one coat of bituminous paint.



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2.02.00 Erection

2.02.01 Bracing

The Contractor shall provide all necessary temporary guys and braces to ensure alignment and stability of the members and to take care of all loads to which the structure may be subjected, including erection of equipment and operation of the same.

2.02.02 Temporary Bolting-Up

As erection proceeds the Contractor shall plum up and level all members and shall securely bolt up to take care of all dead load, wind load and erection stresses. Wherever erection equipment or other loads are carried by members during erection, proper provision shall be made to take care of the stresses resulting from the same.

2.02.03 Turned Bolt

For field connections where bolting is specified, holes for the turned bolts may be reamed in the field, if required. All drilling or reaming for turned bolts shall be done after the parts to be connected are assembled.

2.02.04 Welding

Where specified on drawings, welding shall be done in accordance with IS: 816 for steel and IS: 2812 for Aluminium & Alloys.

2.02.05 Cutting and Fitting

No cutting of sections, flanges, webs of angles shall be done without the approval of the Engineer. Where indicated on the drawings holes, cuttings, etc. shall be provided as required for installation, to the work by the other Contractors. No additional holes or cuttings, than those shown on drawings, shall be made without the approval of the Engineer.

2.02.06 Drifting

Correction minor misfits and a reasonable amount of reading and cutting of excess stock from rivets may be permitted. For this, light drifting may be allowed to draw holes together. Twist drills shall be used to enlarge as necessary to make connections, reaming that weakness the members or make it impossible to fill the holes properly or to adjust accurately after reaming shall not be allowed.

Any error in shop work which prevents the proper assembling and fitting of



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parts by moderate use of drift pins or a moderate amount of reaming and slight chipping and cutting shall immediately be called to the attention of the Engineer and approval of the method of correction obtained. The use of cutting torches to enlarge or alter rivet holes shall not be permitted.

2.02.07 Spot Painting

All field rivets and bolts and also any serious abrasion to shop paint shall be spot painted with the same materials and used for the shop paint or equivalent.

2.02.08 Good

All cutting to concrete or masonry shall be made good to the satisfaction of the Engineer.

2.02.09 Grouting

All bearing plates, loose, lintels and beams, etc. shall be set to proper grade and level by the Contractor and the Engineer's approval obtained before proceeding with the grouting. Grouting shall be done in 1:1½:3 concrete with 6 mm down stone chips or as specified in schedule of items.

2.02.10 Anchor Fasteners

The anchor fasteners shall be of two type viz. light duty for carrying tensile load upto 0.5MT per fasteners and heavy duty for carrying tensile load of 0.5MT to 5.0MT per fasteners. These anchor fasteners shall be fixed into concrete. The Contractor shall submit the Manufacture's literature showing the average pull out and average shear value for anchor of various sizes. Anchors shall be fixed in position strictly as per the manufacturers instructions and as approved by the Engineer.

Heavy Duty Anchor Fasteners

The safe tensile load carrying capacity of the anchors shall be arrived by providing the minimum factor of capacity of 2.5 for the characteristic load of the anchor. Minimum size of anchor shall be M8 (8mm). All anchors shall be from the approved manufacturers like HILTI or equivalent.

- Anchor fasteners shall be supplied and fixed in position by the contractor. Anchor fasteners can be of mechanical bonding or chemical bonding.
- Capacity of the anchor shall be established after considering the effect of concrete grade, embedment depth, concrete thickness, anchor spacing and edge distance from the concrete edge.
- The selection for the particular type of bonding for the anchors shall be made after considering the concrete grade, available embedment depth, load to be transferred, space available for installing anchors.



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- d) The mechanical bonding anchor are torque controlled anchors made from carbon steel of grade 8.8 as per IS:1367 part 3. Anchors in bolt as well as nut version are acceptable. The bolt version anchors consists of bolt washer, sleeves, plastic section, expansion sleeves and a cone. Nuts version anchor consists of nuts, threaded rod, washer, sleeves, plastic section, expansion sleeves and a cone. All steel component of anchor shall be electro galvanised to minimum 5 micron coating thickness. The plastic section shall be of polyacetal Derlin 100 or equivalent.
- e) Chemical bonding anchor shall consist of foil capsule and threaded rod. The foil capsule shall contain the resin and hardener. The threaded rod shall have chiselled tip. The behaviour of anchors under fire shall conform the heating curves as per ISO:834. Anchors of size M8 to M24 shall conform to grade 5.8 and anchors of size M27 to M39 shall conform to grade 8.8 as per IS:1367 part 3. All steel components of the anchors shall be electro-galvanised to minimum 5 micron thickness.

Light Duty Anchors

This anchor shall comprise of stud, nut, washers, expansion sleeve. The one end of the stud shall have thread and the other end shall have cold formed conical head. All steel components of the anchors shall be electro-galvanised to minimum 5 micron thickness. The expansion sleeve shall preferably be of stainless steel of SS316. The anchors shall conform to minimum grade 5.8 as per IS:1367 part 3.

2.02.11 Pipe Joints

MS pipes or GI pipes shall be joined by threaded sockets or by welding. Cast iron pipes shall be socket and spigot joined and caulked with hemp and molten head.

2.03.0 FENCING

2.03.01 Chain Link Fencing

The material requirement shall conform to IS: 2721 latest edition. The chain link fencing shall be woven from 3.15mm dia. wire with mesh size of 50mm. The mesh wire shall not vary from specified dia. by more than ± 0.05 mm. all steel wire shall be hot dipped galvanised wire. The dia shall be measured over the galvanised coating. The line wire shall be 4.0mm dia. mild steel. The stirrup wire for securing the line wire to the intermediate post (RCC/structural steel) shall be 2.5 mm diameter mild steel. The tying wire for securing the chain link fencing to the line wire shall be 1.6mm diameter mild steel. Hair pin chain staples for fastening down the bottom of galvanised chain line fencing to the concrete sill shall be 3.15mm wire. The ends shall be bent outwards for securing anchorage.



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Cleat for eye bolts shall be of uniform size and shall consist of mild steel angle of 75 x 50 x 8 mm. The eye bolts strainer shall consist of bolt with welded eye sufficiently threaded and fitted with a nut and washer. Two-way eye bolt strainer shall have suitable ring nuts fitted after the wires have been strained on one side. Stretcher bar shall consist of mild steel flats 25 x 4.75 mm. They shall be secured to the cleats by steel bolts.

The chain link fencing shall be strained between each pair of straining posts and secured to each straining posts by means of a stretcher bar. One of top line wire shall be threaded through appropriate adjacent row of mesh, care being taken that no meshes in the row are bypassed by the line wire except where deviation is necessary at the straining posts. The second top line wire shall be strained in front of the fencing. The fencing shall be attached to the top and bottom line wire by wire ties spaced at 150mm apart and to the other middle line wire by wire ties spaced at 450mm apart.

The bottom of fencing shall be treated as follows:

Continuous concrete sill 125mm wide x 225mm high for full length between posts shall be cast with the top 25mm above GL and 25mm below the chain link fencing. Hair pin staples shall be threaded through the bottom row of mesh at 750mm c/c and set in the sill to a depth of 150mm.

2.03.02

Barbed Wire Fencing

The barbed wire shall be conform to IS:278 latest edition. The barbed wire shall be galvanised and galvanising shall conform to the requirement laid down for 'light-coated wire' of IS:4826 and it shall be smooth and relatively free of lumps etc. Wire with excessive roughness blisters, salammoniac spots shall be rejected. The barbed wire shall be made from two line wire and two point wire of 2.5 mm thickness each. The barbs shall have four point and shall be formed by twisting two point wires, each two turns, tightly around both or one line wire (Type A - around both line wire, Type B - around one line wire) making altogether four complete turns. The barbs shall be so finished that four points are set and located or locked as far as possible at right angle to each other. The barbs shall have a length of not less than 13mm and not more than 18mm. The distance between two barbs shall be 75 ± 12 mm.

Straining posts shall be provided at all ends and corners of fences or at changes in direction or acute variation in level and at intervals not exceeding 66 M on straight lengths of fence. Intermediate posts shall be spaced at regular intervals not exceeding 3.0m. Struts shall be fitted to all straining posts behind the chain link fabric in the direction of line of fence. There shall be four evenly spaced row of line wire in all. The top line wire shall be doubled, making five line wire in all. The bottom wire shall be closed to the ground. Each line wire shall be strained tightly by means of eyebolts strainers or winders at each straining points. Each line wire shall be secured to each intermediate post by a



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wire stirrup passed through a hold in the post and secured to the line wire by three complete turns on each sides of the post. The barbed wire shall be fitted with one dropper at the centre of each bay, secured to the wire so that they could not be bunched together. Droppers for barbed wire shall be of mild steel of not less than 25 x 4.75 mm thick with 38 x 4.85 mm half round staples for fastening the barbed wire to them. Bracing for the rows of barbed wire shall be approved by the Engineer.

3.00.00 ACCEPTANCE CRITERIA

- a) All items shall be correct shape, size, weight etc. shown on drawings and schedule of items.
- b) For installed items, the tolerances shall be as follows
 - i) Permissible deviation from, straightness – 1 in 1000.
 - ii) Seats, stiffener connections etc. shall be as per approved drawings and shall not interfere with architectural clearances.
- c) All castings shall be free from blowholes, cracks, and other blemishes.
- d) All MS wire fencing shall be in true vertical plain, and shall not bulge.

4.00.00 IS CODES

IS:278	Specification for Galvanised Steel Barbed wire for fencing.
IS:816	Code of practice for use of Metal Arc welding for general construction in mild steel.
IS:1367	Industrial Fasteners – Threaded steel fasteners - Technical supply condition.
IS:2721	Specification for Galvanised Steel Chain Link fence fabric.
IS:2812	Arc welding of Aluminum and Alloy

5.00.00 RATES AND MEASUREMENTS

5.01.0 Rates

Rates shall include supply, fabrication and installation for misc. metals works as required for completion of works like gates, fencing, handrails, ladders, hangers, anchors etc., unless otherwise specified in Schedule of Items. Rate for fencing shall also include excavation, concreting and supply, erection



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& fabrication of post (post made of either structural steel or reinforced cement concrete), unless any specific item is excluded.

5.02.0

Measurements

Measurement for MS gates shall be in MT.

Measurement for galvanised MS wire fencing shall be in Sqm.

Measurement for Anchors shall be in nos. for the type as specified in schedule of items.

Measurement of other misc. metals shall be done in MT unless otherwise specified in schedule of items.



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MASONRY AND ALLIED WORKS**

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MASONRY AND ALLIED WORKS

SPECIFICATION NO. PE-TS-999-600-C009



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TECHNICAL SPECIFICATION FOR MASONRY AND ALLIED WORKS

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MASONRY AND ALLIED WORKS

1.00.00 SCOPE

This section covers furnishing, installation including handling, transporting, batching, mixing, laying scaffolding, centering, shuttering, finishing, curing, protection, maintenance and repair of common building materials till handing over of masonry and allied works for use in structures and locations covered under the scope of this package.

2.00.00 MATERIALS

a) Brick

Bricks for general masonry work shall be of class designation 7.5 of nominal dimensions as per standard specification under IS: 1077, well burnt, of uniform size, shape and colour, free from cracks, flaws or modules of free lime and emit clear ringing sound when struck. Fractured surface shall show uniform texture free from grits, lumps holes etc. Water absorption after 24 hours immersion shall not exceed 20% by weight for bricks. Dimensional tolerance shall not exceed 8% of the size shown in drawings for bricks. All bricks shall have rectangular faces and sharp straight edges. The bricks shall show no efflorescence after soaking in water and drying in shade.

Each brick shall have the manufacturer's identification marks clearly marked on the frog. Representative samples shall be submitted and approved samples shall be retained by the Engineer for further comparisons and reference. Any brick not found up to the specification shall be removed immediately from site at the Contractor's own cost.

Bricks shall not be dumped at site. They shall be stacked in regular tiers, even as they are unloaded; to minimize breakage and defacement of bricks. Bricks selected for different situation of use in the work shall be stacked separately.

b) Stone

All stones shall be obtained from approved quarries, hard, tough, durable compact grained, uniform in texture and colour and free from decay, flaws, veins, cracks and sand holes. The surface of a freshly broken stone shall be bright, clean, and sharp and shall show uniformity of texture, without

loose grains and free from any dull, chalky, or earthy appearance. Stone showing mottled colours shall not be used for face work. A stone shall not absorb more than 5 per cent of its weight of water after 24 hours immersion. The type of stone shall be as specified on drawings and/or instructed by the Engineer. Samples shall be submitted by the Contractor and approved samples shall be retained by the Engineer for comparison of bulk supply.

c) Cement

Cement used shall be Ordinarily Portland Cement or Portland Slag Cement or Portland Pozzolana Cement conforming to IS Codes and shall be fresh when delivered. In special cases, Rapid Hardening Portland Cement, Low Heat Cement etc. may be permitted or directed to be used by the Engineer. The Contractor shall submit the manufacturer's certificate for each consignment of cement procured to the Engineer. If at any time, the Engineer feels that the cement being used by the Contractor is not up to specification, he may stop the work and send the samples of the cement to a testing laboratory for standard tests and all expenses incurred thus shall be borne by the Contractor. The Contractor shall also have no claim for this type of suspension of work.

The cement shall be stored above the ground level in perfectly dry and watertight sheds. The bags shall be stacked in a manner so as to facilitate removal or first in first out basis. Any material considered defective by the Engineer shall not be used by the Contractor and shall be removed from the site immediately.

d) Coarse Aggregate

Coarse aggregates shall be as per IS: 383 latest editions, consisting of hard, strong and durable pieces of crushed stone and shall be free from organic or clay coatings and other impurities like disintegrated stones, soft flaky particles etc. and any other material liable to affect the strength, durability or appearance of concrete.

Aggregates other than crushed stone conforming to the provisions of specification may be used if permitted by the Engineer.

Washing of aggregates by approved means shall be carried out, if desired by the Engineer.

Grading of coarse aggregates shall generally conform to IS: 383 and shall be such as to produce a dense concrete or the specified proportions and strength and of consistence that will work readily into position without

segregation.

Aggregates shall be stored on brick soling or an equivalent platform so that they do not come in contact with dirt, clay, grass, or any other injurious substances at any stage.

Aggregate of different size shall be kept in separate stacks. If so desired by the Engineer aggregate from different sources shall be stacked separately with proper care to prevent intermixing.

e) Sand

Sand shall be hard, durable, clean, and free from adherent coatings or organic matter and shall not contain clay balls or pellets. The sand shall be free from impurities such as iron pyrites, alkalis, salts, coal, mica, shale or other laminated materials in such forms or quantities as to affect adversely the hardening, strength, durability or appearance of mortar, plaster or concrete or to cause corrosion to any metal in contact with such mortar, plaster or concrete. All sand shall be properly graded and shall be as per relevant IS Code. Sand for concrete shall conform to IS: 383.

f) Water

Water shall be clean, fresh and free from organic matters, acids or soluble salts and other deleterious substances which may cause corrosion, discoloration, efflorescence etc.

g) Reinforcement

Reinforcement steel shall be clean and free from loose mill scales, dust, loose rust, oil and grease or other coatings, which may impair proper bond. Structural steel shall conform to IS: 2062. Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement shall conform to IS: 432. Cold twisted steel bars shall conform to IS: 1786. Hand drawn steel wire fabric shall conform to IS: 1566. Hexagonal wire netting shall conform to IS: 3150. All steel bars including and above 10 mm diameter shall be of tested quality. All wire netting shall be galvanized.

Reinforcement bars shall be stored off the ground and under cover if so desired by the Engineer. If necessary, a coat of cement wash shall be given to the bars to guard against rusting.

3.00.00 INSTALLATION

3:01.00 Soling

3.01.01 Brick Soling

The ground shall be dressed, consolidated by ramming, or by light rolling and a 12 mm thick cushion of sand laid. On the sand cushion the bricks shall be laid with fine joints and placed firmly in position by hammering with wooden mallet. The surface shall be free from undulations. The 'frog' side shall be on the underside. The joints shall be broken the in all direction and bricks cut as required. The pattern of laying and number of layers shall be as per Schedule of item. Orientation shall be as desired by the Engineer. After laying of each layer of bricks sand shall be spread over and worked into the joints to pack the bricks tight.

3.01.02 Stone Soling

The stones for soling shall be selected on the basis of thickness of soling specified in the Schedule of Items. The larger stones shall be laid and the gaps filled by smaller stones. The interstices shall then be firmly packed with sand by flooding with water.

3.02.00 Brick-on-Edge

Excavation shall be done close to the brick dimensions and in perfect alignment. Bricks shall be firmly placed by hammering with wooden mallets and sides and joints packed firmly with earth so that the edging is not disturbed easily. Alignment and level shall be acceptable to the Engineer.

3.03.00 Masonry

3.03.01 General

All masonry work shall be true to lines and levels as shown on drawings. All masonry shall be tightly built against structural members and bonded with dowels, inserts etc. as shown on drawings.

3.03.02 Cement Mortar

Cement mortar shall be prepared with materials specified in clause 2.00.00. Sand for masonry mortar shall conform to IS: 2116. Cement and sand in the specified proportion shall be mixed dry thoroughly and minimum water added to attain required workability.

Surplus mortar droppings from masonry, if received on surface free from dirt may be mixed with fresh mortar if permitted by the Engineer who may direct addition of additional cement without any extra payment. No mortar, which has stood for more than half an hour, shall be used.

3.03.03

Brick Masonry

Bricks shall be soaked by submergence in clean water for at least two hours in approved vats before use. Bricks shall be laid in English bond unless specified otherwise. Broken bricks shall not be used. Cut bricks shall be used if necessary to complete bond or as closers. Bricks shall be laid with frogs upwards over full mortar beds. Bricks shall be pressed into mortar and tapped into final position so as to embed fully in mortar. Inside faces shall be buttered with mortar before the next bricks is placed and pressed against it. Thus all joints between bricks shall be fully filled with mortar.

Mortar joints shall be kept uniformly 10 mm thick. All joints on face shall be raked to minimum 10 mm depth using raking tool while the mortar is still green to provide bond for plaster or pointing.

Where plaster or pointing is not provided, the joints shall be struck flush and finished immediately. Brickworks two bricks thick or more shall have both faces in true plane. Brickwork of lesser thickness shall have one selected face in true plane.

3.03.04

Exposed Brickwork

Brickwork in superstructures, which is not covered by plaster, shall be as shown on drawing and executed by specially skilled mason. Courses shall be truly horizontal and vertical joints truly vertical. Wooden straight edges with brick course graduations and position of window sills and lintels shall be used to control uniformity of brick courses. Masons must check workmanship frequently with plumb, spirit level, rule, and string. All brickwork shall be cleaned at the end of days work. If face bricks are specified, the brickwork shall be in composite bricks, with face bricks on the exposed face and balance in routine bricks, but maintaining the bond fully. Where face bricks are not specified, bricks for the exposed face shall be specially selected from routine bricks. All exposed brickwork on completion of work shall be rubbed down, washed clean, and pointed as specified. Where face bricks are used carborandum stone shall be used for rubbing down.

3.03.05

Reinforced Brickworks

Reinforcements shall be as specified. All reinforcements shall be thoroughly cleaned and fully embedded in mortar. Where M.S. bars are used as reinforcement, these shall be lapped with dowels if left in R.C. columns or welded to steel stanchions.

3.03.06 Stone Masonry

Stones shall be thoroughly soaked before laying. Stones shall be laid on their natural quarry beds. Individual stones shall be fitted with mallet and properly wedged to reduce thickness of mortar joints. Thickness of joint shall be not less than 8 mm and not greater than 25 mm. At least two stones shall run the full width of the wall for every square meter of surface area.

3.03.07 Exposed Stone work

Stonework, which is to be kept exposed, shall be as shown on approved drawing. It shall be executed by specially skilled mason. Stones used for exposed face shall be specially selected. All exposed stone faces shall be kept clean and free from mortar and pointed up neatly as the work proceeds in a manner called for in the drawings or instructions. A sample wall, 10 Sq.M. area shall be built and approved by the Engineer and all works shall match with this sample.

3.03.08 Composite Masonry

Where stonework facing with brick masonry backing is specified the bond between them shall be achieved by bond stones of dimensions and frequency as desired by the Engineer.

3.03.09 Expansion & Separation Joints

Location of joints shall strictly be as shown on drawings or as instructed by the Engineer. Expansion joints shall be as shown on drawings and specified. Expansion joint filler boards and sealing strips shall have minimum transverse joints. Transverse joints shall meet the approval of the Engineer.

Separation joints shall be with standard waterproof paper or with alkathene sheets about 1 mm in thickness. Length and sealing of laps shall be to the satisfaction of the Engineer.

3.03.10 Mouldings, Cornices, Drip Course

These shall be made as shown in drawings. Bricks or stone shall be cut and

dressed as required. If no subsequent finish is envisaged, these shall be rubbed to correct profile with Carborundum stone.

3.03.11 Curing

Masonry shall be cured by keeping it wet for seven days from the date of laying. In dry weather at the end of days work top surface of masonry shall be kept wet by ponding.

3.03.12 Embedding of fixtures

All fixtures shall generally be embedded in mortar and masonry units shall be cut as required.

3.03.13 Encasing of Structural Steel

This shall be done by building masonry work round flanges, webs etc., and filling the gap between steel and masonry by minimum 12 mm thick mortar. Encased members shall be wrapped with chicken wire mesh when shown on drawings or instructed by the Engineer. The minimum lap in chicken wire mesh shall be 50 mm.

3.04.00 Damp Proof Course (DPC)

Unless otherwise specified Damp-proof course shall be 40 mm thick 'artificial stone' in proportion 1:1½:3 cement sand stone-chips (10 mm down) with admixture of a waterproofing compound as approved by the Engineer. The percentage of admixture shall be as per manufacturer's specifications but not less than 2% by weight of cement. The top surface shall be double chequered and cured by ponding for seven days.

3.05.00 Damp Proof Membrane

Damp proof treatment using fibre or hessian base bitumen felt shall be 6, 8 or 10 course treatment as specified in IS: 1609. The number of courses shall be as shown as drawings or as specified. Sequence of work shall be as directed by the Engineer. Extreme care shall be taken to prevent damage to felt during and after laying. The Contractor shall be obliged, at his own expense, to rectify any leakage appearing within 5 years of installation by removing and renewing the coats at the point of leakage.

Where shown on drawing, damp proof membrane with one layer bitumen paper or one layer alkathene sheet shall be laid with minimum 150 mm lap under slabs on grade.

3.05.00

Plinth Protection

Plinth of buildings shall be protected with brick-on-edge paving of minimum 750mm width unless otherwise shown on the drawings. The treatment shall consist of laying bricks in cement mortar 1:6 (1 cement: 6 sand) over a 75mm thick bed of dry graded brick aggregate, 40mm nominal size, grouted with sand. The top shall be finished with 1:2 cement mortar pointing (1 cement: 2 sand). Plinth protection shall be laid with a minimum outward slope of 1 in 50. The brick aggregate shall be well graded, broken from well burnt or slightly overburnt and dense brickbats. It shall be homogeneous in texture, roughly cubical in shape, clean and free from dirt or any other foreign matter.

The ground shall first be prepared to the required slope around the building. The high portions of the ground should be cut down; hollows and depressions filled up to the required level from the excavated earth and rammed so as to give uniform outward slope. The bed shall be watered and rammed with heavy iron square rammers. Surplus earth, if any, shall be disposed off beyond a lead of 50m or as directed by the Engineer.

Over this, 75mm thick bed of aggregate of 40mm nominal size, shall be laid with a minimum outward slope of 1 in 50. Aggregates shall be carefully laid and packed, bigger sized being placed at the bottom. The brick aggregates shall be consolidated dry with heavy iron rammers.

The aggregates shall then be grouted evenly with sand at the rate of 0.6 cubic metre per square metre area, adequately watered to ensure filling of voids by sand and again rammed with heavy iron rammers. The finished surface shall give uniform appearance. After the subgrade has been compacted thoroughly, brick flooring with bricks of specified strength in cement mortar 1:6 (1 cement: 6 sand) shall be laid.

The bricks shall be laid on edge in Diagonal/Herring Bone Bond or other pattern as specified or as directed by the Engineer. Bricks shall be laid on 12mm thick mortar bed and each brick shall be properly bedded and set home by gentle tapping with handle of trowel or wooden mallet. Its inside face shall be buttered with mortar before the next brick is laid and pressed against it. On completion of the portion of flooring, the vertical joints shall be fully filled from the top with mortar. The surface shall present a true plain surface with the required slope.

The pointing shall be done in cement mortar 1:2 (1 cement: 2 sand). The mortar shall be pressed into the joints and shall be finished off flush and level with the edges of the bricks so as to give a smooth appearance. The edges shall be neatly trimmed with a trowel and a straight edge. The mortar shall not spread over surface of the masonry.



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Brick flooring & pointing shall be kept wet for a minimum period of seven days. These shall be protected from rain by suitable covering when the mortar is green.

4.00.00 I.S. CODES

Some of the important relevant codes for this section are:

- IS: 1127: Recommendations for dimensions and workmanship of natural building stones for masonry work.
- IS: 1597: Code of Practice for Construction of stone Masonry.
- IS: 1609: Code of Practice for laying Damp proof treatment using bitumen felts.
- IS: 2212: Code of Practice for Brickwork.
- IS: 2250: Code of Practice for preparation and use of masonry Mortar.
- IS: 5134: Bitumen Impregnated Paper & Board.

5.00.00 RATES AND MEASUREMENTS

5.01.00 Rates

Unit rate for masonry work shall include the following:

- a) Raking out joints for plastering or pointing or finishing the joint flush as the work proceeds.
- b) Preparing top sand sides of existing wall for joining old with new work.
- c) Providing, dismantling and removing the scaffolding.

Unit rate for DPC shall be inclusive of formwork and bitumen painting.

5.02.00 Measurement

Brickwork in wall of half brick thickness shall be measured separately in Sqm stating the wall thickness and more than half brick thickness shall be measured by volume. Plaster thickness shall not be considered for computation of volume.



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Masonry work in sub structure and super structure shall be measured separately, unless otherwise specified in the Schedule of items.

No deductions shall be made and no extra payment shall be made for following:

- a) Opening upto 0.1 Sqm each in area. In calculating the area of the opening lintels or sills shall be included along with the size of the opening.
- b) Drainage holes and recesses for cement blocks to embed holdfasts for doors, windows etc.
- c) Pipe and fixtures upto 300mm dia. and nothing extra shall be paid for the mortar used for fixing.
- d) Ends of dissimilar materials (i.e. joists, beams, lintels, posts, girders, rafters, purlins, trusses, corbels, steps, etc); up to 0.1 sqm in section;
- e) Chases of section not exceeding 50 cm in girth;
- f) Iron fixtures, such as wall ties and hold fasts for doors and windows;
- g) Cement concrete blocks as for hold fasts and holding down bolts;
- h) Wall plates, bed plaros, and bearing of slabs, CHAJJAS and the like, where thickness does not exceed 10 cm and bearing does not extend over the full thickness of wall;

Reinforcement in masonry work shall be paid separately under respective items.

Damp proof course shall be measured in Sqm. No deduction shall be made and no extra shall be paid for opening upto 0.1 Sqm in area.

Plinth protection shall be measured under respective item of works executed required for completion of the work as specified.



**TECHNICAL SPECIFICATION FOR
FINISH TO MASONRY AND CONCRETE**

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FINISH TO MASONRY AND CONCRETE

SPECIFICATION NO. PE-TS-999-600-C010



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



**TECHNICAL SPECIFICATION FOR
FINISH TO MASONRY AND CONCRETE**

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FINISH TO MASONRY AND CONCRETE

1.00.00 SCOPE

This Section covers finishing, installation, repairing, finishing, curing, testing, protection, maintenance till handing over of finishing items for masonry and concrete. This shall also include the work to be done to make the surface suitable for receiving the finishing treatment.

Before commencing finishing items the Contractor shall obtain the approval of the Engineer regarding the scheduling of work to minimize damage by other trades. He shall also undertake normal precaution to prevent damage or disfiguration to work of other trades or other installation.

2.00.01 INSTALLATION

2.01.00 Preparation of Surface

All joints in masonry walls shall be raked out to a depth of at least 10 mm with a hooked tool made for the purpose while the mortar is still green. Walls shall be rushed down with stiff wire brush to remove all loose dust from joints and thoroughly, washed with water. All laitance shall be removed from concrete to be plastered.

For all types of flooring, skirting and dado work, the base cement concrete slab or masonry surface shall be roughened by chipping and cleaned of all dirt, grease or loose particles by hard brush and water. The surface shall be thoroughly moist to prevent absorption of water from the base course. Any excess of water shall be mopped up.

At any point, the level of base shall be lower than the theoretical finished floor level by the thickness of floor finish. Any chipping or filling to be done to bring the base in the required level shall be brought to the notice of the Engineer and his approval shall be taken regarding the method and extent of rectification work required.

Prior to commencement of actual finishing work, the approval of the Engineer shall be taken as to the acceptability of the base.

2.02.00 PLASTERING

2.02.01 Mortar

Mortar for plastering shall be as specified.

For sand cement plaster, sand and cement in the specified proportion shall be

mixed dry, on a watertight platform and minimum water added to achieve working consistency. The sand for plaster shall conform to IS: 1542.

No plaster, which has stood for more than half an hour, shall be used; plaster that shows tendency to become dry before this time shall have water added to it.

2.02.02 Application of Plaster

Plaster, when more than 12 mm thick, shall be applied in two coats a base coat followed by the finishing coat. Thickness of the base coat shall be sufficient to fill up all unevenness in the surface; no single coat, however, shall exceed 12 mm in thickness. The lower coat shall be thicker than the upper coat; the overall thickness of the coats shall not be less than the minimum thickness shown on the drawings. The undercoat shall be allowed to dry and shrink before applying the second coat of plaster. The undercoat shall be scratched or roughened before it is fully hardened to form a mechanical key. The method of application shall be 'thrown on' rather than 'applied by trowel'.

To ensure even thickness and true surface, patches of plaster about 100 mm to 150 mm square or wooden screed 75 mm wide and of the thickness of the plaster, shall be fixed vertically about 2000 mm to 3000 mm apart, to act as gauges. The finished wall surface shall be true to plumb, and the Contractor shall, without any extra cost to the Owner, make up any irregularity in the brickwork with plaster.

All vertical edges of brick pillars, doorjambs etc. shall be chamfered or rounded off as directed by the Engineer. All drips, grooves, mouldings and cornices as shown on drawing or instructed by the Engineer shall be done with special care to maintain true lines, levels and profiles. After the plastering work is completed, all debris shall be removed and the area left clean. Any plastering that is damaged shall be repaired and left in good condition at the completion of the job.

2.02.03 Finish

Generally, the standard finish shall be used unless otherwise Shown on drawing or directed by the engineer. Wherever any special treatment to the plastered surface is indicated, the work shall be done exactly as shown on the drawings, to the entire satisfaction of the engineer regarding the texture, color and finish.

a) Standard Finish

Wherever punning is indicated, the interior plaster shall be finished rough; otherwise the interior plaster shall generally be finished to a smooth surface.

The exterior surface shall generally be finished with a wooden float.

b) Neat Cement Finish

Immediately after achieving a true plastered surface with the help of a wooden straight edge, the entire area shall be uniformly treated with a paste of neat cement at the rate of one (1) kg. per Sq.M. and rubbed smooth with a trowel.

c) Coloured Plaster Finish

This shall be done in the same way as specified in Clause 2.02.02 but using Coloured cement in place of ordinary cement. When coloured plastering is specified in more than one coat, the topcoat only shall be made with coloured cement.

Coloured cement shall be either ready mixed material or may be obtained by mixing pigments and cement at site, as approved by the Engineer. The pigments to be mixed with cement shall conform to Appendix-A of IS: 2114 latest editions.

Samples of colouring material shall be submitted to the engineer for approval and material procured, shall conform in all respects to the approved samples, which shall remain with the Engineer. All coloured cement and/or pigments shall be stored in an approved manner in order to prevent deteriorations.

d) Pebble-dash Finish

Mortar of required thickness consisting of 1 part cement and 4 parts sand by volume shall be applied in the usual manner as described under plastering Clause 2.02.02. While the mortar is still plastic small pebbles or crushed stone of size generally from 10mm to 20mm as approved by the Engineer shall be thrown on the plastered surface. The aggregate shall be lightly tapped into the mortar with a wood float or the flat end of oil a trowel, in order to ensure satisfactory bond between the dashing and the mortar.

e) Rough-cast Finish

A wet plastic mix of 3 parts coloured cement 6 parts sand and 4 parts aggregate by volume (gravel or crushed stone of size from 6 mm to 12 as approved by the Engineer) shall be thrown on to the wall by means of a plaster's trowel and left in the rough condition.

f) Scraped Finish

Ordinary plaster as described under Clause 2.02.02 after being leveled and allowed to stiffen for a few hours, shall be scraped with a steel straight edge to remove the surface skin. The pattern shall be as approved by the Engineer.

g) Textured Finish

Mortar consisting of 1 part cement and 3 parts sand by volume shall be applied in a manner as specified under “Plastering” Clause 2.2.2 Ornamental treatments in the form of horizontal or vertical rib texture fan texture etc. shall be applied by means of suitable tools to the freshly applied plastered surface, as approved by the Engineer.

h) Sand Faced Plaster

The plaster shall be applied in 2 coats. The first coat or the scratch coat should be approximately 14mm and shall be continuously carried out without break to the full length of wall or natural breaking points such as doors, windows, etc. The scratch coat shall be dashed on the prepared surface with heavy pressure, brought to true and even surface and then lightly roughened by cross scratch lines, to provide bond for the finishing coat. The mortar proportion for this scratch coat shall be as specified in the respective item or work. The scratch coat shall be cured for at least 7 days & then allowed to dry. The second coat shall be 6mm thick and it shall not be applied until at least 10 days have elapsed after the application of scratch coat. Before application of the second coat, the scratch coat shall be evenly damped. This coat shall be applied from top to bottom in one operation & without joints; finish shall be straight, true, & even. The mortar of this coat shall be as specified under the respective item of work. White sand for finish shall be used for the second coat & for finishing work. Sand for finish shall be of even coarse size & shall be dashed on the surface & sponged.

2.02.04

Curing

All plastered surfaces after laying shall be watered, for a minimum period of seven days, by an approved method, and shall be protected from excessive heat and sunlight by suitable approved means. Moistening shall commence, as soon as the plaster has hardened sufficiently and not susceptible to damage. Each individual coat of plaster shall be kept damp continuously, for at least two days, and then dried thoroughly, before applying the next coat.

2.03.00

Pointing to masonry

All Joints of brickwork shall be raked out to a depth of 10 mm with a hooked tool made for the purpose while the mortar is still green. The brickwork shall

then be brushed down with a stiff wire brush, so as to remove all loose dust from the joints and thoroughly washed with water. Mortar consisting of 1 part cement and 3 parts clean, sharp, well graded sand by volume shall be pressed carefully into the joints and finishes with suitably tools to shape as shown on the drawings. Any surplus mortar shall be scalped off the wall face leaving the surface clean.

The pointed surface shall be kept wet for at least three days for curing.

2.04.00 Plaster with Metal Lath

The supports, hangers, brackets, cleats etc. shall be as shown on drawings and/or as approved by the Engineer. These shall have a coat of prime paint before and another coat of approved paint after erection.

The metal lath shall be expanded metal, with 12 mm x 38 mm mesh, 16 thick and 3 mm wide strands. Side laps shall be minimum 12 mm and end laps 25 mm minimum. The plastering shall be minimum 20 mm thick measured from the back of lath and applied in two-layers. The mortar for plastering shall consist of 1 part cement and 4 parts sand by volume mixed as specified in plastering, Clause 2.02.01. The application, finish etc. shall be as specified under relevant clause above. Where called for a 2 mm Plaster of Paris punting shall be applied over plaster as a finishing coat to give perfectly smooth and even finish.

2.05.00 Lime Punning

For plastered surfaces, where an even smooth surface is specified, lime punning with 5 parts of shell lime properly slaked, strained and aged, mixed with 1 part clean, washed, sieved, fine sand by volume shall be done. The thickness of lime punning shall be not less than 2 mm and more than 3 mm. The plastered surface shall be saturated with water before application of the lime punning. The punting shall be applied by skilled workman and given a smooth and even finish free from undulations, cracks etc. and to the satisfaction of the Engineer.

2.06.00 Plaster of Paris Punning

Plastered surfaces, where specified shall be finished with Plaster-of-Paris punning. The material shall be from approved manufacturers and approved by the Engineer. The thickness of the punning shall be 2 mm and shall be applied by skilled workmen. The finish shall be smooth, even and free from undulation, cracks etc.

Before bulk work is taken in hand, a sample of punning shall be done on roughly 10 Sq.M. areas and approval of the Engineer taken. The work shall

then be taken in hand as per approved sample.

2.07.00

Stone Facing

Stone facing where specified shall be done as shown on design drawings and approved shop drawings. The stone shall be as specified on drawings. Samples of stone shall be submitted to the Engineer for approval and then bulk purchase made. The Contractor shall submit three copies of shop drawings for the Engineer's approval before commencing the work.

The thickness of facing stone shall be not less than 25 mm unless otherwise specified on drawings.

The stone slabs shall be cut and finished to sizes as per pattern shown on drawings. They shall be fastened to wall with suitable non-corrodible anchorage as approved by the Engineer. Where mild steel clamps, stays etc. are used for anchorage, they shall be galvanized (weight of zinc coating shall not be less than 700 gms per square meter of surface) to prevent rust stains developing on the finished surface. There shall be at least 12 mm gap between the stone and masonry, which shall be filled up and packed by a mortar of 1 part cement and 3 parts of sand by volume. After the mortar is set and cured for at least four days, the exposed surface shall be rubbed and polished as approved by the Engineer.

The completed surface shall be neat, or uniform texture and acceptable to the Engineer.

Where pointing is specified on drawings it shall be done by mortar as specified on drawings.

3.00.00

ACCEPTANCE CRITERIA

Finish to masonry and concrete shall fully comply with the Specifications, approved samples and instructions of the Engineer with respect to lines, levels, thickness, colour, texture, pattern and any other special criteria as mentioned in the body of the specification or as shown on drawings.

4.00.00

I.S. CODE

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.



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IS: 1661: Code practice for cement and cement-lime plaster finish on wall & ceilings.

IS: 4101: code of practice for external facings and veneers.

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall also include providing, dismantling and removing of scaffolding, surface preparation, curing and all type of surface, shapes/ profiles and at all elevations.

5.02.00 Measurement

All plastering shall be measured net (on surface area on which it is applied) in Sqm. Plaster work shall be classified according to the type used and shall be measured separately. Plaster on ceiling and walls shall be measured separately. Soffits of stairs shall measured as plastering on ceiling.

No deduction shall be made for opening not exceeding 0.5 Sqm and for ends of beams, joints, etc. also no payment shall be made for reveals, jams, soffits, sills of these openings.

50% deduction shall be made for opening exceeding 0.5 Sqm but not exceeding 3.0 Sqm each and no addition shall be made for reveals, jams, soffits, sills etc.

In case of opening exceeding 3.0 Sqm each, deduction shall be made for opening but jams, soffits, and reveals shall be measured and paid for.



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PAINTING, WHITEWASHING, POLISHING

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Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



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PAINTING, WHITE WASHING, POLISHING, ETC.

1.00.00 SCOPE

This section covers painting, white washing, varnishing, polishing etc. of both interior and exterior surfaces of wood work, masonry, concrete plastering, plaster of paris, false ceiling, structural and other miscellaneous steel items, rain water down comer, floor and roof drains, soil, waste and service water pipes, and other ferrous and non-ferrous metal items.

Copper, bronze, chromium plate, Nickel, stainless steel and aluminium shall generally not be painted or finished except if otherwise specified.

Before commencing painting, the Contractor shall obtain the approval of the Engineer in writing regarding the schedule of work to minimize damage; disfiguration or staining to work of other trades or other installations.

2.00.00 INSTALLATION

2.00.01 Materials

Materials shall be highest grade products or well-known approved manufacture and shall be delivered to the site in original sealed containers, bearing brand name, manufacturer's name and colour shade, with labels intact and seals unbroken. All materials shall be subject to inspection, analysis and approved by the Engineer. It is desired that materials of one manufacturer only shall be used as far as possible and paint of one shade is obtained from the same manufacturing batch. Each and every supply of primer, finish paint etc. shall be accompanied by manufacturer's test certificate. All paint shall be subject to analysis from random samples taken at site from painters bucket, if so desired by the Engineer.

All prime coats shall be compatible to the material of the surface to be finished as well as to the finished coats to be applied.

All unspecified materials such as snellac, turpentine or linseed oil shall be of the highest quality available and shall conform to the latest IS standards. All such materials shall be made by reputable recognized manufacturers and shall be approved by the Engineer.

All colours shall be as per painting schedule and tinting and matching shall be done to the satisfaction of the Engineer. In such cases, where samples are required, they shall be executed in advance with the specified materials for the approval of the Engineer.



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a) White Wash/Colour Wash

Shall be done from pure shell lime or fat lime, or a mixture of both as instructed by the engineer, and shall conform to IS: 712 latest editions. Samples of lime shall be submitted to the Engineer for approval, and lime as per approved sample shall be brought to site in unslaked condition. After slaking, it shall be allowed to remain in a tank for two days and then stirred up with a pole, until it attains the consistency of thin cream. 100 grams of gum to 6 liters of white wash water and a little of indigo or synthetic ultramarine blue shall be added to the lime. Mineral colour not affected by lime shall be added to white wash to get the required tint/shade approved by the Engineer.

b) Dry distemper

Shall be made from suitable pigments, extenders, lime proof tinters, water-soluble binders etc. and shall conform to IS: 427. The distemper shall be diluted with prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for a day's work shall be prepared.

c) Oil Bound Washable Distemper

Shall be of oil emulsion type containing suitable preservatives and shall conform to IS: 428. The distemper shall be diluted with prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for a day's work shall be prepared.

d) Waterproof Cement Paint

Shall be made from best quality white cement and lime resistant colours with accelerators, waterproofing agents and fungicides. The paint shall conform to IS: 5410.

e) Acrylic Emulsion Paint

Shall be water-based acrylic copolymer emulsion with rutile titanium dioxide and other selected pigments and fungicide conforming to IS: 5411 (Part-1). It shall exhibit excellent adhesion to plaster and cement surface and shall resist deterioration by alkali salts. The paint film shall allow the moisture in wall to escape without peeling or blistering. The paint, after it is dried, shall be able to withstand washing with mild soap and water without any deterioration in colour, or without showing flaking, blistering, or peeling.



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f) Synthetic Enamel Paint

Shall be made from synthetic resins and drying oil with rutile titanium dioxide and other selected pigments to give a smooth, hard, durable and glossy finish to all exterior and resist interior surfaces. White and pastel shades shall not yellowing and darkening with aging. The paint shall conform to IS: 2932 and IS: 2933.

g) Aluminium Paint

Shall be in two pack containers and shall resist weathering. The paint shall conform to IS: 2339.

h) Varnishing

Shall be best quality alkyd varnish suitable for brushing over the tint of paint or light natural wood and shall not darken or yellow with age.

i) French Polish

Shall be made from best quality shellac, denatured spirit and other suitable alcohol soluble ingredients and made by a well known approved manufacturer. The material shall conform to IS: 348.

French polish shall not be used on bare wood it shall only be used as finishing coat on wood after the woods pretreated with a liquid wood filler conforming to IS: 345 is applied and rubbed out.

j) Bitumen paint (black bituminous anti-corrosive paint)

Bitumen based anti-corrosive paint conforming to IS: 158 shall be used.

2.00.02

Storage

The Contractor shall arrange for safe and proper storage of all materials and tools. The storage space if allotted within the building shall be adequately protected from damage, disfigurement, & stains. Paint shall be kept covered at all times and mixing shall be done in suitable containers. All necessary precautions shall be taken by the contractor to prevent fire.

2.01.00

Preparation of surface

Before starting the work the Contractor shall obtain the approval of the Engineer regarding the soundness & readiness of the surface to be painted on.



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2.01.02 Wood

All surfaces shall be free from, dirt and loose or peeling paints. The surface shall be rubbed down smooth. All nails & screws shall be sunk below the surface and filled with putty after applying an under coat. Small knots that do not justify cutting and sap streaks shall be covered with minimum 2 coats of pure shellace coating applied thinly & extended 25 mm beyond the area. All large, loose, or resinous knots shall be removed and filled with sound wood. All work shall be done as per IS: 2338.

2.01.02 Masonry, Concrete, and Plastered Surface

Surface shall be free from all oil, grease, efflorescence, mildew, loose paint, or other foreign and loose materials. Masonry cracks shall be cleaned out and patch filled with mortar similar to the original surface and uniformly textured. Where this type of resurfacing may lead to the finishing paint being different in shade from, the original surfaces, the resurfaces area shall be treated with minimum one coat of cement primer, which should be continued to the surrounding area for a distance of minimum 100 mm.

Surface with **Mildew or Efflorescence** shall be treated as below:

All mildewed surfaces shall be treated with an approved fungicide such as ammoniacal wash consisting of 7g of copper carbonate dissolved in 80ml liquor ammonia and diluted to water, or 2.5 percent magnesium silicofluoride solution and allowed to dry thoroughly before paint is applied.

2.01.03 Metal

The surface preparation shall be done in accordance with IS:1477(Part-1) 'Code of practice for painting of ferrous metals in building' and as directed by Engineer. All metal surfaces shall be absolutely clean, dry, and free from rust, scales, weld slag, flux deposit, wax, grease, dried soap films, foreign matters like cement mortar etc and free from existing loose red oxide zinc chromate primer and should be removed by means of wire brushes, hand scrappers, sand paper, emery cloth, emery papers, or by mechanical power tools etc. or as directed by Engineer. For exposed chemical resistant paints, surfaces shall be blast cleaned to near white metal. All galvanized iron surfaces shall be pretreated with a compatible primer according to the manufacturer's direction. Any abrasion in shop coat shall be touched up with the same quality of paint as the original coat. The actual painting work should be commenced only after obtaining clearance from the Engineer regarding proper cleaning of the surface.



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2.02.00 Application

2.02.01 General

The method of application shall be as recommended by the manufacturer. In case of selection of special shades and colour (not available in standard shades) the Contractor shall mix different shades and prepare test panels of minimum size 1 meter square as per instruction of the Engineer and obtain his approval prior of application of finishing paints.

Proper tools and implements shall be used. Scaffoldings used shall be independent of the surface to be painted to avoid shade differences of the freshly repaired anchor notes.

Painting shall be done by skilled labours in a workmanlike manner. All materials shall be evenly applied so as to free of sags, runs, crawls, or other defects. All coats shall be of proper consistency. In case of application by brush, no brush marks shall be visible. The brushes shall be clean and in good condition before application of paint.

All priming undercoat for painting shall be applied by brush only, and rollers spray equipments etc. shall not be used.

No work shall be done under conditions that are unsuitable production of good results. No painting shall be done when plastering is in progress or is drying. Application of paint, which seals the surfaces to moisture shall only be done after the moisture on and below the surface has dried out.

All coats shall be thoroughly dry before succeeding coat is applied. Coats of painting as specified are intended to cover surfaces perfectly. In case the surface is not covered properly by applying the specified number of coats, further coats shall be applied by the Contractor when so desired by the Engineer.

All primers and undercoats shall be tinted to approximate the colour of the finishing coats. Finished coats shall be of exact colour and shade as per approved samples and all finish shall be uniform in colour and texture. All parts of mouldings and ornaments shall be left clean and true to finish.

Painting on ferrous metal surface shall, be done as per IS: 1477 (Part I & 2). The total dry thickness of film should not be less than 120 Micron.

2.02.02 White Washing

The surface where white washing is to be applied shall be cleared of all loose materials and dirt. All holes and irregularities of the surface shall be filled up



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with lime putty and shall be allowed to dry up before white washing.

One coat of whitewash shall consist of one stroke from top downwards, another from bottom upwards over the first stroke and another from left to right before the previous one dries up. Second coat shall be applied and in case the Engineer feels that one or more coats are required the Contractor shall do so without any extra cost to the Owner. No brush marks shall show on the finished surface.

2.02.03 Dry Distemper

New plastered surface shall be allowed to dry for at least two months. New lime or lime cement plastered surface shall be washed with a solution of 1 part Vinegar to 12 parts water or 1:50 sulphuric acid solution and for 24 hours after which the wall shall be thoroughly washed with clean water. For cement-plastered surface, the surface shall be washed with solution of 100 gms. of zinc sulphate to 1 litre of water and allowed to dry.

Dry distempering shall be done as per manufacturers instruction. In applying the distempers the brush, should first be applied horizontally and immediately crossed off perpendicularly. Brushing shall not be continued too long, otherwise brush marks may result.

2.02.04 Oil bound washable distemper

The distemper shall be applied after surface is primed with an alkali resistant primer, and followed by minimum two coats of oil bound washable distemper all as per manufacturer's instruction.

2.02.05 Waterproof Cement Paint

Surface to be coated with cement paint shall be washed and brushed down. As soon as the moisture has disappeared, the surface shall be given one coat of paint. Care shall be taken so that the paint does not dry out too rapidly. After 4 to 6 hours, the water shall be sprinkled over the surface to assist curing and prevent cracking. After the first coat has dried (24 to 48 hours) the second coat shall be applied in a similar manner. The finished surface shall be kept moist by occasional sprinkling with water for seven days after painting.

2.02.06 Acrylic Emulsion Paint

Paint shall be applied after providing one coat of cement primer solvent of approved quality and primer shall be conform to IS: 109. Lime gauged cement plastered surfaces shall not be painted for at least one month after plastering. A sample patch shall be painted to check alkali reaction if so desired by the Engineer. Painting shall be done strictly as per manufacturer's specification.



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2.02.07 Synthetic Enamel Paint

Shall be applied on properly primed surface. Subsequential coat shall not be applied till the previous coat is dry. The previous shall be lightly sand papered for better adhesion of subsequent coats.

2.02.08 Aluminium Paint

The paint, supplied in two pack containers shall be mixed and applied strictly as per manufacturer's direction. When more than one coat of paint is required or indicated, the next coat shall only be applied after the previous coat become hard dry.

2.02.09 Clear Synthetic Varnish

The Varnish shall be applied on wood surface after (a) filling, (b) staining & (c) sealing operations are carried out. The application of a combination of filler and stain shall not be permitted.

For the finishing coats of varnish, the surface shall be allowed to dry and be rubbed down lightly, wiped off and allowed to dry. Careful attention to cleanliness is required for varnishing. All dust and dirt shall be removed from the surface as well as from the neighbourhood. Damp atmosphere and draughts shall be avoided, and exposure to extreme heat or cold & dampness shall not be allowed.

The varnish shall be applied liberally with a brush and spread evenly over a portion of the surface with light strokes to avoid frothing. It shall be allowed to flow on white the next section is being laid on excess varnish shall then be scrapped off the brush and the first section be crossed, recrossed and then laid off lightly. The varnish once it has begun to set shall not be retouched. In case of any mistake in application, the varnish shall be removed and the work started afresh.

The varnish shall be minimum of two coats, with the first coat being a flatting varnish. This shall be allowed to dry hard and be flatted down, before applying the next coat. Sufficient time must be allowed between coats to get a hard dry surface before next coat is applied. All work shall be as per relevant IS Code.

2.02.10 French polish

All unevenness of the surface shall be rubbed down to smoothness with sand paper and the surface shall well dusted .The pores in the shall be filled up with



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a paste of whitening in water or methylated spirit with a suitable pigment like burnt siemme or umber.

After application of the filler paste, the French polish shall be applied with a pad of woollen cloth covered by a fine cloth. The pad shall be moistened with polish and rubbed hard on the surface in a series of overlapping circles so that the polish is sparingly but uniformly applied over the entire area to give an even surface. A trace of linseed oil may be used on the pad for case of application. The surface shall be allowed to dry before further coats are applied in the same manner. To finish off, the pad shall be covered with a fresh piece of clean fine cloth, slightly damped with methylated spirit, and rubbed lightly and quickly with circular motions to leave the finished surface with a uniform texture and high gloss.

2.02.11 Chemical Resistant Paint

For chemical resistant paints, epoxy, chlorinated rubber, or vinyl butryl paint system shall be used. Manufacturer's recommendation shall be followed regarding the paint system, exposed to moderately to severe corrosive condition and subject to acid/alkali spillage & fumes, shall be followed.

2.03.00 Protection

Furniture and other movable objects, equipment, fittings and accessories shall be moved, protected and replaced upon completion of work. All stationary equipment shall be well covered so that no paint can fall on them. Work finished by other agencies shall be well protected. All protections shall be done as per instructions of the Engineer.

2.04.00 Cleaning up

In addition to provisions in general conditions the Contractor shall, upon completion of painting etc. remove all marks and make good surfaces, where paint has been splashed or splattered, including all equipment, fixtures, glass, furniture, fittings etc. to the satisfaction of the Engineer.

3.00.00 ACCEPTANCE CRITERIA AND TESTING

- a) All painted surfaces shall be uniform and pleasing in appearance.
- b) All varnished surfaces shall be of uniform texture and high glossy finish.
- c) The colour, texture etc. shall match exactly with those of approved samples.
- d) All stains, splashes, and splatters of paints and varnishes shall be removed from surrounding surfaces.



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Testing

- a) As, each part of the work is under progress, i.e. preparation of surface, providing primer, providing different coats of finishing paints, it shall be passed by the Engineer. Variation from the drawings or specification or standard etc. shall not be accepted. The Contractor shall ascertain from the Engineer as to which parts will be inspected and passed from time to time. The Contractor shall provide all necessary arrangement for inspection of the painting work during its different working phase. The Contractor shall provide necessary scaffolding, approach for inspection of the above as per direction and satisfaction of the Engineer. All the necessary cost for scaffolding, approach, platform, lighting arrangement testing and inspection shall be borne by the Contractor. Such inspection and testing will not, however, exonerate the Contractor from his responsibilities for proper workmanship, material etc.
- b) The Contractor shall carry out all sampling and necessary testing in accordance with the relevant Indian Standards and shall conduct such tests as called for by the Engineer. Where no specific testing procedure is mentioned in the relevant codes, the tests shall be carried out as per the prevalent accepted Engineering practice as per the direction of the Engineer. Tests shall be done in a laboratory, approved by the Engineer, and cost of testing shall be borne by the contractor.
- c) Material/workmanship unsuitable for acceptance shall be removed and replaced by the Contractor. The work shall be redone as per Specification of the contract and direction of the Engineer without extra cost to owner.

4.00.00

I.S. CODE

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS: 348	Specification for French polish
IS: 427	Specification for Distemper, dry colour as required.
IS: 428	Specification for Distemper oil emulsion, colour as required.
IS: 1477 (I & II)	Code of Practice for painting of ferrous metal in buildings.



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POLISHING**

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- IS: 2338 Code of Practice for finishing of wood and
(I & II) wood based materials.
- IS: 2339 Specification for Aluminium, Paints for general purposes in
dual containers.
- IS: 2395 Code of Practice for painting concrete, masonry, and Plaster
surface.
- IS: 2932 Specification for enamel, exterior type-1.
- IS: 5410 Specification for cement paint, colour as required.

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall be unit rates for complete items described in the “Schedule of Items”.

Rate shall include cleaning, preparation of surface, supply and application of primer, painting and providing all protection and scaffolding required at site.

5.02.00 Measurements

Painting over the concrete/masonry/wooden surface shall be measured net (on the surface area on which it is applied) in Sqm.

No deduction shall be made for opening not exceeding 0.5 Sqm and ends of beams, joints, etc. also no payment shall be made for reveals, jams, soffits, sill of these openings.

50% deduction shall be made for opening exceeding 0.5 Sqm but not exceeding 3.0 Sqm each and no addition shall be made for reveals, jams, soffits, sills etc.

In case of opening exceeding 3.0 Sqm each, deduction shall be made for opening but jams, soffits, and reveals shall be measured and paid for.

Corrugated surfaces shall be measured flat and measured area shall be increased by 15%.

Painting of structural steel works shall be measured in M.T. of fabricated steel (as per section D-17 clause 6.02.00 i.e Mode of measurement of technical specification for fabrication of structural steel works) unless specified otherwise.



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FLOOR FINISH AND ALLIED WORKS

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Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



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FLOOR FINISH AND ALLIED WORKS

1.00.0

SCOPE

This section covers furnishing, installation, finishing, curing, testing, protection, maintenance till handing over various types of floor finishes, and allied items of work as listed below

a) In Situ Finishes

- i) Integral finish to concrete base
- ii) Terrazzo finish
- iii) Granolithic finishes
- iv) Patent Stone
- v) Metallic Hardener like “Ironte”/Hardonate Finish
- vi) Mastic Asphalt finishes
- vii) Chemical Resistant finish

b) Tiled Finishes

- i) Terrazzo tile
- ii) Chequered tile
- iii) Glazed tile
- iv) Tesse rae (Mosaic etc.)
- v) Chemical Resistant
- vi) Rubber, Vinyl etc.
- vii) Stone Slab including Kota Stone.

1.01.00

Base

The base to receive the finish is covered under other relevant specifications.



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1.01.01 Sequence

Commencement, scheduling and sequence of the finishing works shall be planned in detail and must be specifically approved by the Engineer in view the activities of other agencies working in that area. However, the Contractor for the finishing items shall remain fully responsible for all normal precautions and vigilance to prevent any damages whatsoever till handing over.

2.00.00 INSTALLATION

2.00.01 Special Materials

Basic materials are covered elsewhere under the Specification. In general, all such materials shall be as per relevant Codes where available. In all cases these materials shall be of the best quality available indigenously unless specified otherwise.

The materials for finishing items must be procured from well-reputed specialized manufacturers and on the basis of approval of samples by the Engineer. The materials shall be ordered, procured and stored well in advance to avoid compulsion to use substandard items to maintain in the construction schedule.

2.00.02 Workmanship

Only workers specially experienced in particular items of finishing work shall be engaged, where such workers are not readily available, with the Engineer's permission, experienced supervisors recommended by the manufacturer shall be engaged. In particular cases where the Engineer so desires the Contractor shall get the finishing items installed by the manufacturer.

2.00.03 Preparation of the Base Surface

The surface to be treated shall be thoroughly examined by the Contractor. Any rectification necessary shall be brought to the notice of the Engineer and his approval shall be taken regarding method and extent of such rectification work.

For all types of flooring, skirting, dado and similar locations, the base to receive the finish shall be adequately roughened by chipping, raking out joints and cleaning thoroughly all dirt, grease etc. with water and hard brush and detergent if required, unless otherwise directed by the manufacturer of any special finishing materials or specifically indicated in this specification.



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To prevent of water from the finishing treatment the base shall be thoroughly soaked with water and all excess water mopped up.

The surface shall be bone dry where adhesives are used for fixing the finishes.

Prior to commencement of actual finishing work the approval of the Engineer shall be taken as per the acceptability of the surface.

2.01.00 In Situ Finishes

2.01.01 Integral Finish To Concrete Base

While the surface of the concrete laid as per specification for 'Cement Concrete' has been fully compacted and levelled but the concrete is still 'green' thick slurry, made with neat cement shall be applied evenly and worked in with iron floats. When the slurry starts to set it shall be pressed with iron floats to have a firm compact smooth surface without trowel mark or undulations. This finish shall be as thin as possible by using 2.2 kg. of cement per Sq.M. of area.

The surface shall be kept in shade for 24 hours and then cured for at least 7 days continuously by flooding with water. The surface shall not be subjected to any load or abrasion till 21 days after lying.

As desired by the Engineer the surface, while still 'green' shall be indented by pressing strings, the marking shall be of even depth, in straight lines and the panels shall be of uniform and symmetrical patterns.

2.01.02 Terrazzo Finish in Situ

It shall consist of an underbed and a topping laid over an already laid and matured concrete base.

a) Thickness

Unless otherwise specified the total thickness of the 'finish shall be minimum 40 mm for horizontal and 25 mm for vertical surface of which the topping shall be not less than 10 mm. While the topping shall be of uniform thickness the underbed may vary in thickness to provide necessary slopes. The vertical surface shall project out 6 mm from the adjacent plaster or other finish. Necessary cutting into the surface receiving the finish shall be done to acc ate the specified thickness. All junctions of vertical with horizontal shall be rounded neatly to uniform radius of 25 mm.

b) Mix

i) Underbed



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The underbed for floors and similar horizontal surfaces shall consist of a mix of 1 parts cement, 1½ parts sand and 3 parts stone chips by volume. For vertical surfaces the mix shall consist of 1 part cement to 3 parts sand by volume. The sand shall be coarse. The stone chips shall be 10 mm down well graded. Only sufficient water to be added to give a workable consistency.

ii) Topping

The mix for the topping shall be composed of cement, colour Pigment, marble dust and marble chips. Proportions of the ingredients shall be such as to produce the terrazzo of colour texture and pattern approved by the Engineer. The cement shall be white or gray or a mixture of the two to which pigment shall be added to achieve the desired colour. To 3 parts of this mixture 1 part marble powder by volume shall be added and thoroughly mixed dry. To 1 part of this mix 1 to 1½ parts of marble chips by volume shall be added and thoroughly mixed dry again.

The pigment must be stable and nonfading. It must be very finely ground. The marble powder shall be from White marble and shall be finer than IS Sieve No.: 30. The size of marble chips shall be between 1 mm to 20 mm. Sufficient quantity to cover each visible area shall be prepared in one lot to ensure uniform colour. Water to make it just workable shall be added to a quantity that can be used up immediately before it starts to set.

c) Laying

The underbed shall be laid in panels. The panels shall not be more than 5 Sq.M. in area of which no side shall be more than 2.5 M. long. For exposed locations the maximum area of a panel shall be 2.0 Sq.M. The panel shall be laid in alternate bays or chequered board pattern. No panel shall be cast in contact with another already laid until the latter has contracted to the full extent.

Dividing strips made of aluminium or glass shall be used for forming the panels. The strips shall exactly match the total depth of underbeds plus topping.

After laying, the underbed shall be levelled compacted and brought to proper grade with a screed or float. The topping shall be laid after about 24 hours while the underbed is still somewhat "green" but firm enough to receive the topping. A slurry of the mixture of cement and pigment already made shall be spread evenly and brushed in just before laying the topping. The topping shall be rolled for horizontal areas and thrown and pressed for vertical areas to



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extract all superfluous cement and water and to achieve a compact dense mass fully bonded with the underbed. The surface of the topping shall be trowelled over, pressed and brought to a smooth dense surface showing a minimum 75% area covered by marble chips in a even pattern of distribution.

d) Curing

The surface shall be left for curing for about 12 to 18 hours and then cured by allowing water to stand on the surface or by covering with wet sack for four days.

e) Grinding and Polish

When the surface has sufficiently hardened it shall be watered and ground evenly with rapid cutting coarse grade (no.80) grit blocks, till the marble chips are exposed and the surface is smooth. Then the surface shall be thoroughly washed and cleaned. A grout with already prepared mixture of cement and pigment shall be applied to fill up all pinholes. The surface shall be cured for 7 days by keeping it moist and then ground with fine grit blocks (no.: 120). It shall again be cleaned with water, the slurry applied again to fill up any pinholes that might have appeared and allowed to be cured again for 5 days. Finally, the surface is ground a third time with very fine grit blocks (no.: 320) to get smooth surface without any pinhole. A suitable machine shall do the grinding. Where grinding machine can not be used hand grinding may be allowed when the first rubbing shall be with carborundum stone of coarse grade (no.:60), second rubbing with medium grade (no.: 80) and final rubbing and polishing with fine grade (no.: 120). The surface shall be cleaned with water, dried, and covered with soil free, clean sawdust if directed by the Engineer. The final polishing shall be postponed till before handing over if desired by the Engineer. Just before handing over the surface shall be dusted with oxalic acid at the rate of 0.33 gm. per. Sq.M., water sprinkled on to it and finished by buffing with felt or hessian bobs. The floor shall be cleaned with soft moist rag and dried. However, all excess wax polish to be wiped off and the surface to be left glossy, but not slippery.

2.01.03

Granolithic Finish

Granolithic finish shall either be laid monolithically over base concrete or separately over hardened base concrete.

a) Thickness

The finish shall be average 20 mm and minimum 12 mm thick, unless specified otherwise.

b) Mix



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The mix shall consist of 1 part cement: 1 part coarse sand 2 parts coarse aggregate by volume. The coarse aggregate shall be very hard like granite and well graded between 6 mm and 12 mm. Minimum quantity of water to get workability shall be added.

c) Laying of Monolithic Topping

The concrete base shall be laid as per specification "Cement Concrete" and levelled upto the required grade. The form shall remain sufficiently protruding to take the finish.

Within about 3 hours of laying the base while it is still fully -green- the topping shall be laid evenly to proper thickness and grade. If considered necessary the surface of the base shall roughened by wire brushing. Unless manual operation is permitted by the Engineer, mechanical vibrators of suitable design shall be used to press the topping firmly and work vigorously and quickly secure full bond with concrete base.

The laitance brought to the surface during compression shall be removed carefully without disturbing the stone chips. The surface shall then be lightly trowelled to remove all marks. When sufficiently set, hand trowelling shall be done to secure a smooth surface without disturbing the stone chips.

For large areas the laying shall be in panels of maximum 25 Sq.M. area. The panels shall be laid in chequered board pattern.

d) Laying of Topping Separately on Hardened Base

The base concrete shall be prepared as stated in clause 2.00.03 and a slurry of neat cement applied just prior to laying the granolithic concrete mix (1:1:2). The method of compaction etc. shall be same as for monolithic topping.

Curing

Immediately after laying, the finish shall be protected against rapid drying. As soon as the surface had hardened sufficiently, it shall be kept continuously moist for at least 10 days by means of wet gunny bags or ponding of water on the surface. The floor shall not be exposed to heavy traffic during this period.

f) Grinding

If grinding is specified, it shall start only after the finish has fully set. Clause 2.01.02 (e) shall be followed. However, the Engineer shall decide upon the ultimate polish required.



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g) Finishing

Where specified, sodium, silicate or magnesium or zinc silico fluoride treatment shall be done. The number of coats to be applied shall be as per approved drawings or as instructed. The concentration and method of application of the solutions shall be as specified in IS: 5491.

2.01.04

Patent Stone

It shall consist of an underbed and a topping laid on an already laid and matured concrete base.

a) Thickness

The patent stone finish shall have thickness as stipulated under clause 2.01.02 (a) except that the topping shall be 12 mm thick.

b) Mix

i) Underbed

The mix shall be as stipulated under clause 2.01.02 (b).

ii) Topping

The mix for the topping shall consist of 1 part cement and 2 part stone aggregate 6mm nominal size by volume.

c) Laying

The Patent Stone finish including the underbed shall be laid in alternate bays or in Chequered board pattern. No panel shall be cast in contact with another already laid till the contraction of the latter has already taken place.

The maximum area of each panel shall be 3 Sq.M. of which no side shall be more than 2 M. long.

A cement grout shall be applied and worked into the surface to receive the finish; the underbed then laid, compacted, and leveled to proper grade with a screed or float. The topping shall be applied evenly on the underbed while it is not fully set but firm enough and rolled and pressed to get full bond. The topping shall be trowelled to a dense finish to the satisfaction of the Engineer. All trowel marks shall be mopped out with a soft cloth to give a clean smooth surface.



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After the surface is sufficiently set, the finished floor shall be kept moist for 7 days for curing. If desired the finish shall be polished as directed by the Engineer.

2.01.05 Metallic Hardener Like 'Ironite'/'Hardonate' Finish

This will consist of a topping (incorporating iron particles) to bond with concrete base while the latter is 'green'.

a) Thickness

Unless otherwise specified the metallic hardener finish shall be of 12 mm depth.

b) Material

The hardening compound shall be uniformly graded iron particles free from non-ferrous metal impurities, oil, grease, sand soluble alkaline compounds or other injurious materials when desired by the engineer, actual samples shall be tested.

c) Mix

Proportion of the metallic hardener shall be as specified or as indicated by the manufacturer. However, in absence of any such direction 1 part metallic hardener shall be mixed dry, with 4 parts cement, by weight. To this mixture 6 mm nominal size stone chips shall be added in proportion of 1 part cement (mixed with hardener) to 2 parts of stone chips by volume and uniformly mixed. Minimum quantity of water shall be added to make it workable.

d) Laying

The concrete floor shall be laid as per specification 'Cement Concrete' and levelled upto required grade. The forms, if any, shall remain sufficiently projecting to make the finish. The surface shall be roughened by wire brash as soon as possible.

The finish shall be laid while the concrete underbed is still very 'green' within about 3 hours of laying of the latter. The finish shall be of uniform thickness and even dense surface without trowel marks, pin holes etc. This topping layer shall be pressed firmly and worked vigorously and quickly to secure full bond with the concrete base. Just when the initial set starts the surface shall be finished smoothened with steel trowel.



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The finished floor shall be cured for 7 days by keeping it wet.

2.01.06 Mastic Asphalt Finish

This is a one-layer treatment on concrete or brick base.

a) Thickness

The thickness shall be as specified in the drawing.

b) Materials

Bitumen shall be industrial Bitumen of the grade 90/15 and 75/15 conforming to IS: 702.

Mineral filler shall be dry stone dust passing through 75 micron IS Sieve.

Fine aggregate shall be crushed and graded natural limestone or other hard work.

Coarse aggregate shall be crushed siliceous stone or other approved aggregate 6 mm stone chips shall be used for finish upto 20 mm thick & 10 mm chips for thicker finish.

c) Composition

Bitumen mastic shall conform IS: 1195 and shall be either brought to site in blocks weighing about 25 Kg or prepared at site. If brought in blocks, these shall be remelted in mechanically agitated mastic cookers and coarse aggregate, preferably preheated fed in successive portions until the complete change is thoroughly, incorporated. At no stage during the remelting and mixing process, shall the temperature exceed 205°C.

d) Laying

The hot mastic shall be laid on dry base surface cleaned thoroughly by wire brushing and sweeping. The mastic shall be leveled and when cooled to some extent shall be finished with a wooden float with addition of small quantity of fine sand if required. No load shall be allowed till the finish has cooled to normal temperature.



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The mastic shall be laid in suitable panels of about 1.5 Sq.M. in area each formed by formers. Succeeding panels shall be laid overlapping the finish panel so as to melt its edges and form a continuous finish without joint.

2.01.07 Chemical Resistant in Situ Finish

Chemical resistant in situ finish shall be as epoxy resin with suitable filler material over a primer. The minimum thickness shall be 6 mm. About its performance the Engineer shall have to be fully satisfied by test results and examination of similar treatment already in existence. The contractor shall get it done by a specialized Manufacturer and get guarantee of performance from the organization and pass it on to the Owner in addition to his own guarantee.

2.02.00 Tiled Finish

These shall include finish tiles, stone slabs, and similar manufactured or natural items over already laid and matured base of concrete or masonry by means of an underbed or an adhesive layer.

2.02.01 Terrazzo Tile Finish

The finish will consist of manufacture terrazzo and an underbed.

a) Thickness

The total thickness including the underbed shall be minimum 40 mm for floors 30 mm for walls unless otherwise specified.

The skirting, dado and similar vertical surfaces shall project out 6 mm uniformly from the adjacent plaster or other wall finishes. The necessary cutting into the surface receiving the tiled finish, to accommodate the specified thickness shall be done.

b) Tiles: Terrazzo

The tiles shall, unless specifically permitted in special cases be machine made under quality control in a shop. The tile shall be pressed hydraulically to a minimum of 140 Kg. per Sq.cm.

Each tile shall bear on its back permanent and legible trademark of the manufacturer. All angles of the tiles shall be right angles all arises sharp and true, colour and texture of the wearing face uniform throughout.

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Maximum tolerance allowance length and breadth shall be ± 1 mm and the thickness ± 3 mm. Face of the tile shall be plane, free from pinholes and other blemishes.

The tiles shall be composed of a backing and topping. The topping shall be of uniform thickness not less than 10 mm.

The total thickness including the topping shall be as specified but not less than 20 mm in any case.

The backing shall be composed of 1 part ordinary gray cement and 3 parts of stone chips by weight mixed with water.

The topping shall be as specified under clause 2.01.02 (b).

The tile shall be cured at the shop for at least 14 days before delivery to the site. First grinding shall be given to the tiles at the shop before delivery. Tiles shall be packed properly to prevent damage during transit and storage. The tiles must be carefully stored to prevent staining by damp, rust, oil, and grease or other chemicals.

Tiles made in each batch shall be kept and used separately so that colour of each area of the floor may remain uniform.

The manufacturer shall supply along with the tiles the grout mix containing cement and pigment in exact proportions as used in topping of the tiles. The containers for the grout mix shall be suitably marked to relate it to the particular type and batch of tiles.

c) **Mix: Underbed**

The underbed for floor and similar horizontal surfaces shall be 1 part lime putty: 1 part surkhi: 2 parts coarse sand by weight mixed with sufficient water to form a stiff workable mass. For skirting and dado and all vertical surfaces it shall be about 12 mm thick and composed of 1 part cement and 3 parts coarse sand by weight.

d) **Laying**

The underbed mortar shall be evenly spread and brought to proper grade and consolidated to a smooth surface. The surface shall be roughened for better bond. Before the underbed had time to set and while it is still fairly moist but firm, cement shall be hand dusted over it or a cement slurry applied and the tiles shall immediately be placed upon and firmly pressed by wooden mallet on to the underbed until it achieves the desired level. The tiles shall be kept soaked for about 10 minutes just before laying. The



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joints between tiles shall be as close as possible and not more than 1.5 mm wide.

Special care shall be taken to check the level of the surface and the lines of the joints frequently so that they are perfect.

When tiles are required to be cut to match the dimensions these shall be sawn and edges rubbed smooth. The location of cut tiles shall be planned in advance and approval of the Engineer taken.

At the junction of horizontal surface with vertical surface the tiles on the former shall enter at least 12 mm under the latter.

After fixing, the floor shall be kept moist and allowed to mature undisturbed for 7 days. Heavy traffic shall not be allowed.

If desired dividing strips as specified under Clause 2.01.02(c) may be used for dividing the work into suitable panels.

e) Grinding and Polishing

Procedure shall be same as Clause 2.01.02(e). Grinding shall not commence earlier than 14 days after laying of tiles.

2.02.02

Chequered Tile Finish

The finish shall consist of manufactured gray or coloured cement tiles or terrazzo tiles with chequered face and an underbed laid over concrete or brick surface.

a) Thickness

Thickness shall be same as in clause 2.02.01 (a).

b) Tiles: Chequered

The tiles shall have chequers not less than 2.5 cm. c/c and not more than 5 cm. c/c. Depth of grooves shall be not less than 5 mm. The grooves shall be uniform and straight.

The tiles shall conform to clause 2.02.01 (b) except that these may have the topping in terrazzo or plain gray cement or colour pigment added to cement.

c) Under-bed

As per clause 2.02.01 (c).



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- d) Laying
As per clause 2.02.01 (d).

- e) Grinding and Polishing

As per clause 2.02.01 (e) except that the tiles shall be ground and polished by hand and after laying taking special care in polishing the grooves properly and uniformly.

2.02.03

Glazed Tiles Finish

This finish shall be composed of glazed earthenware tiles with an underbed laid over a concrete or masonry base.

- a) Thickness

The total thickness shall be between 20mm and 25mm including the underbed.

The tile finish on vertical surface shall project out 6 mm uniformly from the adjacent plaster or other wall finishes. The necessary cutting into the surface receiving the finish, to accommodate the specified thickness shall be done.

- b) Tiles: Glazed

The tiles shall be of earthenware, covered with glaze white or coloured, plain or with designs, of 150 mm x 150 mm nominal sizes and 5.5 mm to 6 mm on thick unless otherwise specified. The tolerance shall be ± 1.5 mm for length and breadth and ± 0.5 mm for thickness specials like internal and external angles; beads, covers, cornices, corner pieces etc. shall match. The top surface of the tiles shall be glazed with a gloss or matt, unfading stable finish as desired by the Engineer. The tiles shall be flat and true to shape. The colour shall be uniform and fractured section shall be fine grained in textures, dense and homogeneous. The tiles shall be strong and free from flaws like cracks, craze, specks, crawlings, etc. and other imperfections. The edge and the underside of the tiles shall be completely free from glaze and the underside shall have ribs or indentations for better anchorage with the fixing mortar.

The coloured tiles, when supplied, shall preferably come from one batch to avoid difference in colour.

- c) Mix: Underbed



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The mix for the underbed shall consist of 1 part cement and 3 parts coarse sand by weight mixed with sufficient water or any other mix if specified.

- c) Laying
Same as clause 2.02.01 (d).

- e) Finishing

The joints shall be cleaned and flush pointed with white cement and cured for 7 days by keeping it wet. The surface shall be cleaned with soap or suitable detergent, washed fully, and wiped with soft cloth to prevent scratching before handing over.

2.02.04

Tesserae Finish (Mosaic etc.)

This finish consists of manufactured vitreous, glass, ceramic or similar hard small pieces set in an underbed over a concrete or masonry surface, already laid.

- a) Thickness

The total thickness including the underbed shall be between 16 mm & 25 mm.

- b) Tesserae Finish

These shall usually be 6 mm thick small piece of ceramic vitreous china, tinted glass, or similar hard wearing, strong, and durable material in desired shapes and sizes and patterns.

The supply shall come in the desired pattern in full or sections conveniently for handling, stuck to pieces of strong thick paper on the surface to be exposed. The gum used for this purpose must be water soluble and non-staining. The sections shall be properly marked to avoid mistakes and master drawing shall be available at the site for guidance.

- c) Mix: Underbed
Same as clause 2.02.03 (c)

- d) Laying

The specification for laying if given by the manufacturer of the item shall be followed provided it is approved by the Engineer. Otherwise clause 2.02.03 (d) shall generally be followed. However, instead of gray cement the slurry shall be made with white cement to fix the panels. The paper-mounted patterns in sections shall be carefully placed and pressed in position true to lines and levels. Earliest possible the paper shall be peeled



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off and surface examined and cleaned, joints flush pointed with white cement and cured for 7 days by keeping it wet.



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2.02.05 Chemical Resistant Tiled Finish

This shall include all varieties of special tiles used for specific chemical resistance function and an underbed over already laid concrete or masonry.

a) Tiles

The chemical resistant tiles shall be of the best indigenous Manufacture unless otherwise specified and shall be resistant to the chemical (both acid and alkali). The tiles shall have straight edges, uniform thickness, plain surface, uniform nonfading colour, and textures.

Usually the chemical resistant tiles shall not absorb water more than 2% by weight. The tiles shall have at least compression strength of 700 Kg/cm². The surface shall be abrasion resistant and durable.

b) Laying

The mortar used for setting or for underbed these tiles shall be durable, strong and chemical resistant epoxy mortar. The grout, which shall be to the full depth of tile, shall have equal chemical resistant properties. Joints shall be pointed if so desired. The setting and fixing shall be according to the manufacturer's specification approved by the Engineer.

2.02.06 Rubber, Vinyl, or Vinyl Asbestos Tiles Finish

This shall include various types of tiles manufactured from rubber, vinyl etc. set with an adhesive on concrete or masonry base. An underbed may be required to secure desirable surface and grade.

a) Thickness

The thickness of the tiles shall be as incorporated in drawing.

b) Tiles

Unless otherwise desired the tiles shall be squares of approved dimensions. The tolerance in dimensions shall be ± 1.5 mm.

The face of the tiles shall be free from porosity, blisters, cracks, embedded foreign matters or either physical defects which affect appearance or serviceability. All edges shall be cut true and square. The colour shall be nonfading and uniform in appearance, insoluble in water and resistant to alkalies, cleaning agents and usual floor polishes.

Each tile shall be marked on the back legibly and indelibly with



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manufacturer's trademark, the thickness, sizes, batch number, and date of manufacturer.

Tiles shall be delivered securely packed and stored in clean, dry well ventilated place at a temperature near about to that the tiles shall be called upon to stand ultimately.

Adhesive to be used for sticking the tiles shall be approved by the tile manufacturer. The adhesive shall have a short drying time and long life in addition to toughness.

c) Mix: Underbed

The underbed where required to make up the specified thickness or to give the required grade or to get the right type of surface shall be composed of 1 part like putty:1 part cement: 3 parts coarse sand mixed with just sufficient water to make it workable.

d) Laying

The tiles shall be kept in the room to be tiled for at least 24 hours to bring them to the same temperature as the room. For air-conditioned space, the air-conditioning shall be completed before tiling is taken up.

The surface to receive this finish shall be firm even textured but not too smooth, without undulations and other deficiencies. If an underbed is laid the same shall be cured for at least 7 days by keeping it moist and then fully dried.

The surface shall be thoroughly cleaned. All loose dust particles shall be removed. Oil and grease if any shall be completely cleaned by use of detergent.

The adhesive shall be applied to fully dry surface in desired thickness uniformly. The adhesive shall also be applied to the backs and edges of the tiles and allowed to surface dry. The tiles shall be placed neatly on the surface exactly to the approved pattern and set with a suitable tool. If the edges tend to curl, weights are to be used to keep the edges down. Special care shall be taken to avoid formation of air pockets under the tiles. The joints shall be very fine. Any adhesive squeezed out through the joints shall be removed immediately.

e) Finishing

If any adhesive mark is there on the surface a soft cloth soaked in solvent shall be used to wipe it off. The surface shall be cleaned with soft soap,

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dried, and polished with an approved type of polish just before handing over.

2.02.07

Stone Slab Finish: Marble, Stone, and Similar Fine Grained Stone including Kota stone

a) Thickness

The underbed shall be minimum 12 mm and average 20 mm thick. The slabs will be 20 mm thick.

b) Stone Slab

The stone slabs shall be made from selected stock, which is hard, sound, homogeneous and dense in texture and free from flaws. Angles and edges shall be true, square, and free from chipping and surface shall be plane. The slabs shall preferably be machine cut to the required dimensions. Tolerance of ± 5 mm in dimensions and ± 2 mm in thickness will be allowed. Unless specified the slabs shall be minimum 300 mm x 300 mm.

The stone slabs shall come from specific regions and in specified quality with top surface fine chisel dressed. All sides shall also be fine chisel dressed to the full depth to allow finest possible joints.

The slabs shall be delivered to the site well protected against damages and stored in dry place under cover.

c) Mix: Underbed

Same as clause 2.02.01 (c).

d) Laying

The sides and top surface of the slabs shall be machine rubbed or table rubbed with coarse sand stone and washed before laying.

The underbed mortar shall be evenly spread and brought to proper level on the area under each slab. The slab shall be laid over the underbed, pressed, and tapped down with wooden mallet to the proper level. The slab shall then be lifted and the underbed corrected as necessary and allowed to stiffen a little. Next, thick cement slurry shall be spread over the surface. The edges of the slab shall be buttered with slurry of cement, gray / white / mixed with pigment matching the colour of the stone slabs. The slab shall be gently laid and tapped with wooden mallet to bed properly to a very fine joint and to the required level. All surplus cement slurry shall be removed and the surface mopped clean with wet soft cloth. The laid finish shall be cured for 7 days by keeping it wet.



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e) Polishing, Finishing

Fine chiselling shall be done to remove the slight undulations that usually exist at the joints. The polishing and finishing shall be done as specified under clause 2.02.01 (e). However, the joints shall be so fine in the case of stone slabs that grouting shall not be called for.

2.02.08 Stone Slab Finish: Sand Stone and Similar Coarse Grained Stone Finish

Generally clause 2.02.07 shall be followed except that the workmanship and finish shall not be fine as which are explained hereunder.

The slabs shall be rough chiselled or fine chiselled as specified. Tolerance may be allowed upto ± 6 mm for rough finish, but no sharp unevenness and shall be allowed. For fine chiselling the unevenness shall be limited to ± 2 mm. The sides shall be chisel dressed at least to half slab depth so that the maximum deviation from straight line shall be within 25 mm. Beyond this depth the edge may be slightly splayed.

The joint thickness shall be kept limited to 5 mm in case of rough finish and 3 mm in case of fine finish unless wider joints are specified. The joints shall be grouted with white or coloured cement. If fine joints in the flooring are specified, the edges of slabs shall be cut in such a way that it shall form an inverted 'Y'.

3.00.00 ACCEPTANCE CRITERIA

The finish shall be checked specially for:

- a) Level, Slope, Plumb as the case may be
- b) Pattern and Symmetry
- c) Alignment of joints, dividing strip etc.
- d) Colour, texture
- e) Surface finish
- f) Thickness of joints
- g) Details at edges, junctions etc.

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	h) Performance i) Precautions specified for durability 4.00.00 I.S. CODES All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed. IS: 777 : Glazed earthenware tiles IS: 1196 : Code of practice for laying bitumen mastic flooring. IS: 1197 : Code of practice for laying of rubber floors IS: 1237 : Cement concrete flooring tiles IS: 1443 : Code of practice for laying and finishing of cement concrete flooring tiles. IS: 2114 : Code of practice for laying in situ terrazzo floor. IS: 3461 : PVC asbestos floor tiles IS: 4860 : Specification for acid resistant bricks IS: 5518 : Code of practice for laying of flexible PVC Sheet and tile flooring. IS: 5491 : Code of practice for laying in situ granolithic floor topping. 5.00.00 RATES AND MEASUREMENT 5.01.00 Rates Rates shall be for the complete work (including dividing strips, ironite, metals, tiles etc. if any) as per the schedule of items. Rates shall be applicable for application on horizontal and vertical surfaces at all elevations and for all types of work including stairs tread and riser, laying in desired pattern and panels, cost of specials (if any) rounding of corners, mouldings etc.	



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Rates shall be including provision of side shuttering (if required) for casting of floor in alternate panels and or without dividing strips.

5.02.00

Measurement

The finished surface shall be measured in Sqm for area unless otherwise specified. Deduction shall not be made for opening or embedded articles having area not exceeding 0.1 Sqm.



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SHEET WORK IN ROOF AND SIDING

SPECIFICATION NO. PE-TS-999-600-C013



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



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2.02.03	Fibre Glass Reinforced Plastic Sheeting This shall be of thickness and profile as specified. Colour and light transmittance shall be as mentioned. Where used in conjunction with C.G.I. or asbestos sheeting, the end and side laps and fixing device shall be same as used for general sheeting. Where used in lieu of glass, the fixing shall be by means of timber or metal glazing beads. In all cases, the installation shall be completely watertight and able to withstand the designed wind-pressure.
2.02.04	PERMANENT COLOUR COATED (SANDWICHED INSULATED) METAL CLADDING SYSTEM i. Troughed zinc-aluminium alloy coated (both sides) M.S. sheet having 0.6mm minimum thickness (or high tensile steel sheet having minimum yield strength of 350 Mpa of 0.5mm minimum thickness) shall be used on external face (outer face) of cladding system. Weight of coating shall not be less than 150 gm/sq.m. The outer side (exposed face) shall be permanently colour coated with Polyfluro Vinyl Coating (PVF₂) of Dry Film Thickness (DFT) 20 microns (minimum) over primer. Inner side of external sheet shall be provided with suitable pre-coating of minimum 7 microns. ii. Galvanised M.S. sheets of minimum 0.6mm thickness shall be used as inner liner (internal face) of cladding system. The exposed face shall be permanently colour coated with silicon modified polyester paint of DFT 20 microns (minimum) over primer. Inner face of external sheet shall be provided with suitable pre-coating of minimum 7 microns. The rate of galvanization shall not be less than 275 gm/sqm. iii. The permanent colour coated sheet shall meet the general requirements of IS:14246 and shall conform to class 3 for the durability. iv. Inner sheet shall be fixed directly to side runners and Z spacers made out of at least 2 mm thick galvanized steel sheet of grade 375 as per IS:277. Inner sheet shall be fixed at the rate not more than 1.50M centre to centre to hold the insulation and external sheeting. The fasteners shall be of high quality corrosion resistant grade of self tapping / self drilling type provided with suitable cap. v. The insulation shall be of bonded mineral wool of minimum thickness 50mm conforming to IS:8183, having a density of 32 Kg/cu.m. for glass wool & 48 Kg/cu.m. for rock wool.
2.02.05	PERMANENT COLOUR COATED (NON-INSULATED) METAL CLADDING SYSTEM i. Troughed zinc-aluminium alloy coated not less than 150 gm/sq.m M.S. sheets having 0.6 mm minimum thickness (or High tensile steel sheet having

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	minimum yield strength of 350 Mpa of 0.5mm minimum thickness) shall be used for the cladding system. The outer side (exposed face) shall be permanently colour coated with PVF₂ paint of minimum DFT 20 microns over primer and the inner side (internal face) shall be coated with same paint of minimum DFT 12 microns over primer. These shall be fixed directly to runners. The sheets shall meet the general requirement of IS:14246 and shall conform to class 3 for the durability. ii. FLASHING, CAPS, TRIM CLOSURES ETC. All flashings, trim closures caps etc. required for the metal cladding system shall be made out of plain sheets having same material and coating specification as mentioned above for the outer face of the sandwiched metal cladding. 3.00.00 ACCEPTANCE CRITERIA The installations shall present a neat appearance and shall be checked for water tightness. The following shall be checked: a) Side and end laps b) Absence of cracks, holes or damages in sheet c) Spacing of bolts d) Provision of double washers (G.I. and asbestos or bituminous washers) e) Proper installation of flashing. 4.00.00 I.S. CODE All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed. - IS: 3007 : Code of practice for laying of asbestos cement sheets. - IS: 2527 : Code of practice for fixing rainwater gutters and down pipes for roof drainage. - IS: 1626 : Specification for asbestos cement building pipes, gutters and fittings. - IS: 277 : Specification for galvanized steel sheets (plain and	



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corrugated).

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall be unit rate for complete item described in “Schedule of Items” and shall include all wastage.

5.02.00 Measurement

Sheeting work in roof & sides shall be measured in Sq.M. for net area of the work done. Profiled sheeting shall be measured flat and not girthed. Opening less than 0.40 Sqm shall not be deducted. No extra shall be paid for extra labour in cutting and for wastage etc. No payment shall be made for laps, flashings, sealing, fasteners etc. in sheeting works.



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SUSPENDED CEILING

SPECIFICATION NO. PE-TS-999-600-C014



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

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SUSPENDED CEILING

1.00.00 SCOPE

This section covers supply and installation of suspended ceiling together with the suspension system as shown on drawing or specified in schedule of item with all materials, labour and equipments. The work shall also include providing of openings in the ceiling for lighting, air-conditioning diffusers etc. as shown on drawings or as instructed by the Engineer.

2.00.00 INSTALLATION

2.01.00 Suspension System

2.01.01 General

Suspension system shall consist of the grid supporting the ceiling panels, intermediate runner supports for the grid if any and hangers, wall angles etc. required to suspend the grid or the runners from structural works, slabs and beams.

All members of the suspension system shall be of sufficient strength and rigidity to carry, the ceiling boards or sheets in a true and level plane without exceeding a deflection of 1/360th of their span. All joints in ceiling panels shall run straight and cross joint shall be at perfect right angles. Angle moulds where shown on drawings shall be securely fixed to walls. All drillings of structural concrete and installation of suitable anchoring device for installation including welding of the suspension system shall be included in the rate. All M.S. sections used for supports etc. shall be given one coat of synthetic enamel paint over a coat of red lead primer.

2.01.02 Metal Grid Suspension System

Aluminium grid ceiling system shall be "Bead lock" as manufactured by W A Beard shell and Co. Pvt. Ltd. or Ajit India Limited or approved equal. Steel grid ceiling system shall be 'Jolly Snap Grid' as manufactured by Jolly Board Limited or approved equal.

Steel tees as intermediate members and steel channels, as end pieces will be assembled in the form of grid. Size of tees and channels shall be as required.

The cross-tees shall intersect main tee runners in pattern shown on drawing and positively locked together with intersection members. All perimeter areas shall have tee runners fixed to vertical wall surfaces and end channels shall be



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fixed to runners leaving return air space between vertical wall and channels,

unless otherwise shown on drawings. Angle cleats or other suitable fixing device shall be fixed to the structural beams above for fixing of hangers. Main runners shall be hung by M.S. flats, angles, rods or 12G or heavier galvanized tie wire hangers at maximum 1.2 metre centres. Extra hangers shall be provided at light fixtures that are supported from the ceiling system. The spacing of main and cross runners shall be as shown on drawings. Turnbuckles shall be provided in M.S. rods for adjustment in levels.

2.02.00 Ceiling Panels

2.02.01 Material

Ceiling panels shall be best quality material in thickness and properties called for in the "Schedule of items". The Contractor shall submit test certificates to the Engineer for approval before bulk supply. The ceiling panels may be of following type:

- a) Plaster of Paris board (decorative)
- b) Expanded polystyrene insulation board with plastic fascia.
- c) Fibre Insulation board.
- d) Bonded wooden particle board (Plain and decorative)
- e) Glass fibre reinforced polystyrene sheets.
- f) Flat asbestos sheets (with plastic fascia).

2.02.02 Installation of Ceiling Panels

Installation of Ceiling panels shall be strictly as per manufacturer's instruction.

For concealed grid system, tiles shall be fixed to the supporting grid in manner shown on drawing or as specified by the manufacturer. Where V joints in tiles are called for in drawings, these shall be in true lines. Where flush surface is required, the joints shall be filled with approved filler material and finished to give a neat uniform surface. Special care shall be taken to neatly finish the ceiling at junctions with walls, light fixtures, diffusers etc.

2.02.03 Aluminium Lineal Ceiling System

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Aluminium lineal ceiling system shall be "Luxalon 84C " or approved equal and the installation shall be strictly as per manufacturer's instruction/specification subject to approval of the Engineer.

Aluminium lineal ceiling shall comprise of plain panels, 84 mm wide and 12.5 mm deep with a 23.9 mm recessed flange, roll formed out of 0.5 mm thick aluminium alloy panels stove enamelled on both sides, fixed on roll-formed carriers made of enamelled 0.95 mm thick aluminium, 32 mm wide and 39 mm deep with prongs to hold panels in the module of 100mm, at maximum spacing 1.2 M centre to centre. The carriers shall be suspended from roof by 4 mm dia galvanised steel wire hangers with special height adjustment clips made out of spring steel at maximum spacing of 1.2 M c/c. Hangers shall be fixed to roof by 'J' hooks and nylon inserts. 25 mm thick resin bonded mineral wool (spintex 300 or equivalent) insulation bound in polythene shall be laid on top of panels. Lineal ceiling shall be fixed in pattern as per detailed drawings.

3.00.00 SAMPLES

Samples of Ceiling panels and metal suspension system components as noted below shall be submitted for Engineer's approval:

- Panels : 3 samples approximately 300 mm square/long each
- Suspension System : 3 samples of short length : each of main and secondary system

4.00.00 SHOP DRAWINGS

Shop drawings shall be submitted for approval as required and approval shall be obtained prior to delivery of suspended ceiling components. Shop drawings shall be co-ordinated with all related work and shall show the following information:

- A reflected ceiling plan of areas indicated to receive the ceiling showing electrical and mechanical features.
- Typical Intermediate framing for support where required.
- Hanger fastening details.
- Panels - unit support at ceiling penetrations.
- Details of splicing method for main and cross runners.
- A table indicating load bearing capacity of main and cross runner



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- g) A note stating that the suspension system member furnished will not deflect more than $1/360$ of the span under the indicated loading.



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5.00.00 ACCEPTANCE CRITERIA

Finished ceiling shall be at the correct plane and present a pleasing and uniform appearance, free from, sags, warps, disfigured, or damaged board. Cutouts for light fixtures, diffusers etc. shall be of exact dimensions and in exact locations.

6.00.00 RATES AND MEASUREMENT

6.01.00 Rates

Rates shall be for the complete item called for in the “Schedule of Items”. No extra payment will be made for alignment and adjustment of lighting fixtures, air-conditioning diffusers, access panels etc. The rate shall include all cutting and wastage from standard size sheets, runners/carries etc.

6.02.00 Measurement

Actual area of work shall be measured in Sqm correct to second place of decimal. However, no deduction will be made for opening upto 0.25 Sqm. each in area.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

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**WATER SUPPLY, DRAINAGE
AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



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WATER SUPPLY, DRAINAGE AND SANITATION**1.00.00 SCOPE**

This section covers supply of all materials labour and incidentals required for supply, laying and installation of under/over ground pipes for water supply, drainage and sanitation with all fittings, fixtures and jointing, construction of ancillary works like manholes, drop connections, gully chambers, septic tank, soak pits, surface drain etc.

The supply and installation of water supply/sanitation fixtures and accessories like water closets, urinals, wash basins, sinks, mirrors, shelves, towel rail, soap container etc. with all fittings, fixtures, water supply/sanitation pipes and water storage tanks etc.

2.00.00 MATERIAL

All materials, fittings, fixtures, and appliances shall be of the best quality conforming to relevant Indian Standard and shall be procured from approved manufacturers. Unless specifically allowed by the Engineer, the Contractor shall submit samples of fittings and fixtures, which will be retained by him for comparison when bulk supplies are received at the site. Ultimate choice of type, model, and manufacturer lies completely with the Engineer.

It shall be the responsibility of the Contractor to procure the materials selected by the Engineer. Hence orders are to be placed with the manufacturers in time, so that the materials are available at the site well ahead of their requirement.

The materials brought to the site, shall be stored in a separate secured enclosure away from the building materials. Pipe threads, sockets, and similar items shall be specially protected till final installation. Brass and other expansive items shall be kept under lock and key. Fragile items shall be checked thoroughly when received at the site and items found damaged shall not be retained at the site.

2.01.01 Pipes and Pipe Fittings

For water supply, galvanised mild steel pipe of medium grade confirming to IS: 1239 shall be used. The galvanising shall not be less than 400gm/sqm of pipe surface area. Galvanising shall be smooth and shall be subjected to testing as per IS: 2633 for uniformity of coating. The zinc coating shall be free from defects.

For Roof drainage and building sanitation works following type of pipe are coved in this Section:



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- a) Cast Iron pipe
- b) Steel pipe (lined, coated with bituminous composition, out coated with cement concrete or mortar or galvanized)
- c) Concrete pipe
- d) Asbestos cement pipe
- e) PVC pipe
- f) Stoneware pipe
- g) Vitrified pipe
- h) Lead pipe (not to be used for portable water)

2.02.01

Fixtures

All material, fittings, fixtures, appliances, accessories shall be of approved quality and shall be procured from reputed brands like Hindustan/Pasriware/Cera or equivalent or as approved by Engineer. The bidder shall procure the fixtures from the above named reputed manufacturers and shall mention in his bid the type & make of the fixtures he intends to use.

All items brought to the site must bear the manufacturer's identification mark. Procurements shall be made well in advance and should get inspected & approved immediately by the Engineer. All fixtures shall be adequately protected, covered, and plugged till handing over.

All fittings, gratings, fasteners, unless specified otherwise, shall be chromium plated. The chromium plating shall be of grade-2 (10micron thickness) confirming to IS: 4827. Powder coating shall be of approved colour and shall have minimum thickness (DFT) of 20micron. Stainless steel accessories shall be of grade SS-304 and from reputed manufacturer (like Salem Steel) and shall be polished bright finish.

Unless specified in the contract the fixtures shall be as specified hereinafter.

Water closet

a) European type

It shall consist of European type glazed vitreous china basin (confirming to IS: 2556, part-II), with siphon open front solid plastic seat and plastic



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cover, low level glazed stoneware flushing cistern with valve less fittings, supply connections and necessary fittings. All fittings shall be chromium plated. Colour of basin, cistern, seat and cover shall be as approved by the Engineer.

b) Squatting type

It shall consist of Orissa pattern glazed vitreous china squatting pan with integral foot rests (confirming to IS:2556, part-III) and high level cast iron flushing cistern with valve less fittings, supply connections and necessary fittings. All fittings shall be chromium plated. The flushing cistern shall be painted as specified by the Engineer.

Urinals

It shall consist of wall type glazed vitreous china urinals (conforming to IS:2556), cast iron automatic flushing cistern complete with supply connections, flush pipe, lead pipes, gratings, traps and all other necessary fittings. Frequency of automatic flushing shall be approximately once every five minutes. For every four urinals (maximum) located together may be served by one cistern of adequately capacity. All fittings shall be chromium plated.

Wash Basin

It shall be made of glazed vitreous china conforming to IS:2556, part-IV. The basin shall be flat back, wall hung by painted cast-iron brackets and complete with hot and cold CP brass faucets with nylon washers, PVC connection pipe with CP brass nuts, CP brass chain with rubber plug, 32mm dia. Chromium plated brass waste of standard pattern, 32mm dia. CP brass trap union complete with necessary fittings.

Sink

It shall be made of glazed vitreous china conforming to IS:2556, part-V. It shall be wall hung by painted cast iron brackets and complete with one CP brass faucet with nylon washers, PVC connection pipe with CP brass nuts, CP brass chain with rubber plug, 40mm dia. chromium plated brass waste of standard pattern, 40mm dia. CP brass trap union complete with necessary fittings.

Bathroom mirror

It shall be made of the best quality 6 mm thick glass and produced by a reputed mirror manufacturer. It shall be wall mounted with adjustable revolving brackets. The brackets, screws, and other fittings shall be chromium plated.



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Glass shelves

Class shelves shall consist of 6 mm thick clear glass with guardrails and shall be wall mounted with brackets. All brackets, guardrails, and screws shall be chromium plated.

Towel rail

Towel rails shall be 20 mm dia chromium plated MS pipes wall mounted with steel brackets. The brackets, screws etc. shall also be chromium plated.

Soap holder

It shall be made of chromium plated strong members. The holders shall be wall mounted with chromium-plated screws.

Liquid Soap Dispenser

It shall be round and easily revolving with removable threaded nozzle. The body, bracket for wall mounting and screws shall be chromium plated.

Toilet roll holder

It shall be made of glazed vitreous china with suitable cover cum cutter. Wall mounting screw shall be chromium plated.

Valve, cocks, Taps

All valves, stop cocks, taps etc. shall conform to relevant Indian standard specification and shall be of best quality from approved manufacturers. These shall be suitable for normal working pressures. Nominal size and material shall be as required / specified.

2.03.00 Water Storage Tank

Water storage tank shall be PVC of approved brand and make (Syntex or equivalent). Reservoirs made of concrete masonry or fabricated steel shall be covered by respective work specifications.

3.00.00 INSTALLATION

3.01.00 General

Basic layouts may be available in the drawings provided, the details might



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have to be supplemented by the Contractor and get the approval of the Engineer before installation. Special attention shall be given to economise the layout. Symmetry of layout is very important. Fittings meant for operation shall be located and oriented to allow easy reach and operation. Maintenance, repairs, and replacements of pipes, fittings, and fixtures must be conveniently possible. All pipe lines, locations of fittings and fixtures, etc. shall be as per drawings or as directed by the Engineer. Correctness of lines, plumb, orientation, symmetry, and levels shall be strictly ensured. All items shall be fully secured against movement in any direction and so located as to allow easy maintenance.

All pipelines, fittings, and fixtures shall be installed leak proof. When the works under scope of this specification linked up with works executed by others, the connections shall be such as to prevent any splashing or spilling or emission of foul odour and gases.

3.02.00 Portable water supply Pipe Lines

3.02.01 Laying

In addition to fulfilling the functional requirements all pipelines shall be laid true to line, plumb and level and shall run on the surface of the walls, ceiling or in chases. Any deviation shall need approval of the Engineer. Meticulous care shall be taken to avoid chances of airlock and water hammer.

Pipes shall be laid on continuous unyielding surface or on reliable supports at least one near each joint and spacing as directed by the Engineer. The support must be strong, neat and shall have provisions for securing the pipes in every direction and easy maintenance. All pipes used for water supply should be thoroughly and efficiently disinfected before taken in to use.

3.02.02 Back Flow

The layout of pipe work shall be such that there is no possibility of back flow towards the source of supply from any cistern or appliances, whether by siphonage or otherwise. All pipe works shall be so laid or fixed and maintained as to be and to remain completely watertight, thereby avoiding waste of water, damage of property and the risk of contamination of the water conveyed.

3.02.03 Contamination

There shall be no cross connection whatsoever between a pipe/fitting for conveying or containing wholesome water and a pipe/fitting for containing impure water or water liable to contamination or of uncertain quality of water which has been used for any other purpose. No piping shall be laid or fixed so



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as to pass into or through any sewer, scour outlet or drain or any manhole connected therewith.

3.02.04 Underground Piping

Underground piping shall be laid at such a depth that it is not likely to be damaged by traffic and other loads and frost, where applicable. The size and depth of the trench shall be as approved by the Engineer. Back filling shall be done with selected fine earth, unless otherwise permitted, in 150 mm layers and carefully consolidated. Special care shall be taken while filling in the vicinity of the pipe to avoid damage. Before backfilling, the laid pipe shall be fully tested and approved.

Where the pipe rests on rock it may be bedded on a layer of fine selected material or concrete to avoid local point support. The trench shall be so treated by gradient and filling in the area that it does not act as a drainage channel.

3.02.05 Concealed Piping

Where desired by the Engineer or shown on the drawings the pipes shall be concealed in masonry or concrete of the structure. The Contractor may co-ordinate with the building Contractor for leaving the chases, openings, and conduits as necessary. However, the Contractor will rectify if required the chases, openings, and conduits, supplement and make good after laying and testing of the concealed pipelines.

3.02.06 Jointing of Pipes

All G.I. pipes shall be properly thread/weld jointed and made completely water tight and durable. Burr from the joints shall be removed after screwing. Union joints shall be provided for all required location to facilitate maintenance.

3.02.07 Painting

Where required, underground G.I. pipes shall be given 2 coats of bituminous paint on the outside after laying. When painting is to be done above ground G.I. pipes shall be given one coat of red lead or zinc chromate primer and top coats shall be minimum 2 coats of best quality paint as specified.

3.03.00 RAINWATER DOWN COMERS

3.03.01 Pipes

Rainwater down comers shall be standard Cast Iron or Asbestos Cement Pipes.



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In case where specifically desired, M.S. pipes may also be used. M.S. pipes shall be painted outside with two coats of anticorrosive paints under a coat of primer.

Rainwater down comers shall run along and be secured to walls, columns etc. Where desired by the Engineer these may have to be installed in chases cut in the structure. All pipes shall be well secured and supported by adequately strong brackets. The brackets may be wrought iron clevis type, split ring type, or perforated strap iron type as approved by the Engineer. For vertical runs each pipe shall hang freely on its brackets fixed just below the socket. Suitable spacer blocks shall be provided against the vertical surface to which the pipe is fixed.

All bends and junctions shall be supplied with watertight cleanouts.

Roof and floor drains and yard gullies shall be installed, if required, by cutting into the structure and grouted with 1:2:4 cement concrete. All gutters shall be provided with removable gratings.

All horizontal pipes shall have a minimum fall of 1 in 100.

3.03.02 Khurras

The khurras shall be constructed before the work in parapet wall is taken up and it shall be 45x45 cm in size, unless otherwise specified and shall be formed of cement concrete of M-20 grade.

3.03.03 Gutters

The gutters shall be made of G.I. or A.C and procured from reputed specialised manufacturers. Each section shall be sufficiently rigid, edges and corners straight and the slopes perfectly uniform. G.I. gutters shall have the edges strengthened by suitable means.

Unless noted otherwise the gutters shall have a minimum fall of 1 in 120. Adequate number of string supports shall be provided so that there is no sagging even when the gutter is full. Each joint must have a support. Unless otherwise specified the supports shall be fabricated M.S. brackets. All junctions shall be thoroughly watertight. The joints may be made by riveting, bolting or soldering. All joints between successive lengths of gutters shall have on overlap of at least 5 cm. The drop in the overlap shall always be in the direction of the fall of the gutter. Ends of gutters shall be closed watertight. Junction with rainwater down comers shall be made fully watertight and secured.

3.04.00 SOIL AND DRAINAGE PIPES



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3.04.01 Gradients

If not specified the minimum gradients of soil and drainage pipeline shall be as follows:

100 mm nominal dia	:	1 in 35
150 mm nominal dia	:	1 in 65
230 mm nominal dia	:	1 in 120
300 mm nominal dia	:	1 in 200

3.04.02 Relation with water supply pipelines

Unless specifically cleared by the Engineer, under no circumstances shall drainage and sewer pipes be allowed to come close to water supply pipelines.

3.04.03 Laying

Each separate pipe shall be individually set for line and for level. Where lengths of sewer or drain pipes are laid in trench, properly painted sight rails shall be fixed across the trench at a height, equal to length of the boning rod to be used, above the required invert level of the drain or sewer at the point where the sight is fixed. More sight rails shall be required at manholes, change of gradient and intermediate positions if the distance for sighting is more than 50 ft. apart. The excavation shall be boned in at least once in every 6 ft. The foot of the boning rod shall be set on a block of wood of the exact, thickness of the wall of the pipe. Each pipe shall be separately and accurately boned between sight rails.

3.04.04 Support and Protection of Pipelines

All pipes shall be laid with sockets leading uphill. Preferably the pipe shall rest on solid and even foundations for the full length of the barrel. However, the pipe manufacturer's instruction as approved by the Engineer shall be followed in the matter of support and jointing.

To achieve full and continuous support, concrete for bedding and packing is the best. Where pipes are not bedded on concrete, the floor shall be left slightly high and carefully placed so that the pipe barrels rest on undisturbed ground. If anywhere the excavation has been carried too low packing shall be done in concrete. Where laid on rock or very hard ground which cannot be easily excavated to a smooth surface, the pipes shall be laid on a cradle of fine concrete floor of gravel and crushed stone over laid with concrete or on a well consolidated gravel and crushed stone bed as desired by the Engineer. PVC or similar pipes shall be laid directly on stable soil and packed with selected soil.



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The minimum support and protection for glazed stoneware pipes shall be as follows:

- a) When cover is less than 2 metre below ground level and where pipes are unavoidably exposed above ground surface, the pipes shall be completely encased or surrounded with concrete.
- b) Where pipes are laid on soft soil with the maximum water table laying at the invert of the pipe, the sewer shall be bedded on concrete.
- c) Where the pipes have to be laid on soft soil with the maximum water table rising above the invert of the pipe, but below the top of the barrel, the pipe sewer shall be haunched.
- d) Where maximum water table is likely to rise above the top of the barrel or wherever the pipe is laid on soft soil the pipe sewers shall be completely encased or surrounded with concrete.

Vitrified clay pipes shall be laid on a bed of 150 mm thick cement concrete (1:3:6) nominal mix by volume.

Cast iron pipes and concrete pipes may be supported on suitable concrete or brick support, where specified. The supports shall be unyielding and strong enough. At least one support shall be located close to ends. Spacing of intermediate supports shall be as decided by the Engineer. Pipes shall be secured to the supports by approved means.

Anchoring of pipes where necessary shall be achieved by suitable concrete encasing designed for the expected thrust.

3.04.05 Entry into structures

For entry of the pipe lines into any building of structure suitable conduits under the structure or sleeves shall be used. The conduits and sleeves shall be such as to allow easy repairs and replacement of the pipes. When openings or chases are required to be made in the structure for entry of pipelines, locations and sizes shall be marked and checked by the Engineer. After laying of the pipeline the openings and chases shall be mended.

3.04.06 Ducts

Where solid, waste and ventilating pipes are accommodated in ducts, access to cleaning areas shall be provided. Connection to drain shall be through a gully with sealed cover to guard against ingress of sewer gas, vermin, or backflow.

3.04.07 Traps and Ventilating Pipes



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Pipes are carrying off the waste from water closets and waste water and overflow water from baths, wash basins, sinks to drains shall be trapped immediately beneath such fixtures. Traps shall have minimum water seal of 50 mm and shall be ventilated whenever such ventilation is necessary to maintain water seal of the trap. Ventilating pipes shall be carried up vertically from the drain to a height of at least 600 mm above the outer covering of the roof of the building or as shown on drawings. All vertical ventilating, anti-siphonage and similar pipe shall be covered on top with a cowl. The cowl shall be made of C. I. unless desired otherwise by the Engineer.

3.04.08 Manhole & Inspection Chambers

At every change of alignment, gradient or diameter there shall be a manhole or inspection chamber. The maximum distance between manholes shall be 30 meter unless specially permitted otherwise. However, for truck route (for pipes above 900 mm dia.) this distance can be increased to 45 M. The distance between manhole or inspection chamber and gully chamber shall not exceed 6 metres unless desired otherwise provision of IS: 4111 (Part-1) shall be followed for construction of a manhole. Manhole shall be constructed so as to be watertight under test. The change in alignment shall be carried out in such a manner as to provide no lodgement for any splashings in case of accidental flashing of the chamber. The channel or drain at the bottom of chamber shall be plastered with 1:2 cement, sand mortar and finished smooth to the grade. The channels and drains shall be shaped and laid to provide smooth flow.

Connecting to existing sewer lines shall be through a manhole.

Unless otherwise specified, 560 mm dia. circular cast iron manhole cover with frame, heavy-duty, conforming to IS: 1726 shall be provided. The covers shall be close fittings so as to prevent gases from coming out.

3.04.09 Cutting of Pipes

Manufacturer's instructions shall be followed for cutting of pipes where necessary. Suitable and approved tools shall be used for the cutting so as to leave surface clean and square to the axis of the pipe.

3.04.10 Jointing

Jointing of pipes shall be so planned as to avoid completely any movement or strain to the joints already made. If any joint is suspected to be damaged it shall be opened out and redone.

All joints between pipes, pipes and fittings and manholes shall be gas-tight when above ground and watertight when underground. Method of jointing



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shall be as per instructions of the pipe and fittings manufacturer and as approved by the Engineer. However, in the absence of any instruction available from the manufacturer the methods as detailed hereunder shall be used.

a) Cast Iron Pipes

Socket and spigot pipes shall be jointed by the cast lead joints. The spigot shall be centred in the socket of the pipe by tightly caulking in sufficient turns of tarred gasket or hemp yarn to have unfilled half the depth of socket. When the gasket or hemp yarn has been caulked tightly a jointing shall be placed round the barrel and tightened against the face of the socket to prevent airlock. Molten lead shall then be poured in to fill the remainder of the socket and caulked with suitable tools right round the joint to make up for shrinkage of the molten metal on cooling and shall be finished 3 mm behind the socket face.

Joints in cast iron pipes with special jointing arrangements like 'Tyton' Joints etc. shall follow the instructions of the manufactures.

In special cases if flanged joints are accepted by the Engineer the joints shall be made leak proof by inserting approved type of rubber gaskets. The bolts shall be secured in stages to avoid uneven strain.

b) Concrete Pipes

Jointing of concrete pipes shall be generally of rigid type. Unless otherwise stated collar type joint shall be provided. IS: 783 shall be followed for general guidance.

The two adjoining pipes shall be butted against each other and adjoined in correct position. The collar shall then be slipped over the joint, covering equally both the pipes. The angular space shall be filled with stiff mixture of cement mortar 1:2 (1 cement : 2 sand) which shall be rammed with caulking tool. After a day's work, any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured for 7 days.

c) Glazed Stoneware Pipes

Tarred gasket or hemp yarn soaked in thick cement slurry shall first be placed round the spigot of each pipe and the spigot shall then be placed into the socket of the pipe previously laid. The pipe shall then be adjusted and fixed in the correct position and the gasket caulked tightly so as not to fill more than 1/4 of the total depth of the socket. The remainder of the socket shall be filled with a stiff mixture of cement mortar 1:1 (1 cement :



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1 sand). A fillet shall be formed round the joint with a trowel, forming an angle of 45 deg. with the barrel of the pipe. The newly made joints shall be protected, until set and shall be cured by covering with damp cloth or other suitable materials.

d) Vitrified clay pipes

The vitrified clay pipe shall be made from refractory clay mixed with crushed pottery and stone and burnt at a high temperature. These shall be hard, compact, and glazed to make them acid resistant and impervious, and shall be obtained from approved manufacturer.

Special care shall be taken in handling these pipes. The pipes shall not be jointed until the earth has been partly refilled over the portion of the pipe between the joint holes. Before laying the second pipe, the socket of the first pipe laid shall be thinly painted all round on the inside with cement slurry (1 part of cement and 2 parts of clean, sharp sand). A ring of rope yarn (closely twisted hemp or jute) dipped in neat cement paste or tar or bitumen, shall be inserted in the socket of pipe and driven home with caulking tools. The rope shall fully encircle the spigot with a slight overlap and shall not occupy more than one-fourth of the total depth of the socket. Where the spigot end of the pipe is made for receiving the gasket, it shall be wrapped with two or three turns of tarred spun, as close to the end as possible, before inserting into the socket. The joint shall then be completely filled with cement mortar (1:1), which shall have very little water. A fillet shall be formed round the joint with trowel, forming an angle of 45 degrees with the outside pipe. Special care shall be taken so that any excess mortar etc. left inside the pipe joints is neatly cleaned off immediately after each joint is made. A semi-circular wooden scrapper or a rubber disc to which a long handle is fixed could be used for this purpose.

e) Lead Pipes

The joints in lead pipes shall be made as wiped solder joint. The minimum and the maximum length of the wiped solder joints shall be 8 cm. and 9 cm. respectively. The solders shall generally consist of two parts of lead and one part of tin.

f) Polyethylene Pipes

The joints shall be thermo welded or bolted as per manufacturer's instructions.

g) Jointing Cast Iron Pipes with Stoneware Pipes

Where any cast iron drain pipe, ventilating pipe or trap is connected with a



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stoneware or semi-vitrified waste pipe, the beaded spigot end of such cast iron drain pipe, waste or ventilating pipe or trap shall be inserted into a socket of such stoneware pipe and the joint made with mortar consisting of one part of cement and one part of clean sand after placing a ratted gasket or hemp yarn soaked in neat cement slurry round the joint and inserted in it by means of a caulking tool.

h) Jointing Stoneware with Cast Iron Pipes

Where any water closet pan or earthware trap connected to such a pan is to be jointed with a cast iron soil pipe, the joint between the stoneware spigot and the cast iron socket shall always be of a flexible nature. Such joint shall be made with a mixture of bitumen and chopped asbestos fibre.

3.04.11 Trenches and other excavations

Width of the trench at the bottom shall be such as to provide 200 mm clearance on either side of the pipe for facility of laying and jointing.

Excavated material shall be stacked sufficiently away from the edge of the trench and the side of the spoil bank shall not be allowed to endanger the stability of the excavation. Spoil may be carted away and used for filling the trench behind the work.

Turf, top soil or other surface material shall be set aside, turf being carefully rolled and stacked for use in reinstatement.

All excavation shall be properly timbered, where necessary.

Efficient arrangements for dewatering during excavation and keeping it dry till backfilling shall be made to the satisfaction of the Engineer. Sumps for dewatering shall be located away from the pipe layout.

Where the excavation proceeds through roads necessary permissions shall be secured by the Contractors from the appropriate authorities.

Special care shall be taken not to damage underground services, cables etc. These when exposed shall be kept adequately supported till the trench is backfilled.

The backfilling shall be done only after the pipeline has been tested and approved by the Engineer. Special care shall be taken under and sides of the pipe during hand packing with selected material. At least 300 mm over the pipe shall also be filled with soft earth or sand. Consolidation shall be done in 150 mm layers. The surface water shall be prevented from getting into the filled up trench. Traffic shall not be inconvenienced by heaping up unduly the

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backfilling material to compensate future settlement. All future settlements shall be made good regularly to minimize inconvenience of traffic where applicable.		
3.04.12	Protection	Open end of each pipe shall be protected during installation by suitable covers or plugs so that the ends, threads, sockets, or spigot are not damaged and no foreign material can find its way into the pipeline. Fittings and fixtures liable to be misused or stolen during the construction phase shall be fitted only before testing and handing over. 3.05.00 WATER STORAGE TANKS Overhead/loft type water storage tank shall be made of PVC. These tanks shall be provided for each toilet block and placed on the roof/loft of the building. Tank shall be installed with proper supports and anchorage for applicable wind and seismic condition. Installation of tank shall be carried out according to the recommendation of IS: 12701. These tanks shall rest preferable on flat surface so as to distribute the load evenly. The tank shall be leakproof and water tight. The outlet pipe shall be 50 mm above the bottom of the tank and provided preferably with strainers. The wash out or draining pipe shall be connected at the lowest point and flush with bottom of tank. Tank shall be provided with all fittings for inlet, outlet, overflow pipes and ball valves. 3.06.00 SEPTIC TANK AND EFFLUENT DISPOSAL 3.06.01 Septic tank Septic tank shall consist of the tank itself with inlet and outlets there from complete with all necessary earthwork and backfilling. The details of septic tank shall be as shown on drawings. This item shall also include ventilating pipe of at least 100 mm dia whose top shall be provided with a suitable mosquito proof wiremesh and cowl. Ventilating pipe shall extend to a height of about 2 meter when the septic tank is at least 15 meter away from the nearest building and to a height of 2 meter above the top of building when it is located closer than 15 meter. Ventilating pipes can be connected to the normal soil ventilating system of the building where allowed. 3.06.02 Effluent Disposal The effluent from the septic tank shall be disposed by allowing it into an open channel or a body of water if the concerned authority approves or into a soak

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	pit for absorption by soil or shall be allowed to be absorbed by soil through open jointed SW pipes laid in a trench filled with broken bricks. 3.06.03 Soak pit The soak pit shall be complete. It shall consist of a 900 mm dia pit 1000 mm in depth below the invert level of the inlet pipe. The pit shall be lined with stone; brick or concrete blocks set in cement mortar (1:6) and filled with brickbats. Inlet pipe shall be taken down to a depth of 900 mm from the top as an anti-mosquito measure. 3.06.04 Open jointed SW Pipe/dispersion trenches Minimum dia of the SW pipes shall be 150 mm nominal. The trench for laying the pipes shall be a minimum 600 x 600 mm. The joints of the pipes shall be left unsealed. The entire length of the pipe within the trench shall be buried in a 250 mm layer gravel or crushed stone of uniform size. On top of gravel/crushed stone layer is a 150 mm bed of well-graded coarse aggregate. Ordinary soil is used for filling the top of trench. 3.06.05 Commissioning septic tank After the septic tank has been proved watertight and the sewage system is checked the tank shall be filled with water to its outlet level before the sewage is let into the tank. It shall be seeded with well digested sludge obtained from septic tank or sludge digestion tank. In the absence of digested sludge a small quantity of decaying organic matter such as digested cow-dung may be introduced. 3.07.00 Related Works All works, like earthwork, masonry, concrete, steelwork, cutting holes, chases, repairs and rectification associated directly with installation of water supply and sanitation systems shall come under scope of the Contractor unless specifically excluded. These works are not detailed out in this Section. 3.08.00 Regulation The work which is required to be carried out under this section, shall be executed by a licensed Plumber only (engaged by the Contractor) and he shall obtain all necessary sanctions, permissions, certificates etc., from Municipal and/or other Local Authorities and shall abide by all the rules of such Authorities. 4.00.00 TESTING AND ACCEPTANCE CRITERIA	



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4.01.00 Inspection Before installation

All pipes, fittings, and appliance shall be inspected, before delivery at the site to see whether they conform to accepted standards. The pipes and fittings shall be inspected on site before laying and shall be sounded to disclose cracks. Any defective items shall be clearly marked as rejected and forthwith removed from the site.

4.02.00 Testing of Water Supply pipe line

4.02.01 Testing of Mains After Laying

After laying and jointing, the main shall be slowly and carefully charged with water, so that all air is expelled from the main by providing a 25 mm inlet with a stop-cock, allowed to stand full of water for a few days if time permits, and then tested under pressure. The test pressure shall be 5 Kg/sq.cm or double the maximum working pressure, whichever is greater. The pressure shall be applied by means of a manually operated test pump, or in the case of long mains or mains of a large diameter, by a power driven test pump, provided that the pump is not left unattached. In either case due precaution shall be taken to ensure that the required test pressure is not exceeded. Pressure gauges shall be accurate and shall preferably have been recalibrated before the test. The pump having been stopped, the test pressure shall maintain itself without measurable less for at least five minutes. The end of the main shall be closed by fitting a watertight expanding plug and the plug shall be secured by struts to resist the end thrust of the water pressure in the mains.

4.02.02 Testing of Service Pipes and Fittings

The service pipes shall be slowly and carefully charged with water allowing all air to escape avoiding all shock or water hammer. The service pipe shall then be inspected under working conditions of pressure and flow. When all draw-off taps are closed, the service pipes shall be absolutely watertight. All piping, fittings, and appliances shall be checked for satisfactory support and protection from damage, corrosion, and frost.

4.03.00 Testing of Drain and Sewerage Pipelines

All soil pipes, waste pipes, ventilating pipes and all other pipes, when above ground, shall be gas tight. All sewers and drainpipes laid below ground shall be tested water tight. The method of actual tests shall be decided by the Engineer. All test data shall be recorded and submitted to the Engineer for review and instruction. The Engineer's discretion regarding tolerance shall be final.

General guidance for the tests are given below:



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a) Smoke test

All soil pipes, waste pipes and vent pipes and all other pipes when above ground shall be approved gastight by a smoke test conducted under a pressure of 25 mm of water and maintained for 15 minutes after all trap seals have been filled with water. The smoke is produced by burning oily waste or tarpaper or similar material in the combustion chamber of a smoke machine. Chemical smokes shall not be used.

b) Water test

The pipes shall be subjected to a test pressure of at least 1.5 m head of water at the highest point of the section under tests. The tolerance figure of two litres per centimetre of diameter per kilometre may be allowed during a period of 10 (ten) minutes. The test shall be carried out by suitably plugging the low end of the drain and the ends of connections, if any, and filling the system, with water. A knuckle bend shall be temporarily jointed in at the top end and a sufficient length of the vertical pipe jointed to it so as to provide the required test head or the top end may be plugged with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitably for observation.

Subsidence of test water may be due to one or more of the following cases:

- a) Absorption by pipes and joints
- b) Sweating of pipes or joints
- c) Leakage at joints or from defective pipes
- d) Trapped air.

Allowance shall be made for (a) by adding water until absorption has ceased and after which the test proper should commence. Any leakage and the defective part of the work shall be cut out and made good.

c) For straightness

- i) By inserting at the high end of the sewer or drain a smooth ball of a diameter 13 mm less than the pipe bore. In the absence of obstruction, such as yarn or mortar projecting through the joints, the ball will roll down the invert of the pipe and emerge at the lower end; and
- ii) By means of a mirror at one end of the line and lamp at the other. If the pipeline is straight, the full circle of light may be observed. The mirror

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	will also indicate obstruction in the barrel if the pipeline is not straight. 4.04.00 Fittings and Fixtures etc. All fittings and fixtures shall be connected by water tight joints. No dripping of water shall be acceptable. 4.05.00 Testing Septic Tank The septic tank shall be tested for water tightness. It shall be filled up with water and allowed to soak for 24 hours. Then, it shall be topped up and allowed to stand again for 24 hours and loss of level recorded. The fall shall not be more than 15 mm in 24 hrs. 5.00.00 I.S. CODES Important relevant IS Codes for this specification are listed below: Latest editions shall always be consulted. IS: 404 : Lead pipes. IS: 407 : Brass tubes for general purposes. IS: 458 : Concrete pipes (with or without reinforcement) IS: 783 : Code of Practice for laying of concrete pipes. IS: 1172 : Code of basic requirements for water supply, drainage and sanitation. IS: 1200 (Pt.XVI) : Laying of water and sewer lines, including appurtenant items. IS: 1230 : Cast iron rain water pipes and fittings. IS: 1239 (Pt.I & III) : Specification for Mild Steel Tubes and Mild Steel Tubulars and other wrought steel pipe fittings (10 mm to 15 mm nominal diameter). IS: 1536 : Specification for centrifugally cast (Spun) iron pressure pipes for water gas and sewage. IS: 1537 : Specification for vertically cast iron pressure pipes for water, gas and sewage.	

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	IS: 1592 : Asbestos cement pressure pipes, IS: 1626 : Asbestos cement pressure pipes, gutters and fittings (Spigot and Socket types). IS: 2065 : Code of Practice for Water Supply in buildings. IS: 2501 : Copper tubes for general engineering purposes. IS: 2556 : Specification for vitreous sanitary appliances (vitreous china) Part – I - General requirement IS: 2633 : Method of testing, uniformity of coating on zinc coated articles. IS: 3076 : Low density polyethylene pipes for portable water supplies. IS: 3486 : Specification for Cast iron spigot and socket drain pipes (80 mm to 250 mm nominal diameter). IS: 3589 : Specification for Electrically welded steel pipe for water, gas and sewage (200 mm to 2000 mm nominal diameter). IS: 4827 : Specification for electro plated coatings of nickel and chromium on copper and copper alloy. IS: 4964 : High-density polyethylene pipes for portable water supplies. IS: 12701 : Rotational moulded polyethylene water storage tanks	
6.00.00	RATE AND MEASUREMENT	
6.01.00	RATE	
6.01.01	G.I. Pipes For Water Supply	
	Rate shall include providing and fixing of the pipes including all specials and fittings, such as tees, bands, elbows, clamps, drain heads, cleanouts etc. with cutting, making chases and jointing of pipes, making good the walls.	
6.01.02	Rainwater Down-comers Rate shall include providing and fixing of the pipes including all specials and	

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	6.01.03 Sanitary Fixtures Rate shall include providing and fixing of sanitary appliances & fixtures and at all elevation, including all accessories and fittings, connections pipes, waste trap and pipes all complete as per description of “Schedule of Items”. Rate shall also include the jointing of waste & traps to drain pipes. 6.01.04 Drainage and Sewer Pipes Rate shall be inclusive of providing, laying and jointing of pipes as specified. Rate also include cost of lead joints or other joint as specified, cost for painting and cutting and making good walls, floors etc. 6.01.05 Floor and Gully Traps Rate of traps is inclusive of all excavation, filling, repair, making good of opening in floor and walls, grating, painting etc. complete as described in “Schedule of Items”. 6.01.06 Manholes, Septic Tank, Soak Pit and Cover Rate of manholes, septic tank, soak pit shall be paid under respective items of work executed like brick work, plastering, concrete, reinforcement steel etc. provided for completion of the structure as per drawing and specifications. Manhole cover shall be paid separately as per description of item. 6.01.07 Water Storage Tank The rate for water storage tank is inclusive of supply and installation of tank with all fittings, inlets, outlets, valves etc. complete. 6.02.00 MEASUREMENTS 6.02.01 Pipe for Water Supply and Drainage For G.I.Pipe of water supply line, rainwater down comers, drainage and sewer pipe, the measurements shall be in running metres and shall be taken along centre line of pipe or specials. The pipe shall be measured separately according to dia. and class of pipe. Fixtures like bibcock, stopcocks, valves etc. shall be measured in numbers.	



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6.02.02 Sanitary Appliances & Fixtures and Allied Works

All sanitary appliances & fixtures like sink, washbasin, WC, shall be measured in numbers for the complete work as described in schedule of items.

Floor and gully traps shall be measured in numbers unless otherwise specified.

Water storage tank shall be measured in numbers for the capacity as specified in "Schedule of Items".

The item of work executed for completion of manholes, septic tank & soak pit shall be measured in respective items of work like brick work, RCC, plastering etc. CI cover shall be measured in numbers as specified in "Schedule of Items".



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ROAD AND DRAINAGE



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



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**Standard Technical Specification
For Road and Drainage**

1.00.00 Scope

The scope include all works required for the construction of road including construction of embankment, sub-base course, base course, tack coat, bituminous macadam, wearing course, liquid seal coat, shoulder and all incidental items of work specified or not shown but reasonably implied or necessary for the completion of the work etc.

The scope also include all works required for the construction of drainage including construction of road side drains, RCC culverts, pipe culverts, drainage pipes, manholes and all other incidental items necessary for the completion of the work etc.

1.01.00 Works To Be Provided By The Contractor

The works to be provided by the contractor unless specified otherwise shall include but not be limited to the following.

a) Construction of roads including providing all materials, labour, supervision, services, equipments, tools and plants, transportation etc all required for the completion of the work.

b) Submission of detailed scheme of all operations required for executing the work (e.g. material handling, placement, services, approaches etc) to the engineer for approval.

c) Carrying out tests whenever required by the engineer to assess the quality of work and submission of the test results to the engineer after completion of the same etc.

1.02.00 Work To Be Provided By Others

No work under this specification will be provided for by any agency other than the contractor unless specifically mentioned elsewhere in the contract.

1.03.00 Conformity With Designs

The contractor shall carryout the work as per the construction drawings, specification and as directed by the engineer.



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1.04.00 Materials To Be Used

All materials required for the work shall be the best commercial variety and as approved by the engineer.

2.00.00 Codes and Standards

All works under this specification shall conform to the latest revision and/or replacement of the following or any other IRC/IS Codes and Standard Practices unless specified otherwise.

- a) Specification for road and bridge works of Ministry of Shipping & Transport (Road Wing) Published by the IRC
- b) IRC: 19 - Standard specification and code of practice for Water bound Macadam
- c) IRC :SP 11 - Hand Book of Quality Control for Construction of Roads and Runways
- d) IS:456 - Indian Standard Code of Practice for Plain and Reinforced Concrete.
- e) IS:2212 - Code of Practice for Brick work
- f) IS: 783 - Code of Practice for Laying of Concrete Pipes
- g) IS: 1201 - Methods of testing tar and bituminous materials to 1220
- h) IS: 73 - Specification for paving bitumen
- i) IS: 215 - Specification for Road tar
- j) IS: 216 - Coal tar pitch
- k) IS: 217 - Specification for cut-back bitumen
- l) IS: 454 - Specification for cut-back bitumen from waxy crude
- m) IS: 1834 - Specification for hot applied sealing compound for joint in concrete
- n) IS: 1838 - Specification for performed fillers for expansion joints in concrete, non extruding and resilient type



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Part I Bitumen impregnated fibre

Part II CNSL Aldehyde resin and coconut pith

- o) IS : 334 - Glossary of terms relating to bitumen and tar
- p) IS: 1077 - Common burnt clay building bricks
- q) IS : 3117 - Specification for bitumen emulsion roads (anionic type)
- r) IS : 1200 - Method of measurement of building and civil engineering work (Part-17)- Road work including airfield pavements
- s) Other specifications mentioned elsewhere in this specification.

In case any particular aspect of work is not covered specifically by the specification/Indian Standard Code of practices, any other standard practice as may be specified by the engineer shall be followed.

2.01.00

Quality Control

The Contractor shall establish and maintain quality control for all materials, procedures, workmanship and equipments used. All works shall conform to the lines, grades, cross sections and dimensions shown on the drawings, specification and as directed by the engineer. Permitted tolerances for road works are described hereinafter.

a) Horizontal Alignment

Horizontal alignment shall be reckoned with respect to the centre line of the carriageway as shown on the drawings. The edges of the carriageway as constructed shall be correct within a tolerance of $\pm 25\text{mm}$ therefrom. The corresponding tolerance for edges of the roadway and lower layers of the pavement shall be $\pm 40\text{mm}$.

b) Longitudinal Profile

The finished levels of the sub-grade and different pavement courses as constructed shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings or as directed by the engineer and shall not exceed the tolerances as mentioned below.

Sub-grade	$\pm 25 \text{ mm}$
Sub-base	$\pm 20 \text{ mm}$
Base course	$\pm 15 \text{ mm}$
Wearing course	$\pm 10 \text{ mm}$



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Tolerance in wearing course shall not be permitted in conjunction with the positive tolerance on base course if the thickness of the wearing course is thereby reduced by more than 6 mm.

c) Surface Regularity of Sub-grade and Pavement Courses

The surface regularity of the completed sub-base, base course and wearing surfaces in the longitudinal and transverse directions shall be within the tolerances indicated in Table - I. The longitudinal profile shall be checked with a 3m long straight edge at the middle of each traffic lane along a line parallel to the centre of the road. The transverse profile shall be checked with a set of three camber boards at intervals of 10m.

TABLE -I

PERMITTED TOLERANCE OF SURFACE REGULARITY FOR PAVEMENT COURSES

Sl. No.	Type of Construction	Longitudinal profile with 3m straight edge				Cross Profile	
		Maximum permissible Undulation (mm)	Maximum number of undulations permitted in any 300m length with undulation exceeding (mm)				Maximum permissible variation from specified profile under camber template (mm)
			18	12	10	6	
1	2	3	4	5	6	7	8
1.	Earthen sub-grade	25	30	-	-	-	15
2.	Granular sub-base	15	-	30	-	-	12
3.	Water Bound Macadam with oversize metal (40-90 mm size)	15	-	30	-	-	12
4.	Water Bound Macadam with normal size metal (20-50 mm and 40-63 mm size), Bituminous Penetration Macadam	12	-	-	30	-	8
5.	Surface dressing** (two coat) over WBM (20-50 mm or 40-63 mm size metal), Bituminous penetration macadam	12	-	-	20	-	8



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6.	Open graded premix carpet, mix seal Surfacing	10	-	-	-	30	6	
7.	Bituminous macadam	10	-	-	-	20****	6	
8.	Semi-dense carpet	10	-	-	-	20****	6	
9.	Asphaltic Concrete	8	-	-	-	10****	4	

1. ** For surface dressing in all other cases, the standards of surface evenness will be the same as those for the surface receiving the surface dressing.

2. *** These are for machine laid surfaces. If laid manually due to unavoidable reasons, tolerance upto 50 percent above these values in this column may be permitted at the discretion of the Engineer. However this relaxation does not apply to the values of maximum undulation for longitudinal and cross profiles mentioned in columns 3 and 8 on the table.

3. Surface evenness requirements in respect of both the longitudinal and cross profiles should be simultaneously satisfied.

3.01.00 Setting Out

Within 15 days of the award of contract, the contractor shall prepare and submit to the Engineer detailed drawings/schemes of embankment filling and excavation works as proposed to be executed by him showing the dimensions as per construction drawings and specification adding his proposals of drainage and dewatering of pits, watering and compacting the embankment fill etc. On receiving the approval from the Engineer with modifications and corrections if any, the contractor shall set out the work from the control points furnished by the Engineer and fix permanent points and markers for ease of future checking. These permanent points and markers will be checked by the Engineer and certified by him after which the contractor shall proceed with the work. It should be noted that this checking by the Engineer prior to the start of the work will in no way absolve the contractor of his responsibility of carrying out the work to true lines and levels as per the approved drawings. If any errors are noticed in the Contractor's work at any stage, the contractor at his own risk and cost shall rectify the same. Profiles of the embankment made with Bamboo, earth or other convenient materials and strings shall be set up at suitable intervals for the guidance of the workmen.

3.02.00 Clearing and Grubbing

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Before commencement of earthwork, the surface area of ground to be occupied shall be cleared of all fences, trees, logs, stumps, bushes, vegetation, rubbish, slush etc. Cutting of trees shall include trees having girth of any size and removing roots upto a depth of 600mm below ground level or 300mm below formation level whichever is deeper. After the removal of roots of trees, the pot holes formed shall be filled with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the Engineer. The trees shall be cut into suitable pieces as instructed by the Engineer. Before earthwork is started, all the spoils and unserviceable materials and rubbish shall be burnt or removed from the site to the approved disposal areas as may be specified. Useful materials, saleable timbers, firewood etc shall be the property of the Owner and shall be stacked properly at the work site in a manner as directed by the Engineer.

3.03.00 Filling in Embankment**3.03.01 General**

The material used for constructing the embankment shall be earth, moorum, gravel or a mixture of the above or any other material approved by the Engineer. The material shall be free from lumps and clods, boulders and rock pieces, roots and vegetation, harmful salts and chemicals, organic materials, loose silts, fine sands and expansive clays in order to provide a stable embankment. The filling and compaction operation should be such that the best available materials are saved for the top portion and will result in an acceptable and uniform gradation of material and provide impermeability and stability to the embankment when compacted. The size of the coarse material in the mixture of earth shall ordinarily not exceed 75mm. However the Engineer may at his discretion permit the use of material coarser than the specified if he is satisfied that the same will not present any difficulty as regard to the placement and compaction of the fill material are concerned. Ordinarily, only the materials satisfying the density requirements as given below in Table-II shall be employed for embankment construction.



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Table - II

Density Requirements of Embankment Materials

Sl. No.	Type of Work	Maximum laboratory dry density when tested as per IS: 2720 (Part - VII)
1.	Embankment upto 3m height	Not less than 1.44 gm/cc
2.	Embankment exceeding 3m height and embankment of any height subject to long period of inundation	Not less than 1.52 gm/cc
3.	Top 0.5m of the embankment below sub-base and shoulders (where earth shoulders are specified)	Not less than 1.65 gm/cc

Expansive clays exhibiting marked swell and shrinkage properties shall not be used for embankment construction.

The material for embankment construction shall be obtained from approved sources with preference given to the materials available from nearby road excavation or any other excavation under the same contract.

3.03.02 Setting Out

After the site clearance, the work shall be set out true to lines, curves, slopes, grades and sections as shown on the approved drawings or as directed by the Engineer. The contractor shall provide all labour, survey instruments and materials such as strings, pegs, nails, bamboo, stones, lime, mortar, concrete etc required in connection with the setting out of the works and establishment of the bench marks. The limits of the embankment shall be marked by fixing batter pegs on both sides at regular intervals as guides before commencing the earthwork. To ensure the safety, the pegs should normally be fixed about 500mm away from the actual limits of the fill and to be painted in a distinct colour. The centreline of the embankment shall be pegged at regular intervals of 25/30m and at all skews/curves. The actual profile of the embankment shall be made at every third centre line peg with bamboo posts and strings. Preferably prototype profiles developed with wooden planks need to be fixed at every 200m and at the intersection points at curves. The profile shall be about 3m long.



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3.03.03 Stripping and Storing top soil

The construction of the earthen embankment by filling shall conform to the dimensions, slopes and other details shown in the approved drawings. Before commencement of the embankment construction, the surface area of ground to be occupied after clearing and grubbing shall be stripped off to a minimum depth of 150mm or more as directed by the Engineer in order to remove all perishable materials and any soil which may become unstable on saturation or may interfere with the development or proper bonding between the foundation and embankment. It is not necessary to remove all the soil containing fine hair like roots but only the rather heavy mats are to be removed. In localities where most of the available embankment fill materials are not conducive to plant growth or when so directed by the Engineer, the top soil suitable for plant growth existing over the embankment foundation areas shall be stripped to specified depths not exceeding 150mm and stored for covering the embankment slopes where revegetation is desired.

3.03.04 Compacting Original Ground

In all cases, the original ground after stripping shall be compacted by rolling with a minimum six passes of 8-10 tonne roller and as directed by the Engineer.

Where the height of the proposed embankment is less than 0.5m and the original ground does not already have a relative compaction of at least 95 percent of Standard Proctor density (maximum dry density), the same shall be loosened upto a depth of 0.5m and filled in layers not exceeding 250mm in loose thickness and each layer shall be watered and compacted to 100% maximum dry density of the fill material determined in accordance with IS:2720, Part-VII. However before relaying and compacting the loosened material, the surface below this level shall be suitably compacted as directed by the Engineer with a minimum six passes of 8 - 10 tonne roller.

Where so directed by the Engineer, any unsuitable material occurring in the embankment foundation shall be removed and replaced with approved materials suitably compacted. Embankment work shall not proceed until the foundation soil of the embankment is inspected by the Engineer and approved.

3.03.05 Filling

The embankment material shall be spread uniformly over the entire width of the embankment in layers not exceeding 250mm in loose thickness. Successive layers of embankment shall not be placed until the layer under construction has been thoroughly compacted to the requirements set down hereunder. Moisture content of the fill material shall be checked at the source



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of supply and if found less than that specified for compaction, the same shall be made good either at the source or after spreading the soil in loose thickness for compaction. In the latter case water shall be sprinkled directly from a hose line or from a truck mounted water tank and flooding shall not be permitted under any circumstances. After adding required amount of water, the soil shall be processed by means of harrows, rotary mixers or by any other approved method until the layer is uniformly wet.

If the material delivered to the road bed is too wet, it shall be dried by aeration and exposure to the sun till the moisture content is acceptable for compaction. Should circumstances arise where owing to wet weather, the moisture content cannot be reduced to the required amount by the above procedure, the work on compaction shall be suspended.

Moisture content of each layer shall be checked in accordance with IS:2720, Part-II and unless otherwise specified shall be so maintained making due allowance for evaporation losses that during compaction, the moisture content shall be in the range of 1 percent above to 2 percent below the optimum moisture content as determined in accordance with IS:2720, Part-VII.

Clods or hard lumps of earth shall be broken to have a maximum size of 150mm when being placed in the lower layers of the embankment and a maximum size of 60mm when being placed in the top 0.5m portion of the embankment below sub-base.

Hauling equipment shall be dispersed uniformly over the entire surface of the previously constructed layer to minimise rutting or uneven compaction.

Where the embankment is to be constructed across a low swampy ground that will not support the weight of trucks or other hauling equipments, the lower part of the fill shall be constructed by dumping successive loads in a uniformly distributed layer to a thickness not greater than that necessary to support the hauling equipment while placing subsequent layers.

3.03.06

Compaction

Compaction equipment approved by the Engineer shall only be employed for construction. If directed by the Engineer, the Contractor shall demonstrate the efficiency of the plant he intends to use by carrying out compaction trials. Each layer shall be thoroughly compacted to the density as specified in Table-III. Subsequent layers shall be placed only after the finished layer has been tested and accepted by the Engineer.



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Table - III

Compaction Requirements For Embankment

Sl. No.	Type of work/material	Field dry density as a percentage of maximum laboratory dry density as per IS : 2720, Part-VII
1.	Top 0.5m portion of embankment below sub-base and shoulders	Not less than 100
2.	Other portions of embankment	Not less than 95

When density measurements reveal any soft area in the embankment, further compaction shall be carried out as directed by the Engineer. If in spite of that the specified compaction is not achieved, the material in the soft area shall be removed and replaced with approved material and compacted to the density requirements and satisfaction of the Engineer.

3.03.07 Drainage

The surface of the embankment at all times during construction shall be maintained at such a cross fall as will shed water and prevent ponding.

3.03.08 Finishing Operations

Finishing operations shall include the work of shaping and dressing the shoulders, road bed and side slopes to conform the alignment, levels, cross sections and dimensions as shown on the drawings or as directed by the Engineer. Both the upper and lower ends of the side slopes shall be rounded off to improve the appearance and merge the embankment with the adjacent terrain.

3.04.00 Turfing With Sods

3.04.01 General

This work shall consist of furnishing and laying live sod of perennial turf forming grass on embankment slopes, shoulders or other locations as shown on the drawings or as directed by the Engineer. Unless otherwise specified the work shall be taken up following the construction of embankment provided the season is favourable for establishment of the sod.

3.04.02 Materials

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The sod shall consist of dense, well rooted growth of permanent and desirable grasses indigenous to the locality where it is to be used and shall be practically free from weeds and other undesirable matters. At the time the sod is cut, the grass shall have a length of approximately 50mm and the sod shall be free from any debris.

Thickness of the sod shall be as uniform as possible with about 50 to 80mm of soil covering the grass roots depending on the nature of the sod so that practically all the dense root system of the grass are retained in the sod strip. The sods shall be cut in rectangular strips of uniform width not less than 250mm x 300mm in size but not so large so that it is convenient to handle and transport without damage. During wet weather the sod shall be allowed to dry sufficiently to prevent rearing during handling and during dry weather it shall be watered before lifting to ensure its vitality and to prevent dropping of soil during handling.

3.04.03 Placing The Sods

The area to be sodded shall be previously constructed to the required slope and cross section. Soil in the area shall be loosened, freed from all stones larger than 50mm size, sticks, stumps and any other undesirable foreign matters etc and brought to a reasonably granular texture to a depth not less than 25mm for receiving the sod.

Where required, top soil shall be spread over the slopes. Prior to placing the top soil, the slopes shall be roughened and wetted in order to have a satisfactory bond. The depth of top soil (to be spread) shall be 75mm.

Following soil preparation and top soiling (if required), fertilizer and ground limestone when specified shall be spread uniformly. After spreading, the materials shall be incorporated in the soil by discing or other means. The prepared sod bed shall be moistened if not already sufficiently moist and the sod shall be placed thereon within 24 hours after the same has been cut. Each sod strip shall be laid in close contact with each other and shall be lightly tamped with suitable wooden or metal tampers so as to eliminate air pockets and to press it into the underlying soil. At points where water may flow over the sod, the upper edges of the sod strips shall be turned into the soil below the adjacent area and a layer of earth shall be placed over it followed by thorough compaction.

3.04.04 Staking the Sods

Where the side slope is 2 to 1 or steeper and the distance along the slope is more than 2m, the sods shall be staked with pegs or nails spaced approximately 500 to 1000mm along the longitudinal axis of the sod strips.

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	Stakes shall be driven approximately plumb through the sods and to be almost flushed with them. 3.04.05 Top Dressing After the sods have been laid in position, the surface shall be cleaned of any loose sod, excess soil and other foreign materials. Thereafter a thin layer of top soil shall be scattered over the top dressed surface and the area shall be thoroughly moistened by sprinkling water. 3.04.06 Watering and Maintenance The turfing so laid shall be well watered and protected until final acceptance. Watering shall be done in such a way that no erosion or damage to the sodded areas/embankment occur. The Contractor shall erect necessary warning signs and barriers, repair or replace the sods which are failing to show uniform growth of grass or damaged by his operation and shall maintain the sod at his own cost until final acceptance. 3.05.00 Shoulder Construction 3.05.01 Description This work shall consist of constructing shoulder on either side of the pavement in accordance with the requirements of this specification and in conformity with the lines, grades and cross sections shown on the approved drawings and as directed by the Engineer. 3.05.02 Materials Shoulder shall be made of selected earth or granular material as specified conforming to relevant IRC standards. 3.05.03 Construction Operations Except in the case of bituminous pavements, the shoulders shall be constructed in advance to the laying of pavement courses. The compacted thickness of each layer of shoulder shall correspond to the compacted layer of pavement course to be laid adjacent to it. After compaction, the inside edges of shoulders shall be trimmed vertical and the area enclosed between the shoulders shall be cleaned of all spilled materials before proceeding with the construction of the pavement layer.	

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	In the case of bituminous pavements, shoulder shall be constructed only after the pavement courses have been laid and compacted. Regardless of the method of laying, all shoulder construction material shall be placed directly on the shoulder. Any spilled material dragged on to the pavement surface shall be immediately removed without any damage to the pavement and the area so affected shall be thoroughly cleaned. During all stages of shoulder construction, the required crossfall shall be maintained to drain off surface water. 3.06.00 Kerb 3.06.01 Material Kerb if required for the construction of footpath shall consist of precast concrete blocks with concrete grade of M-20. The blocks shall be of 100mm thick and of suitable length. The depth of blocks unless otherwise mentioned elsewhere shall be 375mm considering 225mm height of footpath above the road level. 3.06.02 Laying The kerb shall be laid by cutting trenches of 150mm deep. The width of the trench shall be minimum and just sufficient to insert the kerbs. The inside faces of the kerbs shall be in plumb and the gap between the block shall not be more than 10mm. The gap shall be filled with cement mortar as specified. The kerbs shall be thoroughly packed with a mixture of stone chips (50%) and moorum (50%) at the outside face. The laying and packing shall be done in a proper workmanlike manner acceptable to the Engineer. 3.07.00 Sub-base (Granular Sub-base) 3.07.01 Description This work shall consist of laying and compacting well graded material on the prepared sub-grade in accordance with the specification. The material shall be laid in one or more layers as shown on the drawings and shall conform to the lines, grades and cross sections shown on the drawings and as directed by the Engineer. 3.07.02 Materials The materials to be used for the work shall be natural sand, moorum, gravel, crushed stone, crushed slag, crushed concrete, brick metal, laterite, kankar etc or combinations thereof depending upon the grading required. The mixed	



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materials shall be free from organic and other deleterious constituents and conform to one of the three grading given in Table - IV below.

**Table - IV
Grading for Granular Sub-base Material**

Sieve designation	Percent by weight passing the sieve		
	Grading 1	G r a d i n g 2	G r a d i n g 3
80 mm	100	100	100
63 mm	90 - 100	90 - 100	90 - 100
4.75 mm	35 - 70	40 - 90	50 - 100
75 micron	0 - 20	0 - 25	0 - 30
Minimum CBR value for the fraction of material passing 20 mm sieve.	30 %	25%	20%

Note : The materials passing 425micron sieve for all the three gradings when tested according to IS : 2720, Part V shall have liquid limit and plasticity index not more than 25 percent and 6 percent respectively.

3.07.03 Physical Requirements

The fraction of materials passing 20mm sieve shall give a CBR value as specified in Table – IV when tested in accordance with IS : 2720, Part XVI after preparing the samples at maximum dry density and optimum moisture content corresponding to IS : 2720, Part VII and soaking the same in water for 4 days.

3.07.04 Spreading and Compacting



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Immediately prior to laying of sub-base, the sub-grade already finished shall be prepared by removing all vegetations and other extraneous matters, lightly sprinkled with water if necessary and rolled with one pass of 8 - 10 tonne smooth wheeled roller.

The sub-base material shall be spread on the sub-grade with the help of a drag spreader, motor grader or other approved means. The thickness of loose layers shall be so regulated that the maximum thickness of each layer after compaction shall not exceed 150mm.

Moisture content of the loose material shall be checked in accordance with IS : 2720, Part II and shall be suitably adjusted by sprinkling additional water from a hose line, truck mounted water tank or other approved means so that at the time of compaction it shall be from 1 percent above to 2 percent below the optimum moisture content. While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means if so directed by the Engineer until the layer is uniformly wet.

Immediately thereafter, rolling shall be done with 8 to 10 tonne smooth wheeled rollers or with any other approved plant. Rolling shall commence from the edges and progress towards the centre longitudinally except on super elevated portions where it shall progress from the lower to the upper edge parallel to the centre line of the pavement. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. During rolling, the grade and camber shall be checked and any high spots or depressions which become apparent shall be corrected by removing or adding fresh material.

Rolling shall be continued till the density achieved is at least 100% of the maximum dry density of the material determined as per IS : 2720, Part VII. The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction plant and from compaction planes, ridges, cracks or loose materials. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and recompacted.

3.08.00 Water Bound Macadam Sub-base/Base Course

3.08.01 Description

Water bound macadam shall consist of clean crushed aggregates mechanically interlocked by rolling and bonded together with screenings, binding material wherever necessary and water, laid on the prepared sub-grade or sub-base as the case may be and finished in accordance with the specification and in



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conformity with the lines, grades and cross-sections shown on the approved drawings.

3.08.02

Materials

a) Coarse Aggregates - General Requirements

Coarse aggregates shall be either crushed or broken stone. The aggregates shall conform to the physical requirements set forth in Table - V.

Table – V

Physical Requirements of Coarse Aggregates for Water Bound Macadam

Sl.No.	Type of Construction	Test	Test method	Requirements
1.	Sub-base	Los Angeles Abrasion Value * or Aggregate Impact Value	IS : 2386 (Part IV) IS : 2386 (Part IV) or IS : 5640**	50 percent maximum 40 percent maximum
2.	Base	a) Loss Angeles Abrasion value* or Aggregate Impact Value b) Flakiness Index ***	IS : 2386 (Part IV) IS : 2386 (Part IV) or IS : 5640 ** IS : 2386 (Part I)	50 percent maximum 40 percent maximum 15 percent maximum

* Aggregates shall satisfy requirements of either of the two tests.

** Aggregates like brick metal, kankar and laterite which get softened in presence of water shall be tested for impact value under conditions in accordance with IS : 5640.

*** The requirements of Flakiness Index shall be enforced only in case of crushed or broken stone and crushed slag.

b) Crushed or Broken Stone

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Crushed or broken stone shall be hard, durable and free from excess flat, elongated, soft and disintegrated particles, dirt and other objectionable matters.

c) Grading Requirements of Coarse Aggregates

The coarse aggregates shall conform to one of the gradings given in Table – VI. However the use of Grading-1 shall be restricted to sub-base courses only.

Table - VI
Grading Requirements of Coarse Aggregates

Grading	Size range	Sieve designation	Percent by weight passing the sieve
1.	90mm to 40 mm	100 mm	100
		80 mm	65 - 85
		63 mm	25 - 60
		40 mm	0 - 15
		20 mm	0 - 5
2.	63 mm to 40 mm	80 mm	100
		63 mm	90 - 100
		50 mm	35 - 70
		40 mm	0 - 15
		20 mm	0 - 5
3.	50 mm to 20 mm	63 mm	100
		50 mm	95 - 100
		40 mm	35 - 70
		20 mm	0 - 10
		10 mm	0 - 5

d) Screenings

Screenings to fill the voids in the coarse aggregate shall generally consist of the same material as the coarse aggregates. However where permitted, predominantly non-plastic material such as moorum or gravel (other than rounded river borne material) may be used for this purpose provided liquid limit and plasticity index of such material is below 20 and 6 respectively and fraction passing 75 micron sieve does not exceed 10 percent.

As far as possible, screenings shall conform to the grading set forth in Table-

VII. Screenings of Type-A in Table-VII shall be used with coarse aggregates of Grading-1 in Table-VI. Screenings of Type-A or B shall be used with coarse aggregates of Grading-2. Screenings of Type-B shall be used with coarse aggregates of Grading-3.

**Table - VII
Grading For Screenings**

Grading classification	Size of screenings	Sieve designation	Percent by weight passing the sieve
A	12.5 mm	12.5 mm	100
		10.0 mm	90 - 100
		4.75 mm	10 - 30
		150 micron	0 - 8
B	10 mm	10 mm	100
		4.75 mm	85 - 100
		150 micron	10 - 30

e) Binding Material

Binding material to be used for water bound macadam construction shall comprise of a suitable material approved by the Engineer having plasticity index value less than 6 as determined in accordance with IS : 2720, Part V. Application of binding material may not be necessary when the screenings used are of crushable type such as moorum or gravel.

3.08.03

Construction Operations

a) The sub-grade/sub-base to receive the water bound macadam coarse shall be prepared to the specified grade and camber and made free of any dust and other extraneous materials. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm. Where water bound macadam is to be laid over an existing black topped surface, 50mm x 50mm furrows shall be cut at an angle of 45 degrees to the centre line of the road at 1m intervals in the latter before laying the coarse aggregates.

b) Inverted Choke



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If water bound macadam is to be laid directly over the sub-grade without any other intervening pavement course, a 25mm course of screenings (Grading-B) shall be spread on the prepared sub-grade before application of coarse aggregates is taken up.

c) Spreading Coarse Aggregates

The coarse aggregates shall be spread uniformly over the prepared surface in such quantities that the thickness of each compacted layer is limited to 100mm for Grading-1 and 75 - 100mm for Grading-2 and 3. The spreading shall be done from stockpiles along the side of the roadway or directly from the vehicles. In no case shall the aggregate be dumped in heaps directly on the surface prepared to receive the aggregates nor shall hauling over permitted. The surface of the aggregates spread shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregates as may be required. No segregation of large or fine particles shall be allowed and the coarse aggregates as spread shall be of uniform gradation with no pockets of fine material. The coarse aggregates shall not normally be spread more than 3 days in advance of the subsequent construction operation.

d) Rolling

Immediately following the spreading of the coarse aggregates, rolling shall be started with three wheeled power rollers of 8 to 10 tonne capacity or with tandem or vibratory rollers of approved type. The weight of the roller shall depend upon the type of the aggregate and be indicated by the Engineer.

Except on super elevated portions where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the centre. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inwards parallel to the centre line of the road. Each pass of the roller shall uniformly overlap not less than one half the width of the track made in the preceding pass.

Rolling shall continue until the aggregates are thoroughly keyed and the creeping of aggregates ahead of the roller is no longer visible. During rolling slight sprinkling of water may be done if necessary. Rolling shall not be done when the sub-grade is soft or yielding or when it causes a wavelike motion in the sub-grade or sub-base course.

The rolled surface shall be checked transversely and longitudinally with templates and any irregularities found shall be corrected by loosening the surface, adding or removing necessary amount of aggregates and rerolled until the entire surface conform to the desired camber and grade. In no case shall the use of screenings be permitted to make up the depressions.

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e) Application of Screenings

After the coarse aggregate has been rolled, screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screenings are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregates. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers either by the spreading motion of hand shovels or by mechanical spreader or directly from trucks. Trucks operating for spreading the screenings shall be so driven as not to disturb the coarse aggregates.

The screenings shall be applied at a slow and uniform rate (in three or more applications) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms or hand brooms or with both. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregate. These operations shall continue until no more screenings can be forced into the voids of the coarse aggregates.

The spreading, rolling and brooming of screenings shall be carried out in only such lengths of road which could be completed within one day's operation.

f) Sprinkling and Grouting

After the screenings have been applied, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to seep the wet screenings into the voids and to distribute them evenly. The sprinkling, sweeping and rolling operations shall be continued with additional screenings applied as necessary until the coarse aggregates are thoroughly keyed, well bonded and firmly set to its full depth and a grout has been formed of screenings. Care shall be taken to see that the base or sub-grade does not get damaged due to the addition of excess quantity of water during construction.

g) Application of Binding Material

After the application of screenings, the binding material where it is required to be used shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water and the resulting slurry shall be swept in with hand brooms or mechanical brooms to fill the voids properly and rolled during which water shall be applied to the wheels of the rollers if necessary to wash down the binding material sticking to them. These operations shall continue until the



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resulting slurry after filling the voids form a wave ahead of the wheels of the moving roller.

h) Setting and Drying

After the final compaction of water bound macadam course, the road shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings or binding material as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam is set. The Engineer shall have the discretion to stop hauling traffic from using the complete water bound macadam course if in his opinion it would cause excessive damage to the surface.

3.09.00 Tack Coat

3.09.01 Description

The work shall consist of application of a single coat of low viscosity liquid bituminous material to an existing road surface preparatory to another bituminous construction.

3.09.02 Materials

The binder used for tack coat shall be bitumen of a suitable grade as approved by the Engineer and conforming to IS-73, IS-217 or IS-454 as applicable or any other approved cutback.

3.09.03 Construction Operations

a) Preparation of Base

The surface on which the tack coat is to be applied shall be thoroughly swept and scraped clean of dust and any other extraneous materials before the application of the binder.

b) Application of Binder

Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer and sprayed on the base at the rate specified below. The rate of spread in terms of straight run bitumen shall be 5 kg per 10 square metre area for an untreated water bound macadam surface. The binder shall be supplied uniformly with the aid of sprayers. The tack coat shall be applied just ahead of the oncoming bituminous construction.



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3.10.00 Bituminous Macadam Binder Course

3.10.01 Description

This work shall consist of construction in a single course of 50mm/75mm thickness of compacted crushed aggregates premixed with a bituminous binder laid immediately after mixing on a base prepared previously in accordance with the specification and in conformity with the lines, grades and cross sections shown on the approved drawings.

3.10.02 Materials

a) Binder

The Binder shall be straight run bitumen of a suitable grade as directed by the Engineer complying with IS : 73.

b) Aggregates

The aggregates shall consist of crushed stone, crushed gravel (shingle) or other stones. They shall be clean, strong, durable, fairly cubical in shape and free from any disintegrated pieces, organic and other deleterious matter and adherent coats. The aggregates shall preferably be hydrophobic and of low porosity.

The aggregates shall satisfy the physical requirements set forth in Table - VIII.

Table – VIII

Physical Requirements of Aggregates For Bituminous Macadam

Sl. No.	Test	Test method	Requirements
1.	Los Angeles Abrasion Value *	IS : 2386 (Part IV)	35 percent maximum
2.	Aggregate Impact Value *	IS : 2386 (Part IV)	30 percent maximum
3.	Flakiness Index	IS : 2386 (Part I)	35 percent maximum
4.	Stripping Value	IS : 6241 (Part IV)	25 percent maximum
5.	Water Absorption	IS : 2386 (Part III)	2 percent maximum



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*Aggregates may satisfy requirements of either of the two tests.

The aggregates for bituminous macadam for different thickness shall conform to Grading- A or B as given in Table-IX or X as the case may be.

**Table-IX
Aggregates Grading For 75mm Compacted Thickness of Bituminous Macadam**

Sieve Designation	Percent by weight passing the sieve	
	Grading A	Grading B
63 mm	100	
50 mm	90 - 100	
40 mm	35 - 65	100
25 mm	20 - 40	70 - 100
20 mm	-	50 - 80
12.5 mm	5 - 20	-
4.75 mm	-	10 - 30
2.36 mm	-	5 - 20
75 micron	0 - 5	0 - 4

**Table-X
Aggregates Grading For 50mm Compacted Thickness of Bituminous Macadam**

Sieve Designation	Percent by weight passing the sieve	
	Grading A	Grading B
50 mm	100	
40 mm	90 - 100	
25 mm	50 - 80	100
20 mm	-	70 - 100



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12.5 mm	10 - 30	-
10 mm	-	35 - 60
4.75 mm	-	15 - 35
2.36 mm	-	5 - 20
75 micron	0 - 5	0 - 4

c) Proportioning of Materials

The binder content for premixing shall be 3.5 and 4.0 percent by weight of the total mix for aggregate Grading-A and B respectively unless directed otherwise by the Engineer. The quantity of aggregates to be used shall be sufficient to yield the specified thickness after compaction.

d) Variation in Proportioning of Materials

The Contractor shall have the responsibility for ensuring proper proportioning of materials and producing a uniform mix. A variation in binder content upto ± 0.3 percent by weight of total mix shall however be permissible for individual specimens taken for quality control tests.

3.10.03

Construction Operations

a) Weather and Seasonal Limitations

Bituminous macadam shall not be laid during rainy weather or when the base course is damp or wet.

b) Preparation of Base

The base on which the bituminous macadam is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross sections as shown on the drawings and as directed by the Engineer. The surface shall be thoroughly swept and scraped clean and free of any dust and foreign matter.

c) Tack Coat

A tack coat shall be applied over the base.

d) Preparation and Transport of Mix

Hot mix plant of adequate capacity shall be used for preparing the mix. The temperature of binder at the time of mixing shall be in the range 150 Deg. - 165 Deg. C and to that of aggregates shall be in the range 125 Deg. - 150 Deg. C provided the temperature difference between the binder and the aggregate at no time exceeds 25 Deg. C. Mixing shall be thorough to ensure that a homogenous mixture is obtained in which all particles of the aggregates are



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coated uniformly. The mixture shall be transported from the mixing plant to the point of use in a suitable vehicle. The vehicle employed for transport shall be clean and be covered over in transit if so directed by the Engineer.

e) Spreading

After mixing, the mix shall be spread immediately by means of a self propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mix to the specified lines, grade and cross sections. However in restricted locations and in narrow widths where the available plants cannot operate in the opinion of the Engineer may permit manual laying of the mix. The temperature of mix at the time of laying shall be in the range 110 Deg. - 135 Deg. C.

In multilayer construction, the longitudinal joint in one layer shall offset into the layer below by about 150mm. However, the joint in the topmost layer shall be at the centre line of the pavement.

Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

f) Rolling

After spreading of mix, the rolling shall be done with 8 to 10 tonne power roller or with any other approved plant. Rolling should start as soon as the materials are spread. Rolling shall be done with care to avoid any undulation in the pavement surface.

Rolling on the longitudinal joint shall be done immediately after the paving operation. After this, the rolling shall commence at the edges and progress towards the centre longitudinally except on superelevated portions where it shall progress from the lower to the upper edge parallel to the centre line of the pavement.

The initial or breakdown rolling shall be done as soon as it is possible to roll the mixture without cracking the surface and no mix pick up on the roller wheels. The second or intermediate rolling shall follow the break down rolling as early as possible and be done while the paving mix is still at a temperature that will result in maximum density. The final rolling shall be done while the material is still workable enough for removal of roller marks.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding fresh materials. The rolling shall then be continued till the entire surface has



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been rolled to compaction and there is no crushing of aggregates and till all the roller marks are eliminated. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. The roller wheels shall be kept damp if necessary to avoid the bituminous material from sticking on the wheels and being picked up. In no case shall fuel/lubricating oil be used for this purpose.

Rolling operation shall be completed in every respect before the temperature of the mix fall below 80 Deg. C.

Rollers shall not stand on the newly laid material as it may lead to undue deformation. The edges along and transverse of the bituminous macadam laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of appropriate binder before the new mix is placed against it.

The bituminous macadam shall be provided with a final surfacing without any delay. If there is to be any delay the course shall be covered by seal coat before allowing any traffic over it.

3.11.00 Open Graded Premix Carpet

3.11.01 Description

This work shall consist of laying and compacting open graded carpet of specified thickness in a single course of suitable small sized aggregates premixed with bituminous binder on a previously prepared base to form wearing course in accordance with the specification.

3.11.02 Materials

a) Binder

The binder shall be bitumen of suitable grade as approved by the Engineer and satisfying the requirements of IS: 73, 217, 454 or any other approved cutback as applicable.

b) Aggregates

The aggregates shall consist of angular fragments of clean, hard, tough and durable rock of uniform quality throughout. They shall be obtained by crushing rock, gravel or river shingle and be free of elongated and flaky pieces, soft and disintegrated materials, vegetable and any other deleterious matter etc. They shall preferably be hydrophobic type. The aggregates shall satisfy the quality requirements set forth in Table-VIII except that the flakiness Index shall be limited to a maximum of 30.

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c) Proportioning of Materials

The materials shall be proportioned as per the quantities given in Table-XI for 20mm thick open graded premix carpet.

Table - XI**Quantity of Materials Required For 10 Sq. M of Road Surface For 20mm Thick Open Graded Premix Carpet**Aggregates for Carpet

i) Stone Chippings - 12mm size ; passing 0.18 Cu.m
20 mm sieve and retained on 10 mm sieve

ii) Stone Chippings - 10 mm size; passing
12.5 mm sieve and retained on 6.3 mm sieve 0.09 Cu.m

Total 0.27 Cu.m

Binder for premixing (quantities in terms of straight run bitumen)

i) For 0.18 Cu.m of 12 mm size stone 9.5 Kg
Chippings at 52 Kg per Cu.m

ii) For 0.09 Cu. M of 10mm size stone
Chippings at 56 Kg per Cu.m 5.1 Kg



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Total 14.6 Kg

3.11.03

Construction Operation

a) Weather and Seasonal Limitations

Open graded premix carpet shall not be laid during rainy weather or when the base course is damp or wet or when the atmospheric temperature in shade is 16 Deg. C or below.

b) Preparation of Base

The underlying base on which the bituminous carpet is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross section in accordance with the drawing, specification and as directed by the Engineer. The surface shall be well cleaned by removing caked earth and other foreign matters with wire brushes, sweeping with brooms and finally dusting with sacks as necessary.

c) Tack Coat

A tack coat complying with clause 3.09.00 shall be applied over the base preparatory to laying of the carpet. However application of tack coat shall not be necessary when the laying of carpet follows soon after laying the bituminous course.

d) Preparation of Premix

Mixers of approved type shall be employed for mixing the aggregates with the bituminous binder. The binder shall be heated to the temperature appropriate to the grade of bitumen approved by the Engineer in boilers of suitable design avoiding local overheating and ensuring a continuous supply. The aggregates shall be dry and suitably heated to a temperature as directed by the Engineer before these are placed in the mixer. After about 15 seconds of dry mixing, the heated binder shall be distributed over the aggregates at the rate specified. The mixing of binder with chipping shall be continued until the chippings are thoroughly coated with the binder. The mix shall be immediately transported from the mixer to the point of use in suitable vehicles or wheel barrows. The vehicles employed for transport shall be clean and be covered over in transit if so directed.

e) Spreading and Rolling

The premixed material shall be spread on the road surface with rakes to the



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required thickness and camber or distributed evenly with the help of a drag spreader without any undue loss of time. The camber shall be checked by means of camber boards and inequalities evened out. As soon as sufficient length of bituminous material are laid, rolling shall be commenced with 6 to 8 tonne power rollers preferably with smooth wheel tandem type or with any other approved plant. Rolling shall begin at the edges and progress toward the centre longitudinally except on the superelevated portions where it shall progress from the lower to upper edge parallel to the centre line of the pavement.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding premixed materials. Rolling shall then be continued until the entire surface has been rolled to compaction and all the roller marks have been eliminated. In each pass of the roller, preceding track shall be overlapped uniformly by at least 1/3 width. The roller wheels shall be kept damp to prevent the premix from adhering to the wheels and being picked up. In no case shall fuel/lubricating oil be used for this purpose. Rollers shall not stand on newly laid material as it may lead to undue deformations.

The edges along and transverse of the carpet laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of approved binder before the new mix is placed against it.

f) Seal Coat

A seal coat conforming to clause 3.12.00 shall be applied to the surface immediately after laying the carpet. No traffic shall be allowed on the road till the seal coat has been placed.

3.12.00 Seal Coat

3.12.01 Description

This work shall consist of application of a seal coat as specified for sealing the voids in the bituminous surface laid to the specified levels, grade and camber.

Type-A : Liquid seal coat comprising of an application of a layer of bituminous binder followed by a cover of stone chippings.

Type-B : Premixed seal coat comprising of a thin application of fine aggregate premixed with bituminous binder.

3.12.02 Materials



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a) Binder

The binder shall be bitumen of suitable grade as directed by the Engineer and conforming to the requirements of IS : 73, 217 or 454 as applicable or any other approved cutback.

The quantity of binder to be adopted in terms of straight run bitumen shall be 9.8 Kg and 6.8 Kg per 10 square metre area for Type-A and Type-B seal coat respectively.

b) Stone Chippings for Type A Seal Coat

The stone chippings shall consist of angular fragments of clean, hard, tough and durable rock of uniform quality throughout. They shall be free of elongated or flaky pieces, soft or disintegrated stone, vegetable or other deleterious matters etc. Stone chippings shall be of 6mm size defined as 100 percent passing through 10mm sieve and retained on 2.36mm sieve. The quantity used for spreading shall be 0.09 cu.m per 10 sq.m area. The chippings shall satisfy the quality requirements spelled out in Table- VIII except that the upper limit for flakiness Index shall be 30.

c) Fine Aggregate for Type B Seal Coat

The fine aggregate shall be sand or fine grit and shall consist of clean, hard, durable, uncoated dry particles and shall be free from dust, soft or flaky material, organic matter or other deleterious substances. The aggregate shall pass 1.7 mm sieve and be retained on 180 micron sieve. The quantity used for premixing shall be 0.06 cubic metre per 10 square metre area.

3.12.03

Construction Operations

a) Preparation of Base

The seal coat shall be applied immediately after laying the bituminous course which is required to be sealed. Before application of seal coat, the surface shall be cleaned free of any dust or other extraneous matters.

b) Construction of Type-A Seal Coat

The binder shall be heated in boilers of suitable design to the temperature appropriate to the grade of bitumen approved by the Engineer and sprayed on the dry surface in a uniform manner preferably with the help of mechanical sprayers. Excessive deposits of binder caused by stopping or starting of the



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sprayer or through leakage or due to any other reason shall be suitably corrected before the stone chippings are spread.

Immediately after the application of binder, stone chippings in a dry and clean state shall be spread uniformly on the surface preferably by means of a mechanical grittier or otherwise manually so as to cover the surface completely. If necessary the surface shall be broomed to ensure uniform spread of chippings. Immediately after the application of the cover material, the entire surface shall be rolled with a 8 - 10 tonne smooth wheeled roller. Rolling shall commence from the edges and progress towards the centre except in superelevated portions where it shall proceed from the inner edge to the outer. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. While rolling is in progress additional chippings shall be spread by hand in whatever quantities required to make up the irregularities. Rolling shall continue until all aggregate particles are firmly bedded in the binder and present an uniform closed surface.

c) Construction of Type-B Seal Coat

Mixers of approved type shall be employed for mixing the aggregates with the bituminous binder. The binder shall be heated in boilers of suitable design to the temperature appropriate to the grade of bitumen approved by the Engineer. Also the aggregates shall be dry and suitably heated to a temperature as directed by the Engineer before the same are placed in the mixer. Mixing of binder with aggregates to the specified proportions shall be continued till the latter is thoroughly coated with the former. The mix shall be immediately transported from the mixing plant to the point of use and spread uniformly on the bituminous surface to be sealed. As soon as sufficient length has been covered with the premixed material, the surface shall be rolled with 6 - 8 tonne smooth wheeled power rollers. Rolling shall be continued till the premixed material completely seals the voids in the bituminous course and a smooth uniform surface is obtained.

3.12.04 Opening to Traffic

In case of Type-B Seal coat, traffic may be allowed soon after the final rolling when the premixed materials are cooled down to the surrounding temperature. However in case of Type- A seal coat, the traffic shall not be permitted until the following day.

3.13.00 Repair of Existing Water Bound Macadam Surfaces

Pot holes or patches and ruts in the water bound macadam base or surface course which is to be surface treated shall be repaired by removing all loose materials by cutting in rectangular patches and replacing with suitable materials. The repair shall be done as under.

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Pot holes, patches and ruts shall be drained of any water and cut to regular shape with vertical sides and then be filled either with i) coarse aggregates and screenings conforming to the specification for water bound macadam and compacted with rollers or other approved rammer etc or with ii) premixed material conforming to the specification for open graded premix carpet and compacted with rollers or other approved means after painting the sides and bottom of the holes with a thin application of bitumen or a combination of both as directed by the Engineer.

3.14.00 Road Side Drains**3.14.01 Drains**

The road side drains shall be made in sizes and slopes as shown on the approved drawings. The sides and bottom shall be neatly dressed after excavation. Proper connections shall be made to the culverts outside the plant area as per the drawings and instructions of the Engineer.

The excavated spoils other than that required for backfilling shall be transported and filled in low areas within the plant area or in embankments as instructed by the Engineer. The lining for drains shall be as per the drawings. Lining of drains may be of bricks or cement concrete blocks of specified grade as shown on the approved drawing or as directed by the Engineer. If shown on approved drawing, drains shall be of R.C.C. construction with necessary slopes.

3.15.00 Culverts

Excavation in trenches for foundation of culverts and wing walls shall be done with side slopes as per the drawings and instructions of the Engineer after clearing the site etc. As described in the "Specification for Earthwork in Excavation and Backfilling", backfilling in layers with watering and compaction shall be done after the construction of foundations. The construction of culverts shall be done true to the lines and levels as shown on the drawings. The specification for Masonry and/or Plain and Reinforced Cement concrete shall be followed as applicable.

3.16.00 Pipe Culverts and Drainage Pipes**3.16.01 Materials**

The drainage pipes shall be made of R.C.C and shall be either class NP-2 or NP-3 as shown on the approved drawings. Pipe culverts shall be made of reinforced concrete pipe and shall be of class NP4 or RDSO class for railways as shown in the drawing. All pipes shall meet the requirements of IS : 458 and



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shall be procured from approved manufacturers with collars as per manufacturer's specification. The tenderer shall specifically mention the particular manufacturer's product he proposes to use.

Cement shall be ordinary Portland Cement as per IS:269. Coarse Aggregates shall be as per IS:383. Maximum size shall not exceed one third the thickness of the pipe or 20 mm whichever is smaller. Fine aggregates for concrete shall be as per IS:383.

3.16.02

Laying of Pipes

Laying of concrete pipes shall correspond to IS:783 and as per the specification given below.

a) The foundation bed for pipe shall be excavated true to lines and grades shown on the drawings and as directed by the Engineer. When trenching is involved, its width on either side of the pipe shall not be less than 150mm and not more than one third the diameter of pipe unless otherwise instructed/permited by the Engineer. The sides of the trench shall be as nearly vertical as possible. Side slope, shoring, bailing out water etc as required shall be done by the Contractor.

Side slips if there be any shall be removed by the Contractor. After laying of the pipes are completed, backfilling of the trenches shall be done as per "Specification for Earthwork in Excavation and Backfilling" to the satisfaction of the Engineer. The surplus spoils shall be transported and filled in low areas within the plant area as instructed by the Engineer.

When bedrock or boulder stratum is encountered during excavation, the excavation shall be taken down to at least 200mm below the bottom of the pipe with prior permission of the Engineer and all rock/boulders in the area shall be removed and space filled with approved earth free from stone or fragmented materials, shaped to the requirements and thoroughly compacted to provide adequate support for the pipe.

Filling of trench shall be carried out simultaneously on both sides of the pipe in such a manner that unequal pressures do not occur and shall be done as per the "Specification for Earthwork in Excavation and Backfilling". When two or more pipes are to be laid adjacent to each other, they shall be separated by a distance equal to at least half the diameter of the pipe subject to a minimum of 450 mm. Laying of pipes shall start from the outlet and proceed towards inlet. All pipes and fittings shall be gradually lowered into the trench or placed on the supports by approved means taking due care to avoid any damage. Under no circumstances the pipes shall be dropped into the trench or on supports from heights.

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b) Pipe bedding shall be first class projection bedding for positive projecting pipes as per IS : 783 having a projection ratio not greater than 0.70. The pipe shall be carefully laid on bedding made up of fine granular materials in an earth foundation; the bedding shall be carefully shaped to fit the lower part of the pipe exterior for at least ten percent of its overall height and in which the fill material is thoroughly compacted in layers not exceeding 150mm in depth around the pipe for the remainder of the pipe laid in trench.

When indicated on the drawings or directed by the Engineer, the pipe shall be bedded on a cradle constructed of concrete having a mix not leaner than M-15. The shape and dimension of the cradle shall be as indicated on the drawing or as directed by the Engineer. The pipe shall be laid on the concrete bedding before the concrete is set.

c) The drop walls shall be made with first class brickwork in 1:4 cement mortar.

d) The pipe culverts shall be made with proper care with respect to the invert of the pipe, gradient if any etc as specified on the drawings and as instructed by the Engineer.

e) Where R.C.C pipes are encased in concrete at road crossings or at other places the pipes need be suitably supported avoiding reinforcements of concrete blocks, joints properly done before concreting is taken up. Concreting of total height of block may be done in a single operation or may be done upto some height for pipes to be properly laid in position and the balance height of the block shall be concreted subsequently.

f) The R.C.C. pipes shall be joined with cement mortar. Cement mortar shall consist of 1 part of cement and 2 part of clean sand with only enough water for workability. Procedure of jointing shall be as per IS : 783.

3.16.03**Relation With Water Supply Pipeline**

Unless specifically cleared by the Engineer, under no circumstances shall the drainage pipes be allowed to come close to water supply pipelines.

3.17.00**Manholes and Inspection Chambers**

The maximum distance between the manholes shall be 30m unless specifically permitted otherwise. In addition, at every change of alignment, gradient or diameter there shall be a manhole or inspection chamber. The distance between the manhole or inspection chamber and gully chamber shall not exceed 6 meters unless permitted otherwise. Manhole shall be constructed so as to be water tight under test. The channel or drain at the bottom of chamber shall be plastered with 1:2 cement sand mortar and finished smooth to the grade. The channels and drains shall be shaped and laid to provide a smooth

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flow. Connection to the existing pipelines shall be through a manhole. Manholes shall be provided with standard covers usually of C.I. or as directed by the Engineer. The cover shall be closely fitted so as to prevent gases from coming out.

4.00.00 Testing and Acceptance Criteria

All testing as mentioned in the specification and as mentioned in Clause No. 900 of the “Specification for Roads and Bridge Works, 1983” published by IRC on behalf of Ministry of Shipping and Transport (Roads Wing) shall be carried out by the Contractor as per the direction of the Engineer.

5.00.00 MEASUREMENT

Method of measurement shall be as per the latest version of IS:1200, Part-17 and as directed by the Engineer.



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Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



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SUB-SECTION – D XVII

FABRICATION OF STRUCTURAL STEEL WORK

1.00.00 SCOPE

This specification covers supply, fabrication, testing, painting and delivery to site of structural steelwork including supply of all consumable stores and rivets, bolts, nuts, washers, electrodes and other materials required for fabrication and field connections of all structural steelwork covered under the scope of the contract.

2.00.00 GENERAL

2.01.00 Work to be provided for by the Contractor

The work to be provided for by the Contractor, unless otherwise specified elsewhere in the contract, shall include, but not be limited to the following

- a) Preparation of complete detailed fabrication drawings and erection marking drawings required for all the structures covered under the scope of the contract based on the approved design drawings. As decided by the Engineer, some or all of these detailed drawings will have to be submitted for approval.
- b) To submit revised design with calculations and detailed fabrication drawings in case any substitution of the designed sections are to be made.
- c) To submit design calculations for joints and connections developed by the contractor along with detailed fabrication drawings.
- d) Furnish all materials, labour, tools and plant and all consumables required for fabrication and supply, all necessary rivets, bolts, nuts, washers, tie rods and welding electrodes for field connections,
- e) Furnish shop painting of all fabricated steelwork as per requirements of this Specification.
- f) Suitably mark, bundle, and pack for transport all fabricated materials.
- g) Prepare and furnish detailed Bill of Materials, Drawing Office Dispatch lists, Rivet and Bolt List and any other list of bought out items required in connection with the fabrication and erection of the structural steelwork.
- h) Insure, load and transport all fabricated steelwork field connection materials to site.

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	i) Maintain a fully equipped workshop at site for fabrication, modification and repairs of steelwork at site as may be required to complete the works in accordance with the Contract. 2.02.00 Work by others No work under this specification will be provided for by any agency other than the contractor, unless specifically mentioned otherwise elsewhere in the contract. 2.03.00 Codes and standards All work under this specification shall, unless otherwise specified in the contract, conform to the requirements of the latest revision and/or replacements of the following or any other relevant Indian Standard specifications and codes of practice. In case any particular aspect of the work is not specifically covered by any Indian Standard specification, any other standard practice, as may be specified by the Engineer shall be followed: IS : 226 - Structural steel (Standard Quality) IS : 800 - Code of Practice for general construction in steel. IS : 806 - Code of practice for use of steel tubes in general building construction. IS : 808 - Rolled steel beams, channels, and angle sections IS : 813 - Scheme of symbols for welding IS : 814 - Covered electrodes for metal arc welding of structural steel IS : 815 - Classification and coding of covered electrodes for metal arc welding of structural steels. IS : 816 - Code of practice for use of metal arc welding for general construction in mild steel IS : 817 - Code of practice for training and testing metal arc welders IS : 818 - Code of practice for safety and health requirements in electric and gas welding and cutting operations IS : 822 - Code of practice for inspection of welds IS : 919 - Recommendations for limits and fits for Engineering	

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IS : 961 - Structural Steel (High Tensile) IS : 1148 - Rivet bars for structural purposes IS : 1149 - High tensile rivet bars for structural purposes IS : 1161 - Steel Tubes for structural purposes IS : 1200 - Method of measurement of steelwork and ironwork (Part 8) IS : 1239 - Mild Steel Tubes IS : 1363 - Black hexagon bolts, nuts and lock nuts (dia. 6 to 30 mm) and black hexagon screws (dia 6 to 24 mm) IS : 1364 - Precision and semi-precision hexagon bolts, screws, nuts and 1 locknuts (dia, range 6 to 39 mm) IS : 1367 - Technical supply conditions for threaded fasteners IS : 1442 - Covered electrodes for the metal are welding of high tensile structural steel IS : 1608 - Method for tensile testing of steel products other than sheet strip, wire and tube IS : 1730 - Dimensions for steel plate, sheet, and strip for structural and general engineering purposes. IS : 1731 - Dimensions for steel flats for structural and general engineering purposes IS : 1852 - Rolling and cutting tolerances for hot-rolled steel products IS : 1977 - Structural steel (ordinary quality) St-42-0 IS : 2062 - Steel for General Structural Purposes IS : 2074 - Ready mixed paint, red oxide Zinc chromate priming IS : 2595 - Code of Practice for Radiographic Testing IS : 2629 - Recommended practice for Hot-Dip Galvanizing of Iron and Steel IS : 2633 - Method for testing uniformity of coating on Zinc Coated Articles					

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	IS : 3757 - High strength structural bolts IS : 4759 - Specifications for Hot-Dip Zinc Coatings on Structural Steel and other allied products IS : 7205 - Safety Code for Erection of Structural Steelwork IS : 7215 - Tolerances for fabrication of steel structures IS : 7280 - Bare wire electrodes for submerged arc welding of structural steels. IS : 9595 - Recommendations for metal arc welding of carbon and carbon manganese steels. 2.04.00 Conformity with Designs The contractor shall design all connections, supply and fabricate all steelwork and furnish all connection materials in accordance with the approved drawings and/or as instructed by the Engineer keeping in view the maximum Utilization of the available sizes and sections of steel materials. The methods of painting, marking, packing and delivery of all fabricated materials shall be in accordance with the provisions of the contract and/or as approved by the Engineer. Provision of all relevant Indian Standard Specifications and Codes of Practice shall be followed unless otherwise specified in the contract. 2.05.00 Materials to be used 2.05.01 General All steel materials required for the work will be supplied by the contractor unless otherwise specified elsewhere in the contract. The materials shall be free from all imperfections, mill scales, slag intrusions, laminations, fittings, rusts etc. that may impair their strength, durability, and appearance. All materials shall be of tested quality only unless otherwise permitted by the Engineer and/or Consultant. If desired by the Engineer, Test Certificates in respect of each consignment shall be submitted in triplicate. Whenever the materials are required to be used from unidentified stocks, if permitted by the Engineer, a random sample shall be tested at an approved laboratory from each lot of 50 tones or less of any particular section. The arc welding electrodes shall be of approved reputed manufacture and conforming to the relevant Indian Standard Codes of Practice and Specifications and shall be of heavily coated type and the thickness of the coating shall be uniform and concentric. With each container of electrodes,	

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	the manufacturer shall furnish instructions giving recommended voltage and amperage (Polarity in case of D.C. supply) for which the electrodes are suitable. 2.05.02 Steel All steel materials to be used in construction within the purview of this specification shall comply with any of the following Indian Standard Specifications as may be applicable: a) IS : 2062 - Steel for general structural purposes b) IS : 961 - Structural steel High Tensile c) IS : 1977 - Structural steel (Ordinary quality) St-42-0 In case of imported steel materials being used, these shall conform to specifications equivalent to any of the above as may be applicable. 2.05.03 Rivet Steel All rivet steel used in construction within the purview of this Specification shall comply with one of the following Indian Standard Specifications as may be applicable: a) IS : 1148 - Rivet Bars for structural purpose b) IS : 1149 - High tensile rivet bars for structural purposes. Where high tensile steel is specified for rivets, steps shall be taken to ensure that the rivets are so manufactured that they can be driven and heads formed satisfactorily without the physical properties of steel being impaired. 2.05.04 Electrodes All electrodes to be used under the Contract shall be of approved reputed manufacture, low hydrogen electrode and shall comply with any of the following Indian Standard Specifications as may be applicable a) IS : 814 - Covered electrodes for metal arc welding of structural steel b) IS : 815 - Classification and coding of covered electrodes for metal arc welding of mild steel and low alloy high tensile steel	

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	c) IS : 1442 - Covered electrodes for the metal arc welding of high tensile structural steel d) IS : 7280 - Bare wire electrodes for submerged arc welding of structural steels 2.05.05 Bolts and Nuts All bolts and nuts shall conform to the requirements of Indian Standard Specification IS: 1367 - Technical Supply Conditions for Threaded Fasteners. Materials for Bolts and nuts under the purview of this contract shall comply with any of the following Indian Standard Specifications as may be applicable. a) Mild Steel All mild steel for bolts and nuts when tested in accordance with the following Indian Standard Specification shall have a tensile strength of not less than 44 Kg/mm² and a minimum elongation of 23 per cent on a gauge length of 5.6 _/A, where "A" is the cross sectional area of the test specimen i) IS: 1367: Technical supply conditions for threaded fasteners ii) IS: 1608: Method for tensile testing of steel products other than sheet, strip, wire and tube b) High Tensile Steel The material used for the manufacture of high tensile steel bolts and nuts shall have the mechanical properties appropriate to the particular class of steel as set out in IS: 1367 or as approved by the Engineer. 2.05.06 Washers Washers shall be made of steel conforming to any of the following Indian Standard Specifications as may be applicable under the provisions of the Contract: a) IS : 2062 - Steel for general structural purposes b) IS : 961 - Structural Steel (High Tensile Quality) c) IS : 1977 - Structural steel (Ordinary Quality) St-42-0	

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	d) IS : 6649 - Hardened washers				
2.05.07	Paints				
	Paints to be used for shop coat of fabricated steel under the purview of this contract shall conform to the Indian Standard Specification IS: 2074 - Ready mixed Paint, Red oxide Zinc Chromate Priming.				
2.06.00	Coal Bin				
2.06.01	Shape of bins shall be circular, polygonal, square, or rectangular in plan. Bottom hopper portion may have be conical-cum-hyperbolic or any other profile shape as shown in the drawing. Bin shall be termed as bunkers or silos according to their shape and plane of rupture of coal.				
2.06.02	For general requirements, fabrication and construction details IS: 9178 (Pt.1 & 11) shall be followed as general guidance. The bins shall be fabricated and erected in segments.				
2.06.03	The Coal bins shall be made of mild steel plates joined together with full strength butt weld and provided with stiffeners at regular interval. Stiffeners shall be provided on the external face and it may be welded with external face.				
2.06.04	Bending of plates and rolled sections to the required shape for fabrication shall be done by plate bending machine or cold bending process Without resorting to heating, hammering, angle smithy and black smithy process.				
2.06.05	Poking hole (manual or pneumatic) and striking plate shall be provided to facilitate coal flow. Poking holes shall have circular MS pipe and cover cap as detailed in the drawing.				
2.07.00	New Erection Marks				
2.07.01	Additional structures involving new erection marks may be required to be added at any stage of work.				
2.07.02	All such new erection marks shall be detailed and included in marking schemes and fabrication carded out thereafter.				
2.07.03	All such new erection marks shall be considered under item of original fabrication work. As a result of additional structures becoming necessary if the work is delayed beyond the time schedule stipulated, the Engineer shall give suitable extension of time provided he is satisfied about the reasonableness of the delay involved. However, no claim for extra payments or revision of rates due to delay shall be entertained.				



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2.08.00	ELECTRO FORGED STEEL GRATINGS	
2.08.01	Factory made fabricated electro forged gratings unit with steel conforming to IS: 2062 shall be supplied, fabricated, transported, erected and aligned in floorings, platforms, drain and trench covers, walkways, passages, staircases with edge binding strips and anti skid nosing in treads etc.	
2.08.02	All grating units shall be rectangular in pattern and electro forged. The size and the spacing of the bearing bars and cross bars shall be as detailed in fabrication drawings. The contractor shall submit the grating design for different spans and load intensities along with fabrication drawings. The depth of the grating unit shall be 40 mm, unless specified otherwise.	
2.08.03	The gratings shall be made up in panel units designed to coincide with the span of the structural steel framing or openings as indicated in the design/scope drawings. Maximum possible standardization of the grating panel sizes shall be tried and designed.	
2.08.04	The grating unit shall be accurately fabricated and finished, free from wraps, twists, or any defects that would impair their strength, serviceability, and appearance.	
2.08.05	Grating work shall include cut outs and clearance opening for all columns, pipes, ducts, conduits or any other installation penetrating through the grating work. Such cut outs and clearances shall be treated as specified in subsequent clauses.	
2.08.06	The gratings shall be notched, trimmed and neatly finished around flanges and webs of the columns, moment connections, cap plates, and such other components of the steel structures encountered during the placement of the gratings. In all such cases, the trimming shall be done to follow the profile of the components encountered. After trimming, the binding strip shall be provided on the grating to suit the profile so obtained.	
2.08.07	Opening in gratings for pipes or ducts that are 150mm in size or diameter or larger shall be provided with steel bar toe plates of not less than 5mm thickness and appropriate width, set flush with the bottom of the bearing bars.	
2.08.08	Penetrations in gratings that are more than 50mm but less than 150mm in size or diameter shall be welded with plates of size shown in the detailed drawings set flush with the bottom of the grating panel.	
2.08.09	Unless otherwise indicated on the drawings, grating units at all penetrations shall be made up in split section, accurately fitted and neatly finished to provide for proper assembly and erection at the job site.	

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	patches, bare spots, unevenness of coating, spelter that is loosely attached to the steel, blistered surface, flaking or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection. 2.09.05 There shall be no flaking or loosening when struck squarely with a chisel faced hammer. The galvanized steel member shall withstand minimum four one minute dips in copper sulphate solution as per IS: 2633. 2.09.06 When the steel section is removed from the galvanizing kettle, excess spelter shall be removed by 'bumping'. The processes known as 'wiping' or 'scrapping' shall not be used for this purpose. 2.09.07 Defects in certain members indicating presence of impurities in the galvanizing bath in quantities larger than that permitted by the specifications or lack of quality control in any manner in the galvanizing plant, shall render the entire, production in the relevant shift liable to rejection. 2.09.08 All structural steel shall be treated with sodium dichromate or an approved equivalent solution after galvanizing; so as to prevent white storage stains. 2.09.09 If the galvanizing of any member is damaged, the Engineer shall be shown of the extent of damage, if so directed the galvanizing may have to be redone in the similar manner as stated above at no extra cost to the Owner. 2.10.00 STAINLESS STEEL HOPPERS (As per BOQ item) 2.10.01 Material In case SS Hopper is to be fabricated & erected as per BOQ item with SS415M, following specification shall be followed. Stainless steel hopper of grade SS 415M as manufactured by SAIL or equivalent shall be provided in the lower portion of bunker hopper. SS 415M having the following chemical composition shall be used. <table> <thead> <tr> <th>Material</th><th>%</th><th>Remarks</th></tr> </thead> <tbody> <tr> <td>Carbon</td><td>10.03%</td><td>Max.</td></tr> <tr> <td>Silicon</td><td>1.60%</td><td>Max.</td></tr> <tr> <td>Manganese</td><td>0.80% to 1.50%</td><td></td></tr> <tr> <td>Phosphorous</td><td>0.03%</td><td>Max.</td></tr> <tr> <td>Sulphur</td><td>0.03%</td><td>Max.</td></tr> </tbody> </table>	Material	%	Remarks	Carbon	10.03%	Max.	Silicon	1.60%	Max.	Manganese	0.80% to 1.50%		Phosphorous	0.03%	Max.	Sulphur	0.03%	Max.	
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<table><tr><td>Chromium</td><td>10.80% to 12.50%</td><td></td></tr><tr><td>Nickel</td><td>1.50%</td><td>Max.</td></tr><tr><td>Titanium</td><td>0.75%</td><td>Max.</td></tr><tr><td>Nitrogen</td><td>0.03%</td><td>Max.</td></tr></table> The mechanical properties shall be as follows: <table><tr><td>Description</td><td>Value</td><td>Remarks</td></tr><tr><td>Hardness Rock Well B Scale</td><td>90</td><td>Max.</td></tr><tr><td>Tensile Strength</td><td>450 MPa</td><td>Min.</td></tr><tr><td>Yield Strength</td><td>300 MPa</td><td>Min.</td></tr><tr><td>Elongation</td><td>25%</td><td>Min.</td></tr></table>						Chromium	10.80% to 12.50%		Nickel	1.50%	Max.	Titanium	0.75%	Max.	Nitrogen	0.03%	Max.	Description	Value	Remarks	Hardness Rock Well B Scale	90	Max.	Tensile Strength	450 MPa	Min.	Yield Strength	300 MPa	Min.	Elongation	25%	Min.
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2.10.02	Fabrication The fabrication, erection, alignment and welding shall be carried out as per the accepted practice and in accordance with relevant I.S. and international specification as well as stipulations contained herein. Fabrication drawings shall be prepared by the contractor on the basis of the design / scope drawings furnished by Engineer. The fabrication and erection works shall be done as per the approved fabrication drawings.																															
2.10.03	Fabrication Drawings a) Fabrication drawing shall give the cutting plan for each hopper plate. Such, cutting plan shall be based on the size of the Stainless Steel plate available at store. In order to reduce the wastage and ensure the maximum utilization of stainless steel plate, the cutting plan shall take in the consideration of the reverse curvature and place the various elements of hopper plate in opposite fashion to reduce the end wastage. Similarly the hopper plate element having different radii shall be placed one inside the other, to optimize the stainless steel plate use. Such optimization may also required adjustment in the size of the each element of hopper plate and also additional weld joints. b) The bill of material of hopper plate shall indicate the inner surface area of the hopper, weight of the hopper based on the inner surface area, weight of each of the cut plate of hopper fabrication, weight of cut and scrap pieces																															

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	generated. Contractor shall return to the Owner's store all unutilized (surplus) stainless steel plates and all waste and cut pieces generated. Non return of any part of the surplus/waste steel pieces to the Owner's store will call for the penal recovery at three (03) times the maximum procurement rate for the weight of stainless steel pieces not returned to the store. c) In case the contractor does the cutting of the stainless steel without approved cutting plan then all the wastage (i.e. the difference between the weight of stainless steel plate cuts and the actual finished weight considered for the measurement for payment) shall be subjected to the penal recovery at the rate mentioned above. 2.10.04 Cuffing Cutting may be affected by shearing, or by using plasma. The cut edges of all plates shall be perfectly straight and uniform through out. Cutting shall be done as per the cutting plan shown in the fabrication drawing. Should the Engineer find it necessary, the edges shall be ground smooth afterwards by contractor within the unit rates quoted by him. All the edge s shall be ground smooth before they are welded. 2.10.05 Jointing Welding shall join stainless steel. All weld joints (along the inclined plane) shall be staggered. Any common welding process can weld stainless steel viz. MIG, metal arc or plasma using the covered compatible electrodes as per IS: 5206 or by inert gas arc welding as per IS: 2811. Shielding gas shall be Argon + Hydrogen mixture or Argon + Oxygen mixture. However, Argon + Oxygen mixture shall be preferred. Carbon-di-oxide mixture shall be avoided. 308L and 315L electrodes/fillers shall be used for the welding of Stainless Steel to Stainless Steel and Stainless Steel to Mild Steel respectively. However, the welding process and the type of the electrodes to be used for welding shall be as per welding procedure, as approved by the Engineer. On the basis of the welding procedure, the Contractor shall conduct qualification test. 2.10.06 Bending The stainless steel plates shall be subjected to cold forming and bending in order to get the desired shape and profile. 2.10.07 Welding sequence The type of electrodes, welding sequence, preheat and interpass temperature and post weld heat treatment shall be as approved by the Engineer.	

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	placed on this layer while it is still workable and the bearing is levelled. The bearing should not be displaced as the beam is lowered into position. When the mortar and adhesive are fully set and the beam slightly above the top of the bearing. The upper surface of the bearing shall then be coated with sufficient thickness of epoxy resin mortar so that when the beam is lowered on to the temporary supports it comes into full contact with the mortar and some is squeezed out. The surplus shall be troweled off and after the mortar is fully set the temporary supports removed. 2.12.00 Storage of material 2.12.01 General All materials shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for the work. Any material, which has deteriorated or has been damaged, shall be removed from the contractor's yard immediately, failing which, the Engineer shall be at liberty to get the material removed and the cost incurred thereof shall be realised from the Contractor. The Contractor shall maintain upto date accounts in respect of receipt, use, and balance of all sizes and sections of steel and other materials. In case the fabrication is carried out in contractor's fabrication shop outside the plant site where other fabrication works are also carried out, all materials meant for use in this contract shall be stacked separately with easily identifiable marks. 2.12.02 Steel The steel to be used in fabrication and the resulting cut-pieces shall be stored in separate stacks off the ground section wise and lengthwise so that they can be easily inspected, measured, and accounted for at any time. If required by the Engineer, the materials may have to be stored under cover and suitably painted for protection against weather. 2.12.03 Electrodes The electrodes for electric arc welding shall be stored in properly designed racks, separating different types of electrodes in distinctly marked compartments. The electrodes shall be kept in a dry and warm condition if necessary by resorting to heating. 2.12.04 Bolts, Nuts and Washers Bolts, nuts and washers and other fastening materials shall be stored on racks off the ground with a coating of suitable protective oil. These shall be stored in separate gunny bags or compartments according to diameter, length, and quality.	

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2.12.05

Paints

Paints shall be stored under cover in air tight containers. Paints supplied in sealed containers shall be used up as soon as possible once the container is opened.

2.13.00

Quality Control

The Contractor shall establish and maintain quality control procedures for different items of work and materials to the extent he deems necessary to ensure that all work is performed in accordance with this specification. In addition to the Contractor's quality control procedures, materials and workmanship at all times shall be subjected to inspection by the Engineer or Engineer's representative. As far as possible, all inspection by the Engineer or Engineer's representative shall be made at the Contractor's fabrication shop whether located at Site or elsewhere. The Contractor shall co-operate with the Engineer or Engineer's representative in permitting access for inspection to all places where work is being done and in providing free of cost all necessary help in respect of tools and plants, instrument, labour and materials required to carry out the inspection. The inspection shall be so scheduled as to provide the minimum interruption to the work of the Contractor.

Materials or workmanship not in reasonable conformance with the provisions of this Specification may be rejected at any time during the progress of the work.

The quality control procedure shall cover but not be limited to the following items of work

a)

Steel: Quality manufacturer's test certificates, test reports of representative samples of materials from unidentified stocks if permitted to be used.

b)

Rivets, Bolts, : Manufacturer's certificate, dimension checks, Nuts & Washers material testing.

c)

Electrodes : Manufacturer's certificate, thickness and quality of flux coating.

d)

Welders : Qualifying Tests

e)

Welding sets : Performance Tests

f)

Welds : Inspection, X-ray, Ultrasonic tests

g)

Paints : Manufacturer's certificate, physical inspection

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	reports h) Galvanizing : Tests in accordance with IS 2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS : 4759 - Specification for Hot-Dip Zinc coatings on Structural Steel and other allied products. 2.14.00 Standard dimensions, forms and weights The dimensions, forms, weights and tolerances of all rolled shapes rivets, bolts, nuts, studs, washers etc. and other members used in the fabrication of any structure shall, wherever applicable, conform to the requirements of the latest relevant Indian Standards, wherever they exist, or, in the absence of Indian Standards, to other equivalent standards. 2.15.00 Fabrication Drawings The contractor shall within thirty (30) days after the award of the Contract submit to the Engineer the Schedule of Fabrication and erection of structural Steelworks, for approval. Within one week after receipt of approval on design of any steel structure (part or full) based on the approved design. As decided by the Engineer, six (6) copies each of some or all of the detailed fabrication drawings will have to be submitted for approval. The sequence of preparation of fabrication drawings shall match with the approved fabrication and erection schedule. The above-mentioned approval for fabrication drawings will be accorded only towards the general conformity with the design requirements as well as specifications. The approval of drawing however shall not relieve the contractor of his sole responsibility in carrying out the work correctly and fulfilling the complete requirements of contract documents. The fabrication drawings shall include but not limited to the following: a) Assembly drawings giving exact sizes of the sections to be used and identification marks of the various sections. b) Dimensional drawings of base plates, foundation bolts location etc. c) Comparison sheets to show that the proposed alternative section, if any, is as strong as the original sections shown on the Design Drawings. d) Complete Bill of Materials and detailed drawings of all sections as also their billing weights.	

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	e) Any other drawings or calculations that may be required for the clarification of the works or substituted parts thereof. These drawings shall give all the necessary information for the fabrication, erection, and painting of the steelwork in accordance with the provisions of this Specification. Fabrication drawings shall be made in accordance with the best modern practice and with due regard to sequence, speed and economy in fabrication and erection. Fabrication drawings shall give complete information necessary for fabrication of the various components of the steelwork, including the location, type, size, and extent of welds. These shall also clearly distinguish between shop and field rivets, bolts, and welds and specify the class of bolts and nuts. The drawings shall be drawn to a scale large enough to convey all the necessary information adequately. Notes on the fabrication drawings shall indicate those joints or groups of joints in which it is particularly important that the welding sequence and technique of welding shall be carefully controlled to minimize the locked up stresses and distortion. Welding symbols used shall be in accordance with the requirements of the Indian Standard Specification. IS: 813 - Scheme of symbols for Welding, and shall be consistent throughout. Weld lengths called for on the drawings shall mean the net effective length. The Contractor shall be responsible for and shall carry out at his cost any alterations of the work due to any discrepancies, errors or omissions on the drawings or other particulars supplied by him, whether such drawings or other particulars have been duly approved or not in accordance with the Contract. 3.00.00 WORKMANSHIP 3.01.00 Fabrication 3.01.01 General All workmanship shall be equal to the best practice in modern structural shops, and shall conform to the provisions of the Indian Standard IS: 800 - Code of Practice for general construction in steel and other relevant Indian Standards or equivalent. 3.01.02 Straightening Material Rolled materials before being laid off or worked, must be clean, free from sharp kinks, bends or twists and straight within the tolerances allowed by the Indian Standard Specification on IS: 1552 - Specification for rolling and cutting tolerance for hot-rolled steel products. If straightening is necessary, it may be done by mechanical means or by the application of a limited amount of localized heat. The temperature of heated areas, as measured by approved methods, shall not exceed 600°C.	

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provided that the holes are punched 3 mm less in diameter than the required size and reamed after assembly to the full diameter. Holes for rivets or black bolts shall be not more than 1.5 mm or 2.0 mm (depending on whether the diameter of the rivet or bolt is less or more than or equal to 25 mm) larger in diameter than the nominal diameter of the rivet or black bolt passing through them. Holes for turned and fitted bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject to a tolerance grade of BS as specified in IS: 919. Parts to be connected shall be firmly held together by tacking welds or clamps and the holes drilled through all the thicknesses in one operation and subsequently reamed to size. Holes not drilled through all thickness in one operation shall be drilled to a smaller size and reamed out after assembly. Holes for rivets or bolts shall not be formed by gas cutting process. 3.02.02 Assembly All parts of riveted members shall be well pinned or bolted and rigidly held together while riveting. Drifting to enlarge unmatching holes shall not generally be permitted. In case drifting is permitted to a slight extent during assembly, it shall not distort the metal or enlarge the holes. Holes that must be enlarged to admit the rivets or bolts shall be reamed. Poor matching of holes shall be cause for rejection .The component parts shall be so assembled that they are neither twisted not otherwise damaged, and shall be so prepared that the specified cambers, if any, are maintained. Rivets shall ordinarily be hot driven, in which case their finished heads shall be approximately hemispherical in shape and shall be of uniform size throughout the work for rivets of the same size full, neatly finished and concentric with he holes. Rivets shall be heated uniformly to a temperature not exceeding 1 125°C they shall not be driven after their temperature has fallen below 540°C. Rivets shall be driven by power riveters, of either compression or manually operated type, employing pneumatic, hydraulic or electric power. Hand driven rivets shall not be allowed unless in exceptional cases specifically approved by the Engineer. After driving, rivets shall be tight, shall completely fill the holes and their heads shall be in full contact with the surface. In case of countersunk rivets, the countersinking shall be fully filled by the rivet, any proudness of the countersunk head being dressed off flush, if required. Riveted members shall have all parts firmly drawn and held together before and during riveting and special care shall be taken in this respect for all single					

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	riveted connections. For multiple riveted connections, a service bolt shall be provided in every third or fourth hole. All loose, burnt, or otherwise defective rivets shall be cut out and replaced and special care shall be taken to inspect all single riveted connections. Special care shall also be taken in heating and driving long rivets. The Contractor shall prove the quality of riveting by cutting some rivets chosen at random by the Engineer. No extra payment will be made to the Contractor for such cutting and replacing. Riveting work, for any particular section or group, will be considered satisfactory when at least 90% of the corresponding cut rivets is found to be sound. If the ratio is below 75%, all the rivets in the particular section or group shall be cut, removed and replaced and tested again at the Contractor's expense. For cases between 75% and 90% the engineer shall have the option to instruct cutting and replacing any number of further rivets at the Contractor's cost as he deems necessary. Bolted construction shall be permitted only in case of field connections if called for on the Drawings and is subjected to the limitation of particular connections as may be specified. In special cases, however, shop bolt connections may be allowed if shown on drawing or directed by the Engineer. Washers shall be tapered or otherwise suitably shaped, where necessary, to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project through the nut at least one thread. In all cases the bolt shall be provided with a washer of sufficient thickness under the nut to avoid any threaded portion of the bolt being within the thickness of the parts bolted together. In addition to the normal washer one spring washer or lock nut shall be provided for each bolt for connections subjected to vibrating forces or otherwise as may be specified on the Drawings. 3.03.00 Welded Construction 3.03.01 General Welding shall be in accordance with relevant Indian Standards and as supplemented in the Specification. Welding shall be done by experienced and good welders who have been qualified by tests in accordance with IS: 817. 3.03.02 Preparation of material Surface to be welded shall be free from loose scale, slag, rust, grease, paint, and any other foreign material except that mill scale, which withstands vigorous wire brushing, may remain. Joint surfaces shall be free from fins and tears. Preparation of edges by gas cutting shall, wherever practicable, be done by a mechanically guided torch.	

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3.03.03	Assembling Parts to be fillet welded shall be brought in, as close contact as practicable and in no event shall be separated by more than 4 mm. If the separation is 1.5 mm or greater, the size of the fillet welds shall be increased by the amount of the separation. The fit of joints at contact surfaces, which are not completely sealed by, welds, shall be close enough to exclude water after painting. Abutting parts to be butt-welded shall be carefully aligned. Misalignments greater than 3 mm shall be corrected and in making the correction the parts shall not be drawn into a sharper slope than two degrees (2°). The work shall be positioned for flat welding whenever practicable.	
3.03.04	Welding Sequence In assembling and joining parts of a structure or of built-up members, the procedure and sequence of welding shall be such as will avoid needless distortion and minimize shrinkage stresses in the closing welds of a rigid assembly, such closing welds shall be made in compression elements. In the fabrication of cover-plated beams and built-up members, all shop splices in each component part shall be made before such component part is welded to other parts of the member. Long girders or girder sections may be made by shod splicing not more than three sub-sections, each made in accordance with this paragraph. When required by the Engineer, welded assemblies shall be stress relieved by heat-treating in accordance with the provisions of the relevant Indian Standard or any other Standard approved by the Engineer.	
3.03.05	Welding technique All complete penetration groove welds made by manual welding, except when produced with the aid of backing material not more than 8 mm thick with root opening not less than one-half the thickness of the thinner part joined, shall have the root of the initial layer gouged out on the back side before welding is started from that side, and shall be so welded as to secure sound metal and complete fusion throughout the entire cross-section. Groove welds made with the use of the backing of the same material, as the base metal shall have the weld metal thoroughly fused with the backing material. Backing strips need not be removed. If required, they may be removed by gouging or gas cutting after welding is completed, provided no injury is done to the base metal and weld metal and the weld metal surface is left flush or slightly convex with full throat thickness. Groove welds shall be terminated at the ends of a joint in a manner that will	

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	ensure their soundness. Where possible, this should be done by use of extension bars or run-off plates. Extension bars or run-off plates need not be removed upon completion of the weld unless otherwise specified elsewhere in the contract. To get the best and consistent quality of welding, automatic submerged arc process shall be preferred. The technique of welding employed, the appearance and quality of welds made, and the methods of correcting defective work shall all conform to the relevant Indian Standards. 3.03.12 Temperature No welding shall normally be done on parent material at a temperature below (-) 5°C. However, if welding is to undertaken at low temperature, adequate precautions as recommended in relevant Indian Standard shall be taken. When the parent material is less than 40 mm thick and the temperature is between (-) 5°C and 0°C, the surface around the joint to a distance of 100 mm or 4 times the thickness of the material, whichever is greater, shall be preheated till it is hand warm. When the parent material is more than 40 mm thick, the temperature of the area mentioned above shall be in no case be less than 20°C. All requirements regarding preheating of the parent material shall be in accordance with the relevant Indian Standard. 3.03.13 Peening Where required, intermediate layers of multiple-layer welds may be peened with light blows from a power hammer, using a round-nose tool, peening shall be done after the weld has cooled to a temperature warm to the hand. Care shall be exercised to prevent scaling or flaking of weld and base metal from over peening. 3.03.14 Equipment These shall be capable of producing proper current so that the operator may produce satisfactory welds. The welding machine shall be of a type and capacity as recommended by the manufacturers of electrodes or as may be approved by the engineer. 3.04.00 Finish Column splices and butt joints of compression members depending on contact for stress transmission shall be accurately machined and close-butt over the whole section with a clearance not exceeding 0.1 mm locally at any place. In column caps and bases, the ends of shafts together with the attached gussets, angles, channels etc; after welding/riveting together, should be accurately machined so that the parts connected butt over the entire surfaces of contact. Care should be taken that those connecting angles of channels are fixed with such accuracy that they are not reduced in thickness by machining by more	

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	than 1.0 mm. 3.05.00 Slab bases and caps Bases and caps fabricated out of steel slabs, except when cut material with true surface, shall be accurately machined over the bearing surface and shall be in effective contact with the end of the stanchion. A bearing face, which is to be grouted direct to a foundation, need not be machined if such face is true and parallel to the upper face. To facilitate grouting, holes shall be provided, where necessary, in stanchion bases for the escape of air. 3. 12.00 Lacing bars The ends of lacing bars shall be neat and free from burns. 3. 13.00 Separators Rolled section or built-up steel separators or diaphragms shall be required for all double beams except where encased in concrete, in which case, pipe separators shall be used. 3.14.00 Bearing Plates Provision shall be made for all necessary steel bearing plates to take up reaction of beams and columns and the required stiffeners and gussets whether or not specified in Drawings. 3.15.00 Floor Grating All grating units shall be rectangular in pattern and of pressure locked assembly. The size and spacing of bearing bars and cross bars shall be as approved in detailed drawings. Alternatively diamond pattern grating if approved may be used. The grating shall be made in panel units designed to span as indicated in structural steel framing drawing or as directed by the Engineer. The grating units shall be finished free from warps, twists, or any other defects. Grating work shall include cutouts and clearance openings for all columns, pipes, ducts, conduits etc. The gratings shall be notched, trimmed, and neatly finished around components of the steel structures encountered.	

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	Binding strip shall be provided on the grating to suit the profile. Openings in gratings shall be provided with steel bar toe plates of not less than 5 mm thickness and 100 mm width. Unless otherwise indicated on drawings, all penetrations of grating units shall be made up in split section, accurately fitted, and neatly finished. Grating units shall be provided with all necessary clips, bolts, lock washers etc. for proper assembly and installation on supporting steel members. Maximum deviation in linear dimension shall not exceed 12 mm. 3.10.00 Chequered Plates Minimum thickness of chequered plate floorings, covers etc. shall be 6 mm O/P. Chequered plate shall be accurately cut to the required sizes and shapes and the cut edges properly ground. Stiffeners shall be provided wherever required from design consideration. 3.11.00 Architectural Clearances Bearing plates and stiffener connections shall not be permitted to encroach on the designed architectural clearances. 3.11.00 Shop connections a) All shop connections shall be otherwise riveted or welded as specified on the Drawings. b) Heads of rivets on surfaces carrying brick walls shall be flattened to 10 mm thick projection. c) Certain connections, specified to be shop connections, may be changed to field connections if desired by the Engineer for convenience of erection and the contractor will have to make the desired changes at no extra cost to the exchequer. 3.13.00 Castings Steel castings shall be annealed. 3.14.00 Shop erection The steelwork shall be temporarily shop-erected complete or as directed by the Engineer so that accuracy of fit may be checked before dispatch. The parts shall be shop-erected with a sufficient number of parallel drifts to bring and keep the parts in place. In case of parts drilled or punched using steel jigs to make all similar parts interchangeable, the steelwork shall be shop erected in	



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3.15.00	Shop painting 3.15.01 General Unless otherwise specified, steelwork, which will be concealed by interior building finish, need not be painted; steelwork to be encased in concrete shall not be painted. Unless specifically exempted, all other steelwork shall be given one coat of shop paint, applied thoroughly and evenly to dry surfaces which have been cleaned, in accordance with the following paragraph, by brush, spray, roller coating, flow-coating or dipping as may be approved by the Engineer. After inspection and approval and before leaving the shop, all steelwork specified to be painted shall be cleaned by hand-wire brushing or by other methods of loose mill scale, loose rust, weld slag or flux deposit, dirt and other foreign matter. Oil and grease deposits shall be removed by the solvent. Steelwork specified to have no shop paint shall, after fabrication, be cleaned of oil or grease by solvent cleaners and be cleaned of dirt and other foreign material by trough sweeping with a fibre brush. 3.15.02 Inaccessible parts Surfaces not in contact, but inaccessible after assembly, shall receive two coats of shop paint, Positively of different colours to prove application of two coats before assembly. This does not apply to the interior of sealed hollow sections. 3.15.03 Contact surfaces Contact surface shall be cleaned in accordance with sub-clause 3.13.1 before assembly. 3.15.04 Finished surfaces Machine finished surfaces shall be protected against corrosion by a rust inhibiting coating that can be easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection. 3.15.05 Surfaces adjacent to field welds Unless otherwise provided for, surfaces within 50 of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.	

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	not to injure the skin on galvanized surfaces during transport, handling, and erection. Damages, if occur, shall be made good in accordance or as directed by the Engineer. 4.00.00 INSPECTION, TESTING, ACCEPTANCE CRITERIA AND DELIVERY 4.01.00 Inspection Unless specified otherwise, inspection to all, work shall be made by the or Engineer's representative at the place of manufacture prior to delivery. The Engineer or his representative shall have free access at all reasonable times to those parts of the manufacturer's works which are concerned with the fabrication of the steelwork under this Contract and he shall be afforded all reasonable facilities for satisfying himself that the fabrication is being done in accordance with the provisions of this Specification. The Contractor shall provide free of charge, such labour, materials, electricity, fuel, water, stores, tools and plant, apparatus and instruments as may be required by the Engineer to carry out inspection and/or tests in accordance with the Contract. The Contractor shall guarantee compliance with the provisions of this Specification. 4.02.00 Testing and Acceptance Criteria 4.02.01 General The Contractor shall carry out sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own Cost. The Contractor shall get the specimens tested in a laboratory approved by the Engineer and submit to the Engineer the test results in triplicate within 3 (three) days after completion of the test. 4.02.02 Steel All steel supplied by, the Contractor shall conform, to the relevant Indian Standards. Except otherwise mentioned in the contract, only tested quality steel having mill test reports shall be used. In case unidentified steel materials are permitted to be used by the Engineer, random samples of materials will be taken from each unidentified lot of 50 M.T or less of any particular section for tests to conform to relevant Indian Standards. Cost of all tests shall be born by the contractor. All material shall be free from all imperfections, mill scales, slag intrusions, laminations, fittings, rusts etc. that may impair their strength, durability, and appearance.	

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4.02.02	Welding a) The weld surface shall be cleaned with steel wire brush to remove spatter metal, slag etc. and 100% of welds shall be inspected visually for size, length of weldment and external defects. Weld gauges shall be used for checking weld sizes. The surface shall be clean with regular beads and free from slags, cracks, blow-holes etc. b) Non-destructive examination shall be carried out to determine soundness of weldments as follows: i) 10% at random on fillet-joints. ii) 100% on all butt-joints. c) Should the ND tests indicate defects like improper root penetration, extensive blowholes, slag intrusion etc., such welds shall be back gauged, joints prepared again and rewelded. All defects shall be rectified by the Contractor at no extra costs. d) All electrodes shall be procured from approved reputed manufacturers with test certificates. The correct grade and size of electrode, which has not deteriorated in storage, shall be used. The inspection and testing of welding shall be performed in accordance with the provisions of the relevant Indian Standards or other equivalents. For every 50 tones of welded fabrication, the Engineer may ask for 1(one) test-destructive or non-destructive including X -ray, ultrasonic test or similar, the cost of which shall be borne by the Contractor.	
4.02.04	Rivets, bolts, nuts and washers All rivets, bolts, nuts, and washers shall be procured from M/s. Guest Keen William Ltd. or equivalent and shall confirm to the relevant Indian Standards. If desired by the Engineer, representative samples of these materials may have to be tested in an approved laboratory and in accordance with the procedures described in relevant Indian Standards. Cost of all such testing shall have to be borne by the Contractor. In addition to testing the rivets by hammer, 2% (two per cent) of the rivets done shall have to be cut off by chisels to ascertain the fit, quality of material and workmanship. The removal of the cut rivets and re-installing new rivets shall be done by the Contractor at his own cost.	
4.02.05	Shop painting All paints and primers shall be of standard quality and procured from approved	

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	manufacturers and shall conform to the provisions of the relevant Indian Standards. 4.02. 12 Galvanizing All galvanizing shall be uniform and of standard quality when tested in accordance with IS: 2633 - Method for testing uniformity of coating on Zinc Coated Articles and 15: 4759 - specification for Hot-Dip Zinc Coatings on Structural Steel & other allied products. 4.03.00 Tolerance The tolerances on the dimensions of individual rolled steel components shall be as specified in IS: 1852 - specification for rolling and Cutting Tolerances for Hot-rolled Steel Products. The tolerances on straightness, length etc. of various fabricated components (such as beams and girders, columns, crane gantry girder etc.) of the steel structures shall be as specified in IS: 721 - Tolerances for Fabrication of Steel Structures. 4.04.00 Acceptance Should any structure or part of a structure be found not to comply with any of the provisions of this specification, the same shall be liable to rejection. No Structure or part of the structure once rejected, shall be offered again for test, except in cases where the Engineer considers the defects rectifiable. The Engineer may, at his discretion, check some of the tests at an appropriate laboratory at the contractors cost. When all tests to be performed in the Contractor's shop under the terms of this contract have been successfully carried out, the steelwork will be accepted forthwith and the Engineer will issue acceptance certificate, upon receipt of which, the items will be shop painted, packed and dispatched. No item to be delivered unless an acceptance certificate for the same has been issued. The satisfactory completion of these tests or the issue of the certificates shall not bind the Owner to accept the work, should it, on further tests before or after erection, be found not in compliance with the Contract. 4.05.00 Delivery of materials 4.05.01 General The Contractor will deliver the fabricated structural steel materials to site with all necessary field connection materials in such sequence as will permit the most efficient and economical performance of the erection work. The Owner may prescribe or control the sequence of delivery of materials, at his own	



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4.05.02	Marking Each separate piece of fabricated steelwork shall be distinctly marked on all surfaces before delivery in accordance with the markings shown on approved erection drawings and shall bear such other marks as will further facilitate identification and erection. 4.05.03	Shipping Shipping shall be strictly in accordance with the sequence stipulated in the agreed Programme. Contractor shall dispatch the materials to the e worksite securely protecting and packing the materials to avoid loss or damage during transport by rail, road or water. All parts shall be adequately braced to prevent damage in transit. Each bundle, bale or package delivered under this contract shall be marked on as many sides as possible and such distinct marking (all previous irrelevant markings being carefully obliterated) shall show the following: a) Name and address of the consignee b) Name and address of the consignor c) Gross weight of the package in tonnes and its dimensions d) Identification marks and/or number of the package e) Custom registration number, if required All markings shall be carried out with such materials as would ensure quick drying and indelibility. Each component or part or piece of material when shipped, shall be indelibly marked and/or tagged with reference to assembly drawings and corresponding piece numbers. Each packing case shall contain in duplicate in English a packing list pasted on to the inside of the cover in a water-proof envelope, quoting especially - a) Name of the Contractor b) Number and date of the Contract c) Name of the office placing the contract d) Nomenclature of stores

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	e) A schedule of parts or pieces, giving the parts or piece number with reference to assembly drawings and the quantity of each. The shipping dimensions of each packing shall not exceed the maximum dimensions permissible for transport over the Indian Railways/Roads. After delivery of the materials at site, all packing materials shall automatically become the property of the Owner. Notwithstanding anything stated hereinbefore, any loss or damage resulting from inadequate packing shall be made good by the Contractor at no additional cost to the Owner. When facilities exist, all shipments shall be covered by approved Insurance Policy for transit at the cost of the Contractor. The contractor shall ship the complete materials or part on board a vessel belonging to an agency approved by the Owner or on rail and/or road transport as directed. The Contractor shall take all reasonable steps to ensure correct appraisal of freight rates, weights and volumes and in no case will the Owner be liable to pay any warehouse, wharfage, demurrage and other charges. If, however, the Owner has to make payment of any of the above-mentioned charges, the amount paid will be deducted from the bills of the Contractor. Necessary advise regarding the shipment with relevant details shall reach the Engineer at least a week in advance. 5.00.00 INFORMATION TO BE SUBMITTED 5.01.00 With Tender The following information is required to be submitted with the Tender: a) Progress Schedule The Contractor shall quote in his Tender a detailed schedule of progress of work and total time of completion, itemizing the time required for each of the following aspects of work. i) Preparation and approval of fabrication drawing ii) Procurement of Materials iii) Fabrication and shipping of all anchor bolts iv) Fabrication and shipping of main steelwork.	

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	v) Fabrication and shipping of steelwork for bunkers, tanks and/or silos as applicable. vi) Fabrication and shipping of all other remaining steelwork including miscellaneous steelwork. vii) Final date of completion of all shipments. b) Shop Location of the Tenderer's fabrication workshop giving details of equipment, manpower, the total capacity, and the capacity that will be available exclusively for this contract shall be submitted. 5.02.00 After Award After award of the Contract the successful Tenderer is to submit the following: a) Complete fabrication drawings, material lists, cutting lists, rive and bolt lists, field welding schedules based on the approved design drawings prepared by him in accordance with the approved schedule. b) Monthly Progress Report with necessary photographs in six (6) copies to reach the Engineer on or before the 7th day o. each month, giving the up-to-date status of preparation of detailed shop drawings, bill of materials, procurement of materials, actual fabrication done, shipping and all other relevant information. c) Detailed monthly material reconciliation statements relevant to the Work done and reported in the Progress Report, giving the stock at hand of raw steel, work in progress, finished materials. d) Results of any test as and when conducted and as require by the engineer. e) Manufacturer's mill test report in respect of steel materials, rivets, bolts, nuts, and electrodes as may be applicable. 6.00.00 RATES AND MEASUREMENT 6.01.00 Rates 6.01.01 The items of work in the Schedule of items describe the work in brief. The various items of the Schedule of items shall be read in conjunction with these specifications including amendments and additions, general conditions of	

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	contract, special conditions of contracts, and other tender documents, if any. For each item of Schedule of Items, the bidder's rates shall include the activities covered in the description of the item as well as all necessary operations described in the Specifications. 6.01.02 The bidder's rates shall include cost of all minor details which are obviously and fairly intended and which may not have been included in the description in these documents but are essential for the satisfactory completion of the work. Rates shall also include for taking all safety measures. 6.01.03 The bidder's -rates for all items of schedule of items shall include complete cost towards plant, equipment, erection and dismantling of scaffolding, men, materials and consumables, skilled and unskilled labour, levies, taxes, royalties, duties, transport, storage, repair/rectification/maintenance until handing over, contingencies, overhead and all incidental items not specifically mentioned but reasonably implied and necessary to complete the work. 6.01.04 No claims shall be entertained, if the details shown on the 'Released for Construction' drawings differ from those shown on the bid/tender drawings. 6.01.05 Rates shall be inclusive of all leads and lifts/elevation. 6.01.06 The bidder's rates for Structural Steel shall include for fabrication and erection, transportation to site, preparation checking collecting and distributing of the fabrication drawings and design calculations, erection scheme, alignment, welding, including preheating and post heating, testing of welders, inspection of welds, visual inspection, non destructive and special testing, rectification and correction of defective welding works, production test plate, inspection and testing, erection scheme, protection against damage in transit, stability of structures, etc. The rates shall also be inclusive of providing and installing temporary structures, transport of Owner issue material from store, return of surplus/waste steel materials including cut pieces/waste steel, provision of additional butt/weld joint to reduce the wastage and all other general, special, such requirements as may be required, for the successful completion of the work. The rates for fabrication are inclusive of all tests on welds and material and no extra shall be payable for quality tests specified for fabrication of structure in shop or at site. Separate BOQ items for test on welds like radiography or Ultrasonic, DPT, magnetic particle tests are kept for tests on material/fabrication not covered under regular fabrication item of BOQ. 6.01.07 The bidder's rates for foundation bolts assembly shall include fabrication, threading, heat treatment, erection, installation, and alignment of complete bolt	

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	assembly with nuts, locknuts, anchor plates, stiffener plates, protective tape, etc. This shall also include the cost of all materials not issued by the Owner. Material issued by Owner will be specified in GCC. 6.01.08 The bidders rates for application of inorganic primer shall include surface preparation to near white metal surface by blast cleaning, abrasives, touch up painting, suitable enclosure to avoid contamination and the necessary statutory approval from the factory inspector/pollution control board etc. regarding the method of blast cleaning and abrasives used, and getting approval of the specialized agency supplying the primer specified. 6.01.09 The bidder's rates for application of finish painting system shall include surface preparation, application of intermediate (under) coat, finish coat and final finish coat, and getting approval of the specialized agency supplying the finish paint. 6.01.10 The bidder's rates for electro-forged gratings (if specified) shall include supply, fabrication, transportation to the site, erection and alignment of factory made electro-forged gratings, all taxes, duties thereon etc. The rates shall also include preparation of grating design for different spans and load intensifies, preparation of design and fabrication drawings, edge preparation, blast cleaning followed by finish paint. 6.01.11 The bidder's rates for galvanization of factory made electro-forged gratings (if specified) shall include the application of hot dipped galvanization as finish over the fabricated gratings and the treatment to be given for prevention of white storage stains, as per the technical Aspiration. 6.01.12 The bidder's rates for permanent mild steel bolts, nuts and washers shall include the supply and fixing of such bolts, nuts and washers in position, for various types of Structural Steel works, as per the technical specification. 6.01.13 The bidder's rates for high strength structural bolts, nuts and washers shall include the supply and fixing of such bolts, nuts and washers in position, for various types, of Structural Steel works, as per the technical specification. 6.01.14 The bidder's rates for dismantling, additions to, alterations in and/or modifications shall be inclusive of all operations such as lowering of material, carriage etc., as mentioned in the technical specification. Unutilised steel pieces cut/removed shall be returned to the project stores free of charge. Non-return of unutilized steel pieces to the Owner's store would be considered as wastage and recovery would be affected as per the provision of contract for structural steel consumption. This shall not include the weight of temporarily dismantled/supported members, connected member. The bidder should prepare an optimised cutting plan as per fabrication	

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	drawing to utilise the steel material upto maximum extent and minimise the wastage/scrap. Quantity of wastage/scrap of material should be limited to the percentage mentioned elsewhere in the conditions of tender/contract specifications. 6.01.15 The bidder's rates for re-erection of erection marks after additions to, alterations in and/or modifications shall be inclusive of all operations mentioned in technical specification for the calculated weight of the rectified/modified erection mark rejected at site. This shall not include the weight of temporarily dismantled/supported members, connected member. All the operations mentioned above for restoring such members shall be carried out at no extra cost. The work of erection of any erection mark which has not been dismantled but have been modified/rectified before erection shall not be paid under this item but shall be paid under relevant item of fabrication and erection of steel work of Schedule of items for the modified weight. 6.01.16 The bidder's rates for PTFE shall include design, supply, transportation of the complete assembly with guides and dust protection cover and installation of bearings in position drilling, bolting, erecting aligning etc. along with any taxes, duties thereon etc. 6.01.17 The bidder's rates for Stainless Steel hopper (if specified) shall include fabrication and erection, transportation to site, preparation checking collecting and distributing of the fabrication drawings and design calculations, all other operations mentioned in the technical specification. The rates shall also include for erection scheme, alignment, making cutting plan, cutting, jointing, bending, rolling, grinding, drilling, bolting, assembly, edge preparation, welding including pre-heating, post-heating, testing of welders, inspection of welds, inspection and testing, protection against damage in transit, stability of structures, installation of temporary structures etc. The rates shall also be inclusive of providing and installing temporary structures, transport of Owner issue material from store, return of surplus / waste steel materials including cut pieces/waste steel, provision of additional butt / weld joint to reduce the wastage and all other general, special, such requirements as may be required, for the successful completion of the work. 6.01.18 The bidders rates for preformed flexible open ended bellow strap of neoprene (if specified) shall include supply and transportation, installation in position, drilling, bolting, aligning etc. complete along with any taxes, duties thereon etc. 6.01.19 The bidder's rates for Stainless Steel Hand Rail (if specified) shall include complete Hand Rail including, materials, fabrication, grinding & finishing, stainless steel beading, stainless steel cleats, stainless steel fasteners, neoprene gaskets, preparation of shop drawing but excluding the cost of glazing. The Owner shall supply no material for this item of work.	

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	6.02.00 MODE OF MEASUREMENT 6.02.01 The measurement for the item of foundation bolts assembly including that of nuts; locknuts shall be based on the calculated weight of steel installed in Metric Tonne, corrected to second place of decimal. The weight of the foundation bolt shall be calculated in the same way as that done for the item of fabrication, erection, alignment of structural steel. The weight of the nut / locknut shall be taken as per actual weight supplied by the contractor and accepted by the Engineer. 6.02.02 The measurement for the item of fabrication, erection, alignment, welding, etc. of structural steel work shall be based on the approved weight of steel nearest to a Kg, by applying the unit weight as adopted at the time of issue of structural steel on the measurements worked out as given below. 6.02.03 For ISMB, ISMC, ISA, flats, round bars, square bars and pipes, length shall be taken as per distance between planes normal to the axis of the member passing through the extreme points of the section. 6.02.04 Gussets plates in trusses, and bracings, brackets plates, stiffeners, and skew cuts if any in plates for butt welds, the area shall be assumed as the minimum circumscribed rectangle. However deduction for any notch/skew cut shall be made as mentioned in clause no-6.02.06. 6.02.05 For bunker wall plates, the minimum-circumscribing rectangle of the individual plate/pieces out of which these wall plates are assembled by butt-welding, shall be measured. Care shall be taken to ensure maximum utilization of cut-pieces generated by providing extra butt joints (for which no extra payment shall be made). 6.02.06 For all other plates, where the area of any notch/skew cut in the plate is less than 0.05 sq.m. the area of the plate shall be assumed as that of the minimum circumscribing rectangle for the purpose of measurement and calculation of area for the purpose of payment. However, if the area of any notch/skew cuts in a plate is more than 0.05 sq.m, the area of notch/skew cut shall be deducted from assumed minimum circumscribing rectangular area for the purpose of payment. 6.02.07 No deduction shall be made for the hole in the members, if the area of individual hole is less than 0.05 sq.m. The weight shall be calculated by deducting the area of holes, if area of individual hole is more than 0.05 sq.m. 6.02.08 All cut-pieces and scrap generated due to cutting of holes, skew-cuts of plates, gussets, brackets, stiffeners, etc. shall be stacked separately and handed over to the project stores without being considered for material accounting as the	

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	circumscribing rectangle has been considered for payment. 6.02.09 The splice plate shown in the fabrication drawing or approved by the Engineer shall only be measured for payment. 6.02.10 The weight of permanent bolts, washers and nuts and welds shall not be included in the weights of the members. No extra payment shall be made for welding/bolting. 6.02.11 The bolts and nuts required for erection purpose shall not be paid for and may be taken away by the Contractor after final welding for members. Erection boltholes left after removal of erection bolts shall be suitably plugged with welds. 6.02.12 The measurement for the item of application of inorganic primer including blast cleaning of steel surfaces shall be based on the weight on which the zinc silicate primer is applied, after blast cleaning in Metric Tonne, corrected to third place of decimal. The weight shall be the weight as approved, for erection mark/element of the mark painted, for payment of the item of fabrication and erection of structural steel works. 6.02.13 The measurement for the item of application of finish primer system shall be based on the weight on which the epoxy based finish primer is applied in Metric Tonne, corrected to third place of decimal. The weight shall be the weight as approved, for erection mark/element of the mark painted, for payment of the item of fabrication and erection of structural steel works. 6.02.14 The measurement for the item of gratings shall be based on the actual weight in Kgs, corrected to second place of decimal, as supplied by the Contractor, and accepted by the Engineer. Nothing extra shall be payable for making cutouts, notches, openings of any profile, trimming profiles etc. in the grating units. 6.02.15 The measurement for the item of hot dipped galvanization of gratings shall be based on the actual weight in Kgs, corrected to second place of decimal of gratings galvanized by the Contractor and accepted by the Engineer. 6.02.16 The measurement for the item of permanent bolts with nuts and washers shall be based on the actual weight in Kgs, corrected to second place of decimal, as supplied by the Contractor and accepted by the Engineer, and as per the approved bolts and nuts schedules. 6.02.17 The measurement for the item of High Strength Structural bolts with nuts and washers shall be based on the actual weight in Kgs, corrected to second place of decimal, as supplied by the Contractor and accepted by the Engineer, and as per the approved bolts and nuts schedules.	

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	6.02.18 The measurement for the item of the work of dismantling, additions, alterations, reerection etc. shall be as given below 6.02.19 For dismantling, the unmodified weight of the actually dismantled erection marks shall only be measured. 6.02.20 For the work of addition to, alteration in and / or modification of 'erection marks' either in erected position or in the fabrication yard, measurement of weight for payment purpose shall be calculated as the arithmetic sum of weight of steel cut and removed from the erection mark, weight of steel reutilised out of such cut and removed pieces and weight of additional new steel pieces added to the erection mark. 6.02.21 For re-erection the weight of the modified erection mark shall only be measured. 6.02.22 The weight shall be measured nearest to kg. and shall be arrived in a manner similar to the measurement for the item of fabrication, erection, alignment and welding of structural steel. 6.02.23 The measurement for the item of PTFE bearings shall be based on the load carrying capacity of PTFE in MT, corrected to third place of decimal, supplied by the contractor and as accepted by the Engineer and as per the approved bearing schedule, for the total vertical load carrying capacity, for all bearings. 6.02.24 The measurement for the item of stainless steel hopper shall be based on the actual finished weight of hopper weight in Kgs, corrected to second place of decimal. The hopper weight shall be arrived by multiplying of the inner surface area of the hopper with the unit weight of the hopper plate. 6.02.25 The measurement for the item of flexible open-ended bellows straps of neoprene shall be based in running meter, corrected to second place of decimal. Bellow Straps shall be supplied as per the requirement of the approved drawings. The measurement shall be done for the inner circumference of the bunker on which neoprene has been fixed and for the length supplied by the Contractor 'and as accepted by the Engineer. 6.02.26 The measurement for the item of Stainless Steel Hand Railing shall be based on finished weight of handrail in Kgs corrected to second place of decimal. The weight shall also include the weight of Stainless Steel fasteners, Stainless Steel beading, Stainless Steel cleats etc. The weight shall be the finished weight of Hand Rail, as accepted by the Engineer.	



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**SECTION - D
(PART I)**

SUB-SECTION – D 18

ERECTION OF STRUCTURAL STEELWORK



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



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SUB-SECTION – D 18

ERECTION OF STRUCTURAL STEELWORK

1.00.00 SCOPE

This specification covers the erection of structural steelwork including receiving and taking delivery of fabricated structural steel materials arriving at site, installing the same in position, painting and grouting the stanchion bases all complete as per Drawings, this Specification and other provision of the Contract.

2.00.00 GENERAL

2.01.00 Work to be provided for by the Contractor, unless otherwise specified in the Contract, shall include but not be limited to the following:

- a) The Contractor shall provide all construction and transport equipment, tools, tackle, consumables, materials, labour, and supervision required for erection of the structural steelwork.
- b) Receiving, unloading, checking, and moving to storage yard at Site including prompt attendance to all insurance matters as necessary for all fabricated steel materials arriving at Site. The Contractor shall pay all demurrage and/or wharfage charges etc. on account of default on his part.
- c) Transportation of all fabricated structural steel materials from Site storage yard, handling, rigging, assembling, riveting, bolting, welding and satisfactory installation of all fabricated structural steel materials in proper location according to approved erection drawings and/or as directed by the Engineer. If necessary suitable temporary approach roads to be built for transportation of fabricated steel structures.
- d) Checking center lines, levels of all foundation blocks including checking line, level, position and plumb of all bolts and pockets. Any defect observed in the foundation shall be rectified with Engineer's approval. The Contractor shall fully satisfy himself regarding the correctness of the foundations before installing the fabricated steel structures on the foundation blocks.
- e) Aligning, plumbing, leveling, riveting, bolting, welding and securely fixing the fabricated steel structures including floor gratings, chequered plates etc. in accordance with the Drawings or as directed by the Engineer.
- f) Painting of the erected steel structures.



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g) All minor modifications of the fabricated steel structures as directed by the Engineer including but not limited to the following:

- i) Removal of bends, kinks, twists etc. for parts damaged during transport and handling.
- ii) Cutting, chipping, filling, grinding, etc. if required for preparation and finishing of site connections.
- iii) Reaming of holes for use of higher size rivet or bolt if required.
- iv) Refabrication of parts damaged beyond repair during transport and handling or refabrication of parts, which are incorrectly fabricated.
- v) Fabrication of parts omitted during fabrication by error, or subsequently found necessary.
- vi) Drilling of holes which are either not drilled at all or are drilled in incorrect location during fabrication.
- vii) Carry out tests in accordance with this specification.

2.02.00 Work by Others

No work under this Specification will be provided for by any agency other than the Contractor unless specifically mentioned elsewhere in the contract.

2.03.00 Codes and Standards

All work under this Specification shall, unless specified otherwise, conform to the latest revisions and/or replacements of the following or any other Indian Standard Specification and codes of Practice of equivalent:

IS: 800 - Code of practice for general construction in steel.

IS: 456 - Code of practice for main or reinforced concrete.

2.04.00 Conformity with Designs

The Contractor will erect the entire fabricated steel structure, align all the members, complete all field connections and grout the foundations all as per the provisions of this specification and the sequence and the design criteria laid down by the Engineer. All work shall conform to the provisions of this specification and /or instructions of the engineer. The testing and acceptance of the erected structures shall be in accordance with the provisions of this Specifications and/or the instructions o the Engineer.

The Tenderer must visit the site prior to submission of his tender to acquaint himself with the availability of land and the development necessary by way of filling, drainage, access roads, fences, sheds etc. all of which shall be carried out by the Contractor at his own cost as directed by the Engineer.

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2.06.03

Covered Store

All field connection materials, paints, cement etc. shall be stored on well designed racks and platforms off the ground in a properly covered store building to be built at the cost of the Contractor.

2.07.00

Quality Control

The contractor shall establish and maintain quality control procedures for different items of work and materials as may be directed by the Engineer to assure compliance with the provisions of the Contract and shall submit the records of the same to the Engineer. The quality control operation shall include but not be limited to the Following items of work :

- i) Erection: Lines, levels, grades, plumbs, joint characteristics including tightness of bolts.
- ii) Grouting: Cleaning and roughness of foundation, quality of materials used for grouting, admixtures, consistency, and strength of grout.
- iii) Painting: Preparation of surface for painting, quality of primers and paints, thinners, application and uniformity of coats.

2.08.00

Taking Delivery

The Contractor shall take delivery of fabricated structural steel and necessary connection materials from railhead/trucks as may be necessary and as directed by the Engineer. He shall check, unload; transport the materials to his stores for proper storing at his own cost. The Contractor shall submit claims to insurance or other authorities and pursue the same in case of loss or damage during transit and handling and all loss thereof shall be borne by him.

The Contractor shall also take all precautions against damage of the materials in his custody after taking delivery and till the same are erected in place and accepted. The Contractor shall salvage, collect, and deliver all the packing materials to the Owner free of charge.

3.00.00

WORKMANSHIP

3.01.00

Erection

3.01.01

Plant and Equipment

The suitability and adequacy of all erection tools and plant and equipment proposed to be used shall be thoroughly verified. They shall be efficient, dependable, in good working condition and shall have the approval of the



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Engineer.

3.01.02 Method and sequence of erection

The method and sequence of erection shall have the prior approval of the Engineer. The Contractor shall arrange for most economical method and sequence available to him consistent with the drawings and specifications and other relevant stipulations of the contract.

3.01.03 Temporary Bracing

Unless adequate bracing is included as a part of the permanent framing, the erector during erection shall install, free of cost to the Owner, temporary guys and bracings where needed to secure the framing against loads such as wind or seismic forces comparable in intensity to that for which the structure has been designed, acting upon exposed framing as well as loads due to erection equipment and erection operations.

If additional temporary guys are required to resist wind or seismic forces acting upon components of the finished structure installed by others during the course of the erection of the steel framing, arrangement for their installation by the erector shall be made free of cost to the Owner.

The requirement of temporary bracings and guys shall cease when the structural steel is once located, plumbed, levelled, aligned, and grouted within the tolerances permitted under the specification and guyed and braced to the satisfaction of the Engineer.

The temporary guys, braces, false work, and cribbing shall not be the property of the Owner and they may be removed immediately upon completion of the steel erection.

3.01.04 Temporary Floors for Buildings

It shall be the responsibility of the Contractor to provide free of cost planking and to cover such floors during the work in progress as may be required by any Act of Parliament and/or bylaws of state, Municipal or other local authorities.

3.01.05 Setting Out

Positioning and levelling of all steelwork, plumbing of stanchions and placing of every part of the structure with accuracy shall be in accordance with the approved Drawings and to the satisfaction of the Engineer. For heavy columns,



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etc. the Contractor shall set proper screed bars to maintain proper level. No extra payment shall be made for this.

Each tier of column shall be plumbed and maintained in a true vertical position subject to the limits of tolerance under this Specification.

No permanent field connections by riveting, bolting or shall be carried out until proper alignment and plumbing has been attained.

3.01.06

Field Riveting

All rivets shall be heated and driven with pneumatic tools. Hand passing or "throwing" of rivets are desirable. Any other method of conveying hot rivets from the furnace to the driving point must be approved by the engineer. No-cold rivets shall be driven. All other requirements of riveting including quality and acceptance criteria shall be in accordance with the relevant portions of the Specification for Fabrication of Structural Steelwork of the Project.

3.01.07

Field Bolting

All relevant Portions in respect of bolted construction of the Specification for Fabrication of Structural Steelwork applicable to the Project shall also be applicable for field bolting in addition to the following:

Bolts shall be inserted in such a way so that they may remain in position under gravity even before fixing the nut. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible materials. When assembled, all joint surfaces, including those adjacent to the washers shall be free of scales except tight mill scales. They shall be free of dirt, loose scales, burns, and other, defects that would prevent solid seating of the parts. Contact surfaces within friction type joints shall be free of oil, paint, lacquer, or galvanizing.

All high tensile bolts shall be tightened to provide, when all fasteners in the joint are tight, the required minimum bolt tension by any of the following methods.

a) Turn-of-nut Method

When the turn-of-nut method is used to provide the bolt tension, there shall first be enough bolts brought to a "snug tight" condition to ensure that the parts of the Joint are brought into good contact with each other. "Snug tight" is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Following this initial operation, bolts shall be placed in any remaining



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holes in the connection and brought to snug tightness. All bolts in the joint shall then be tightened additionally by the applicable amount of nut rotation specified in Table-I with tightening progressing systematically from the most rigid part of the joint to its free edges. During this operation there shall be no rotation of the part not turned by the wrench.

TABLE-I

Bolts length not exceeding 8 times dia or 200 mm	Bolt length exceeding 8 times dia or 200 mm	Remarks
1/2 turn	2/3 turn	Nut rotation is relative to bolt regardless of the element (nut or bolt) being turned. Tolerance on rotation-30° over or under.

Bolts may be installed without hardened washers when tightening is done by the turn -of-nut -method. However, normal washers shall be used.

Bolts tightened by the turn-of-nut method may have the outer face of the match-marked with the protruding bolt point before final tightening, thus affording the inspector visual means of noting the actual nut rotation. Such marks can be made by the wrench operator by suitable means after the bolts have been brought up snug tight.

b) Torque Wrench Tightening

When torque wrenches are used to provide the bolt tensions, the bolts shall be tightened to the torques specified in TABLE-II (See Note below the Table). Nuts shall be in tightening motion when torque is measured. When using torque wrenches to install several bolts in a single joint, the wrench shall be returned to touch up bolts previously tightened, which may have been loosened by the tightening of subsequent bolts, until all are tightened to the required tension.

TABLE-II

Nominal Bolt Diameter (mm) (Kg.M) of IS:1367	Torque to be applied for bolt class 8.8
20	59.94



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81.63

24

103.73

Note: The above torque values are approximate for providing tensions of 14.7 T for 20 mm dia.; and 21.2 T for 24 mm dia. bolts under moderately lubricated condition. The torque wrench shall be calibrated at least once daily to find out the actual torque required to produce the above required tension in the bolt by placing it in a tension indicating device. These torques shall be applied for tightening the bolts on that day with the particular wrench.

In either of the above two methods, if required, for bolt entering and wrench operation clearances, tightening may be done by turning the bolt while the nut is prevented from rotating.

Impact wrenches if used shall be of adequate capacity and sufficiently supplied with air to perform the required tightening of each bolt in approximately ten seconds. Holes for turned bolts to be inserted in the field shall be reamed in the field. All drilling and reaming for turned bolts shall be done only after the parts to be connected are assembled. Tolerances applicable in the fit of the bolts shall be in accordance with relevant Indian Standard Specifications. All other requirements regarding assembly and bolt tightening shall be in accordance with this sub clause.

3.01.08

Field Welding

All field assembly and welding shall be carried out in accordance with the requirements of the specification for fabrication work applicable to the project, excepting such provisions therein which manifestly apply to shop conditions only. Where the fabricated structural steel members have been delivered painted, the paint shall be removed before field welding for a distance of at least 50 mm on either side of the joints.

3.01.09

Holes, Cutting and Fitting

No cutting of sections, flanges, webs, cleats, rivets, bolts, welds etc. shall be done unless specifically approved and /or instructed by the Engineer.

The erector shall not cut, drill, or otherwise alter the work of other trades, unless such work is clearly specified in the Contract or directed by the Engineer. Wherever such work is obtain specified the Contractor shall obtain complete information as to size, location and number of alterations prior to carrying out any work. The Contractor shall not be entitled for any payment on account of any such work.

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3.02.00**Drifting**

Correction of minor misfits and reasonable amount of reaming and cutting of excess stock from rivets will be considered as permissible. For this, light drifting may be used to draw holes together and drills shall be used to enlarge holes as necessary to make connections. Reaming, that weakens the member or makes it impossible to fill the holes properly or to adjust accurately after reaming, shall not be allowed.

Any error in shop work which prevents the proper assembling and fitting of parts by moderate use of drift pins and reamers shall immediately be called to the attention of the Engineer and approval of the method of correction obtained. The use of gas cutting torches at erection site is prohibited.

3.03.00**Grouting of stanchion bases and bearings of beams and girders on stone, brick or concrete (Plain or reinforced)**

Grouting shall be carried out with Ordinary Cement grout as described below:

The mix shall be one (1) part cement and one (1) part sand and just enough water to make it workable. The positions to be grouted shall be cleaned thoroughly with compressed air jet and wetted with water and any accumulated water shall be removed. These shall be placed under expert supervision, taking care to avoid air locks. Edges shall be finished properly. If the thickness of grout is 25 mm or more, two (2) parts of 6 mm down graded stone chips may be added to the above noted cement-sand grout mix, if required, by the Engineer or shown on the drawings.

No grouting shall be carried out until a sufficient number of bottom lengths of stanchions have been properly lined, leveled, and plumbed and sufficient floor beams are tied in position.

Whatever method of grouting is employed, the operation shall not be carried out until the steelwork has been finally levelled and plumbed, the stanchion bases being supported meanwhile by steel wedges, and immediately before grouting, the space under steel shall be thoroughly cleaned.

If required by the Engineer, certain admixtures like aluminium powder, "ironite" or equivalent, may be required to be added to the grout to enhance certain desirable properties of the grout. Approved non-shrink pre-mixed grout having required flowability and compressive strength may also be used with Engineer's approval.

3.04.00**Painting after Erection**

Field painting shall only be done after the structure is erected, levelled,



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plumbed, aligned and grouted in its final position, tested and accepted by the Engineer. Normally, final painting shall be done only after the floor slabs are concreted and masonry walls are built. However, touch up painting, making good any damaged shop painting and completing any unfinished portion of the shop coat shall be carried out by the Contractor free of cost to the Owner. The materials and specification for such painting in the field shall be in accordance with the requirements of the specification for fabrication of structural steelwork applicable for the project.

Painting shall not be done in frosty or foggy weather or when humidity is such as to cause condensation on the surfaces to be painted. Before painting of steel, which is delivered unpainted, is commenced, all surfaces to be painted shall be dried and thoroughly cleaned from all loose scale and rust.

All field rivets, bolts, welds, and abrasions to the shop coat shall be spot painted with the same paint used for the shop coat. Where specified, surfaces, which will be in contact after site assembling, shall receive a coat of paint (in addition to the shop coat, if any) and shall be brought together while the paint is still wet.

Surface, which will be inaccessible after field assembly shall receive the full, specified protective treatment before Bolts and fabricated steel members who are galvanized or otherwise treated and steel members to be encased shall not be painted.

The final painting shall be of tow coats of Synthetics Enamel painting or Aluminium paint of approved manufacture as per the approved "Schedule of Painting". The shades shall also be as per the approved schedule. Synthetic enamel paint shall conform to IS: 2932.

3.05.00 Final cleaning up

Upon completion of erection and before final acceptance of the work by the Engineer, the contractor shall remove free of cost all false work, rubbish and all Temporary Works resulting in connection with the performance of his work.

4.00.00 TESTING AND ACCEPTANCE CRITERIA

4.01.00 General

Loading tests shall be carried out on erected structures, if required by the Engineer, to check adequacy of fabrication and/or erection. Any structure or a part thereof found to be unsuitable for acceptance as a result of the test shall have to be dismantled and replaced with suitable member as per the Contract and no payment towards the cost of the dismantled portion and any connected



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work shall be made to the contractor. In course of dismantling, if any damage is done to any other parts of the structure or to any fixtures, the same shall be made good free of cost by the Contractor, to the satisfaction of the Engineer. The Cost of the tests specified hereinafter shall be borne by the Owner; but if the structure fails to pass the tests, the cost of the tests shall be recovered from the Contractor. Any extra claim due to loss of time, idle labour, etc. arising out of these testing operations shall not be entertained, however, only reasonable and appropriate time extensions will be allowed.

The structure or structural member under consideration shall be loaded with its actual dead load for as long a time as possible before testing and the tests shall be conducted as indicated in the following sub-clauses 4.01.01, 4.01.02 and 4.01.03. The method of testing and application of loading shall be as approved by the Engineer.

4.01.01 Stiffness Test

In this test, the structure or member shall be subjected, addition to its actual dead load, to a test load equal to 1.5 times the specified superimposed load, and this loading shall be maintained for 24 hours. The maximum deflection attained during the test shall be within the permissible limit. If, after removal of the test load, the member or structure does not show a recovery of at least 80 per cent of the maximum strain or deflection shown during 24 hours under load, the test shall be repeated. The structure or member shall be considered to have sufficient stiffness, provided that the recovery after this second test is not less than 90 per cent of the maximum increase in strain or deflection recorded during the second test.

4.01.02 Strength Test

The structure or structural member under consideration shall be subjected, in addition to its actual dead load, to a test load equal to the sum of the dead load and twice the specified superimposed load, and this load shall be maintained for 24 hours.

In the case of wind load, a load corresponding to twice the specified wind load shall be applied and maintained for 24 hours, either with or without the vertical test load for more severe condition in the member under consideration or the structure as a whole. Complete tests under both conditions may be necessary to verify the strength of the structure. The structure shall be deemed to have adequate strength if, during the test, no part fails and if on the removal of the test load, the structure shows a recovery of at least 20 per cent of the maximum deflection or strain recorded during the 24 hours under load.

4.01.03 Structure of same design



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Where several structures are built to the same design and it is considered unnecessary to test all of them, one structure, as a prototype, shall be fully tested, as described in previous Sub-clauses, but in addition, during the first application of the test load, particular note shall be taken of the strain or deflection when the test load 1.5 times the specified superimposed load has been maintained for 24 hours. This information is required as a basis of comparison in any check test carried out on samples of the structure.

When a structure of the same type is selected for a check test, it shall be subjected, in addition to its actual dead load, to a superimposed test load, equal to 1.5 time the specified live load, in a manner and to an extent prescribed by the Engineer. This load shall be maintained for 24 hours, during which time, the maximum deflection shall be recorded. The check test shall be considered satisfactory, provided that the maximum strain or deflection recorded in the check test does not exceed by more than 20% of the maximum strain or deflection recorded at similar load in the test on the prototype.

4.01.04

Repair for subsequent test and use after strength tests

An actual structure which has passed the "Strength Test" as specified in Sub-clause 4.1.2 hereinbefore and is subsequently to be erected for use, shall be considered satisfactory for use after it has been strengthened by replacing any distorted members and has subsequently satisfied the 'Stiffness Test' as specified in Sub-clause 4.01.01 hereinbefore.

4.02.00

Tolerances

Some variation is to be expected in the finished dimensions of structural steel frames. Unless otherwise specified, such variations are deemed to be within the limits of good practice when they are not in excess of the cumulative effect of detailed erection clearances, fabricating tolerances for the finished parts and the rolling tolerances for the profile dimensions permitted under the Specifications for fabrication of structural steel work applicable to this Project and as specified below: The specified tolerance is mainly for welded erection. In case of bolted erection, no tolerance is desired so that all prefabricated bolt holes are matched on erection.

I. For Buildings Containing Cranes

Component	Description	Variation Allowed
1.	2.	3.
Main columns	a) shifting of column axis	

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	at foundation level with respect to building line i) In longitudinal direction ii) In lateral direction b) Deviation of both major column axis from vertical between foundation and other member connection levels: i) For a column upto and including 10M height ii) For a column greater than 10M but less than 40M height c) For adjacent pairs of columns across the width of the building prior to placing of truss d) For any individual column deviation of any bearing or resting level from levels shown on drawings. e) For adjacent pairs of columns either across the width of building or longitudinally level difference allowed between bearing or seating Trusses least. Trusses	i) ± 3.0 mm ii) ± 3.0 mm i) ± 3.5 mm from true vertical ii) ± 3.5 mm from true vertical for any 10 M length measured between connection levels, but not more than ± 7 mm per 30m length. ± 9.0 mm on true span. ± 3.0 mm 3.0 mm 1/1500 of the span or greater than 10mm whichever is the 1/250 of depth of truss or 20 mm

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		span from vertical plane running through center of supports.	which ever is the - least.		
Crane Cirders	a) Difference in levels of crane rail measured between adjacent columns.	2.0 mm.			
	b) Deviation to crane rail-gauge	± 3.0 mm			
	c) Relative shifting of ends of adjacent crane rail in plan and elevation after thermite welding.	1.0 mm.			
	d) Deviation of crane rail axis from centre line of web.	± 3.5 mm			
Setting of Expansion gaps	At the time of setting of the expansion gaps, due regard shall be taken of the ambient temperature above or below 30°C. The coefficient of expansion or contraction shall be taken as 0.000012 per °C per unit length.				
iv) For Building without Cranes					
The maximum tolerances for line and level of the steel work shall be ±3.0 mm on any part of the structure. The structure shall not be Out of Plumb more than 3.5 mm on each lox section of height and not more than 7.0 mm per 30 m section.					
These tolerances shall apply to all parts of the structure unless the drawings issued for erection purposes state otherwise.					
4.03.00	Acceptance				
Structures and members have passed the tests and conform to all requirements specified in the foregoing Sub-clause 4.01.00, 4.01.01, 4.01.02, 4.01.03 and 4.01.04 and other applicable provisions of this specification and are within the limits of tolerances specified in Sub-clause 4.02.00 and/or otherwise approved by the Engineer shall be treated as approved and accepted for the purpose of fulfillment of the provisions of this contract.					

5.02.02 Fortnightly Progress Report

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The Contractor shall submit fortnightly progress reports in triplicate to the Engineer showing along with necessary photographs, 125 mm x 90 mm size, and all details of actual achievements against the target programme specified in Sub-clause 5.02.01 above. Any shortfall in the achievement in a particular fortnight must be made up within the next fortnight. Along with this report, the Contractor shall also furnish details of fabricated materials in hand at site and the strength of his workers.



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Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
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ROOF DECKING

1.00.00 Scope

This section of the specification covers the supply, fabrication and erection of profiled light gauge Metal Decks (coated and painted) as roof decking to the main plant building and any other area as indicated in the drawings.

2.00.00 Material

2.01.01 Roof of main plant TG and Deareator bay and bunker building consists of permanently colour coated (on exposed face) galvanized MS trough metal sheet decking plate of approved colour over roof purlins for cast-in-situ roof slab as per IS: 14246 and conform to class 3. Thickness of deck plate shall be minimum 0.8mm and minimum trough depth of 44 mm and centre to centre of the valley shall be 130mm with minimum yield strength of 250 Mpa. Silicon modified polyester paint shall be used for permanent coating over galvanized surface with minimum rate of galvanization 150 gm/sqm. DFT of permanent colour coating shall be 20 microns. It shall serve as permanent shuttering for cast-in-situ roof slab. It should have adequate strength to support weight of green concrete and imposed load during construction. The thickness of the deck plate shall however be designed suitably according to the spacing of roof purlins.

3.00.00 INSTALLATION

The Contractor shall furnish all labour, equipment and materials as required for the design, fabrication, coating, erection and fixing of the decking over purlins, painting and for the complete performance of the work in accordance with the construction drawings and as described herein.

The description, which follows, gives a general indication of the nature and extent of the work but is not necessarily exhaustive and does not purport to cover all the details/operations which will be necessary in order to carry out the work.

3.01.00 Detailed Design of Roof Decking

The Contractor, in conjunction with the manufacturer, shall be responsible for the detailing of the profiled decking, fittings and fixtures and shall submit with his tender particulars of the proposed manufacturer and of the particular product proposed for use. The detailing is to be based on typical details furnished by the Engineer. The Contractor shall submit to the Engineer, two copies of the general arrangement and detailed working drawings for the proposed design, together with all calculations necessary to verify the adequacy and completeness of the design & detailing of decking sheets,

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fixtures, flashings and trims. After approval he shall supply further eight copies. The Engineer will verify the correct interpretation of his requirements but may not necessarily check the design and details, and the Contractor shall be entirely responsible for the accuracy of the drawings and the correctness of the design and the suitability of the details. Manufacture of roof decking sheets shall not commence until the necessary approval of the Engineer has been obtained. 3.02.00 Erection & Fixing 3.02.01 Sequence of Manufacture/Erection Cutting Schedules, delivery to site and stacking arrangements in store shall ensure that sheets are erected in a sequence which follows that for the manufacture. The decking sheets shall be erected using an arrangement of sheets and joints to conform with the requirements of this specification. Decking erection for each elevation or feature shall commence at one end only and proceed towards the other end, in order to ensure tight fitting laps. 3.02.02 Position and Location of Laps Side and end laps of roof decking sheets shall be located and positioned in such a manner as to provide the maximum weather protection taking into account the direction of the prevailing wind. The lines formed by horizontal laps and fixing shall where possible, be continuous and coincide with the edges of large openings in the roof. 3.02.03 Alignment of Sheets and Fixings All roof decking sheets shall be fixed plumb and level with all fixings evenly spaced and accurately lined. All dirt and grease shall be removed from the surfaces of the sheets as the work proceeds. 3.02.04 Site Cutting Approval must be obtained before the roof decking sheets are cut at site. Generally cutting of sheets to length will not be permitted, only special cutting and trimming for small openings shall allowed. Where possible, site cut edges shall be concealed at laps. 3.02.05 Damaged Sheets Distorted, blemished or water stained sheets and any other fittings shall not be used.				



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3.02.06 Laps

End laps and side laps to roof decking sheets shall be sufficiently large to ensure that the decking complies with the weather tightness and other requirements of this specification. The length of each decking sheet shall be adjusted so that the end laps shall bear on the purlins. In no case end laps shall not be less than 150 mm and side laps shall not be less than 53 mm.

3.02.07 End Lap Fixings

End lap fixings shall be located at least 25 mm from the end of each sheet.

3.02.08 Side Lap Fixings

The spacing of side lap fixings shall ensure compliance with this specification regarding tightness. The spacing of these fixing screws shall not exceed 500mm. The fixing shall be located in the bottom flat of the corrugation.

3.02.09 Holes

Holes in MS decking sheets shall be punched. In case holes are drilled holes, it is to be ensured that the holes do not go oversize due to the small thickness of the sheeting. All drilling swarf shall be removed from the surfaces of decking, supporting steel work, purlins etc.

3.02.10 Location and Spacing of Fixings

Fixings shall be accurately located in position in the centre of the corrugations to ensure that the heads of bolts, nuts and washers bear squarely down on the surface of the sheeting and are not located at the edge or on the joints in supporting purlins.

3.02.11 Fixings

The tenderer shall submit with his tender details of the proposed method for securing the roofing sheets to the metal purlins. The roof decking sheets are to be fixed to the roof purlins with hex washer head white zinc plated heat treated carbon steel self drilling / self tapping screws of minimum thread diameter of 5.6mm. These self drilling screws shall be drilled through the roofing sheets and purlins supporting the roofing sheets. These purlins shall be suitably spaced as per the requirement of roofing sheets and the roofing sheets shall not sag more than span/250 for the loads likely to be imposed during concreting and in future. The self-drilling screws are to be spaced at a maximum distance of 390mm centre to centre along the length of the purlins and top chord of truss. The screws are to be located preferably in the valley only and shall be

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	installed in accordance with the manufacturer's recommendations using tools approved by the manufacturer which do not damage the coating of the decking sheets. 3.03.00 Protection during Construction Precautions shall be taken during the erection of the roof decking to ensure that partially erected decking are protected during inclement weather and damage at all times. 3.04.00 Damage Any damage to coating & primer during transportation is to redone with the similar type of coating as per the manufacturer's specification at no extra cost to the Owner. 4.00.00 Acceptance Criteria The installation shall present a neat appearance and shall be checked for water tightness. The following shall be checked : a) Side and end laps b) Absence of damage in the sheeting. c) Conformity of fixings with the approved design. 5.00.00 IS Codes All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed. IS : 513 - Specification for cold rolled carbon steel sheets. IS : 3618 - Specification for phosphate treatment of iron and steel for protection against corrosion. IS : 4431 - Specification for carbon & carbon manganese free cutting steel. IS : 1573 - Electroplated Coatings of zinc on iron and steel.	



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6.00.0 RATES AND MEASUREMENTS

6.01.00 Rates

Rates shall be unit rate for complete item described in the Schedule of Items and shall include all wastage.

6.02.00 Method of Measurement

Roofing shall be measured for net area of the work done. Profiled sheeting (coated & painted) shall be measured in plan area of sheets and not girthed. No deduction shall be made for openings measuring up to 0.1 sq.m. in area. No extra shall be paid for extra labour in cutting and for wastage etc. in making opening and cutting to size.

No payments shall be made for laps.



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FALSE FLOORING

1.00.00 General

This section of the specification covers the supply, fabrication and installation of false flooring system having PVC top finish particle board, GI supporting system, painting etc. as per schedule of items in the main plant building and any other area as indicated in the drawings.

The scope of contractor covers supply of all materials, fabrication & installation works required to be carried out for completion of false flooring in the area specified in the drawings.

2.00.00 MATERIAL

2.01.00 Supporting structure

Supporting pedestals shall be made of steel and will be of height as required. Supporting pedestal shall be truly vertical and located at distances to conform with size of floor panels and shall be equipped with locking devices to prevent disturbances of finished elevation. Base of pedestal shall have integral load dispersion plate of size 100x100x8mm to transmit the load evenly to the base floor. Adjustment of pedestal shall be provided by threaded vertical rod of 25mm diameter and elevating nut. The pedestal head shall provide positive interlocking of the steel grid channels supporting system and shall prevent lateral shifting.

The grid channels shall be made of galvanised steel of 40mm x 40mm x 3.15mm thick and shall be placed at 610mm centre to centre both ways to support floor panels in uniform levelled elevations. Nominal height of the false flooring system shall be 600 mm unless otherwise indicated. Pedestal head shall be equipped with conducting grounding pad if so desired by the Engineer

2.02.00 Floor Panels

The floor panels shall be made of fire resistant particle board, phenol formaldehyde bonded. Size of each panel shall be 610mm x 610mm with all panel edges finished to a tolerance of ± 0.2 mm. Floor panel shall have 2mm thick non-static PVC on top, 2mm thick hard PVC strip lipping on four edges and 26 G aluminium sheet fixed with araldite at bottom. Minimum thickness of the panel shall be 35mm, unless otherwise noted. All panels shall be completely interchangeable and easily removable with a suction lift tool. Panels shall be square within a tolerance of ± 0.25 mm on the diagonal. The floor panels shall be cut, wherever required for providing suitable outlets for



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cables and edges shall be lipped with hard PVC sheets.

2.02.01 Strength

Each 610mm x 610 mm floor panel must be capable of withstanding the designed service load. The ultimate strength shall provide a safety factor of 3. The false flooring shall be capable of carrying a axial load of 800 kg and uniform load of 2000 kg/sq.m with maximum deflection of 1/350. If required by the Engineer, the samples shall be accepted only after carrying out load tests. The Engineer may relax the test requirements with concentrated load in case cabinets are not handled with castor fitting arrangement.

One additional pedestal shall be provided under floor stringer along front panel area of each control board for taking possible additional load that may occur from time to time.

2.02.02 Surface finish

All removable panels shall have the top surface finished with 2 mm thick flexible PVC flooring conforming to IS:3462 and shall be fixed to the surface with compatible high-creep resistant adhesive. The PVC floor tile shall be in single piece for each floor panel. Under side of panels shall also be painted with suitable epoxy or oil based paint.

2.02.03 Damaged Floor Panels

Distorted, blemished or stained floor panels shall not be used.

2.03.00 Skirting

Skirting shall be 150 mm high and 2 mm thick, completely matching with false flooring surface finish materials and shall be fixed to the wall surface as per manufacturer's installation instructions.

3.00.00 INSTALLATION

3.01.00 Base

The system shall be placed over a base of RCC floor slab and beams. Any grouting etc. that is necessary to fix the supporting structure shall be done.

The concrete sub floor shall be sealed with two coats of polyurethane paint to prevent moisture from coming in contact with cables and to minimise dust problem.

The floor panels and channels shall be completely interchangeable and remain in position without screwing or bolting under working/imposed loadings.

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	Any damage to the sub floor during installation of the false flooring system shall be made good by the contractor without any extra cost to the Owner. All steel surfaces are to be protected by two coats of polyurethane paint over a compatible primer and any damage to the paint during installation shall be made good. In case the loads exerted by the weight of machines are above the stated characteristics of floor finish material, the floor shall be protected by overlaying hard board during installation of machine or equipment. All installation work of the false flooring system shall be supervised by the manufacturer's authorised representative. 3.03.00 Painting After fixing the false flooring supporting system the sub floor shall be given a coat of polyurethane paint. 3.04.00 Protection during Construction All precautions shall be taken during the erection of the false flooring to ensure that partially erected flooring are protected and shall not be damaged before handing over to owner. 3.05.00 Damage Any damage of coating to supporting system caused during transportation is to be redone with the similar type of coating as per the manufacturer's specification at no extra cost to the Owner. 4.00.00 ACCEPTANCE CRITERIA The false flooring system shall only be accepted after completion of following checks : - Level - Alignment of joints - Thickness of joints - Surface finish - Colour and texture - Details of edges, junctions etc. - Performance	



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h. Criteria specified for strength.

5.00.00

IS CODES

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS:5318 Laying of flexible sheet and flooring.

IS:3462 Flexible PVC flooring

IS:3087 Wood particle boards (medium density) for general purposes.

6.00.0

RATES AND MEASUREMENTS

6.01.00

Rates

Rates shall be unit rate for complete item described in the Schedule of Items and shall include, but not limited to, supply & installation of floor panels, supporting systems, paintings etc.

6.02.00

Method of Measurement

False flooring shall be measured in Sq.M for net area of the work done. No deduction shall be made for openings measuring up to 0.4 sq.m. in area. No extra shall be paid for extra labour in cutting and for wastage etc. in making opening and cutting to size.



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BORED CAST-IN-SITU RCC PILES**

SPECIFICATION NO. PE-TS-999-600-C021

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BORED CAST-IN-SITU RCC PILES

SPECIFICATION NO. PE-TS-999-600-C021



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



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**TECHNICAL SPECIFICATION FOR INSTALLATION OF BORED
CAST-IN-SITU PILES**

1.00.00 SCOPE

This specification covers the installation of bored cast-in-situ reinforced concrete vertical piles of specified load carrying capacity and diameter for various structures. This specification also covers carrying out initial and routine load tests on piles to assess their vertical, horizontal and pull out load carrying capacities.

2.00.00 GENERAL REQUIREMENTS

2.01.00 This specification along with specific requirements under Annexure-A covers the technical requirements for piling work.

2.02.00 The work shall include supplying and providing necessary materials, mobilization of all necessary equipments (Annexure-B), providing necessary engineering supervision through qualified and technical personnel, skilled and unskilled labour, etc. as required to carryout the complete piling work, and submission of records as per schedule.

2.03.00 The Contractor shall carryout all works as mentioned in Scope above. All works shall be executed to the satisfaction of the Engineer.

2.04.00 Pile capacities in vertical compression, horizontal, pullout loads for various pile diameters are given in Annexure-A.

2.05.00 The Contractor shall confirm and guarantee the "Safe Load" capacities by conducting both initial and working load test on piles as mentioned in the specific requirements.

2.06.00 The Contractor shall submit along with tender documents his tender design of piles based on soil data furnished by the Owner along with this specification. The ultimate load capacity of a pile may be estimated using suitable static formula and the minimum factor of safety shall be 2.5. However, safe load carrying capacity shall be conformed and guaranteed by conducting initial and routine load tests.

2.07.00 In case of initial or routine load test piles, if the Contractor fails to establish the safe load capacity as per his design, the Owner has the right to either derate the pile capacity on prorata basis or insist the Contractor to modify the pile design, to achieve the desired safe load capacity at no extra cost to the Owner.

2.08.00 Derating is acceptable up to 90 percent. In such case, additional piles shall be installed as per the design requirements.



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- 2.09.00 The Owner shall decide whether to derate or modify the design based on the design considerations such as providing additional piles in the designed pile cap, provision for extending the pile cap size, etc.
- 2.10.00 In case the Owner decides to modify the design instead of derating the pile, the contractor shall carry out the same and install separate test piles and test the same to guarantee the safe load at no extra cost to the Owner. However no extra shall be charged for the additional test piles as well as testing of these piles as per agreed contract conditions.
- 2.11.00 In case of working piles, if the pile does not meet the guaranteed capacity or rejected due to any other reason, the Contractor shall install extra piles at no extra cost to the Owner. Further, the extra cost, due to the increase in the pile cap size if any, on account of extra piles, shall be borne by the Contractor.
- 2.12.00 It is essential that all equipment and instruments are properly calibrated both at commencement and immediately after the completion of tests so that they represent true values. Certificates to this effect from an approved institution shall be furnished to the Engineer. If the Engineer so desires the Contractor shall arrange for having the instruments tested at an approved laboratory at no extra cost to the Owner and the test report shall be submitted to the Engineer. If the Engineer desires to witness such tests Contractor shall arrange to conduct the test in his presence.
- 2.13.00 The Contractor shall make his own arrangements for locating the coordinates and position of piles as per drawings supplied to him and for determining the Reduced Levels (RL) of these locations with respect to the benchmark indicated by the Engineer. Two established reference lines in mutually perpendicular direction shall be indicated to the Contractor. The Contractor shall provide at site all the required survey instruments to the satisfaction of the Engineer so that the work can be carried out accurately according to specifications and drawings.
- 2.14.00 The contractor shall assure the quality of piling work including cleaning of pile bore, quality of concrete, integrity of piles, etc.
- 2.15.00 **AVAILABLE SUB-SOIL DATA**
- An abstract of the sub soil data is furnished in the tender document. However, the detailed soil investigation report shall be made available for reference of the bidder, if so required, at the office of the Owner. The soil data furnished is in good faith and only for the guidance of the Bidder, to arrive at design parameters and construction methods.



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3.00.00 MATERIALS

3.01.00 General

All materials viz cement, steel, aggregates, water, etc. which are to be used for pile construction shall conform to relevant IS codes for properties, storage and handling of common building materials. However, aggregates more than 20 mm size shall not be used.

3.02.00 CONCRETE

Concrete shall be manufactured either by central batching plant or Ready Mix concrete. However, for initial test piles suitable method as approved by the Engineer may be used. Concrete shall conform to IS: 10262 & IS: 456.

3.02.01 Technical Specification for Cement Concrete (Plain and Reinforced) works along with IS: 2911 Part I/Sec 2 shall be followed for concrete works of piles. Use of plasticiser to control the water cement ratio shall be permitted on specific approval from the Engineer. Water cement ratio shall not be greater than 0.5.

3.02.02 Grade and minimum cement content
Minimum grade of concrete shall be as per Annexure-A conforming to IS: 456. Minimum cement content of 400 Kg/M³ of concrete shall be used for M-20 grade concrete.

3.02.03 Slump of concrete
The slump of concrete shall vary between 150 to 180 mm.

3.03.00 REINFORCEMENT

3.03.01 Longitudinal reinforcement in pile shall be high strength deformed steel bars conforming to IS: 1786 unless specified otherwise. Lateral reinforcement in pile shall be of mild steel conforming to IS: 432 Part-1 or HYSD bars as per IS: 1786.

3.03.02 The longitudinal reinforcement shall be provided considering the combination of vertical (compression and tension) and horizontal loads. However, the minimum longitudinal reinforcement shall be 0.4 percent of the sectional area calculated on the basis of nominal pile diameter. Minimum six numbers of bars shall be provided for longitudinal reinforcement. The diameter of longitudinal reinforcement bars shall not be less than 12mm. The stipulated minimum reinforcement shall be provided for the full length of pile.

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3.03.03	The longitudinal reinforcement shall project 50 times its diameter above cut off level unless otherwise indicated.		
3.03.04	The laterals shall be tied to the longitudinal reinforcement to maintain its shape and spacing. The laterals may in the form of links or spirals. The minimum diameter of the links or spirals shall be 6 mm and the spacing of the links or spiral shall not be less than 150 mm and in no case more than 250 mm.		
3.03.05	Reinforcement cage shall be sufficiently rigid to withstand handling and installation without any deformation and damage. As far as possible number of joints (laps) in longitudinal reinforcement shall be minimum. In case the reinforcement cage is made up of more than one segment, these shall preferably be assembled before lowering into casing tube/pilebore by providing necessary laps as per IS: 456.		
3.03.06	The minimum clear distance between the two adjacent main reinforcement bars shall normally be 100 mm for the full depth of cage.		
3.03.07	The laps in the reinforcement shall be such that the full strength of the bar is effective across the joint and the reinforcement cage is of sound construction.		
3.03.08	Laps shall be staggered as far as practicable and not more than 50% bars shall be lapped at a 'particular section. Lap joints shall be staggered by at least 1.3 times the lapped length (Centre to Centre).		
3.03.09	Proper cover and central placement of the reinforcement cage in the pile bore shall be ensured by use of suitable concrete spacers or rollers, cast specifically for the purpose.		
3.03.10	Minimum clear cover to the longitudinal reinforcement shall be 50 mm, unless otherwise mentioned.		
3.03.11	Bundling of bars is not permitted.		
4.00.00	PILE INSTALLATION Installation of piles shall be carried out as per pile layout drawings, installation criteria, and the direction of the Engineer.		
4.01.00	Equipment and Accessories		
4.01.01	The equipment and accessories for installation of bored cast-in-situ piles shall be selected giving due consideration to the sub soil conditions, ground water conditions and the method of casting, etc. These shall be of standard type and shall have the approval of the Engineer.		

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	4.01.02 List and details of equipment and accessories proposed to be used for the job shall be submitted along with the bid. 4.01.03 The capacity of the rig shall be adequate so as to reach the specified founding level. 4.01.04 Provision shall be kept for chiselling within the pilebore, as specified elsewhere in this specification. Chiselling shall be carried out only with the approval of Engineer. 4.02.00 Installation Criteria 4.02.01 For determining the founding level of piles in soil as specified elsewhere, the Contractor shall have to perform Standard penetration test (SPT) as per IS: 2131 in a separate bore hole. The SPT shall be conducted at 1.0 m interval between the depths covering 5 metres each above and below the specified founding level. The bore shall be 100 mm diameter and method of boring shall conform to IS: 1892. 4.02.02 For determining founding level of piles in rock, as specified elsewhere socketing horizon shall be established by the Contractor by collecting rock cores of NX size in a separate borehole, and testing the same for uniaxial compressive strength (UCS). Cores shall be collected by double tube core barrel attached with diamond bit. Coring shall be done upto a depth as indicated in the "specific requirements." Coring in rock shall conform to IS: 6926. 4.02.03 In case it is not possible to test the cores so obtained for uniaxial compressive strength, cores shall be tested for point load strength index and correlated to obtain uniaxial compressive strength. 4.02.04 Number of boreholes for carrying out SPT in soil or uniaxial compressive strength in rock, shall vary from one in 100 to 150 piles or pile group of 150 Sqm depending on the site condition and as decided by the Engineer. However, at the location of initial load test piles, one such borehole shall be done. 4.02.05 A protocol between contractor and BHEL site shall be maintained regarding the strata at founding level. SPT value and UCS from the nearest borehole shall be indicated therein. 4.02.06 The founding level of the pile shall be decided based on the criteria elaborated in the specific requirements under Annexure-A. Concreting shall not be done until the above conditions for founding level are satisfied. 4.02.07 Approval of founding level by the Engineer shall in no way absolve the Contractor of his responsibility to guarantee the Safe load capacity of the piles as indicated in this document.	



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4.03.00 Control of position and alignment

4.03.01 Piles shall be installed as accurately vertical as possible. The permissible limits for deviation with respect to position and (inclination) alignment shall conform to IS: 2911 Part I/Sec. 2, which is reproduced below for ready reference.

- a) The maximum deviation of vertical piles shall not exceed 1.5 per cent in alignment.
- b) Piles shall not deviate more than 75 mm or D/4 whichever is less (75mm or D/10 whichever is more in case of piles having diameter more than 750mm) from their designed position at the working level.

4.04.00 Boring

4.04.01 Boring operations shall be done by rotary or percussion type drilling rigs using reverse mud circulation (RMC) method. Rotary hydraulic pulley shall be preferred.

4.04.02 The Contractor shall satisfy himself about the suitability of the method to be adopted for site. If DMC (direct mud circulation) or RMC is used Bentonite slurry shall be pumped through drill rods by means of high-pressure pumps. The cutting tool shall have suitable ports for the bentonite slurry to flow out at high pressure. If on mobilisation, the Contractor fails to make a proper bore for any reason, the Contractor has to switchover to other boring methods as approved by the Engineer at no extra cost to the Owner.

4.04.03 Working level shall be above the cut off level. After the initial boring of about 1.0m a temporary guide casing of suitable length shall be lowered in the pile bore. The diameter of guide casing shall be of such diameter, so as to give the necessary finished diameter of the concrete pile. The centre line of guide casing shall be checked before continuing further boring. Guide casing shall be minimum of 1.0m length. Additional length of casing may be used depending on the condition of the strata, ground water level etc.

4.04.04 Use of drilling mud (bentonite slurry) for stabilizing the sides of the pile bore is necessary wherever subsoil is likely to collapse in the pile bore. Drilling mud to be used shall meet the requirement as given in Annexure-C.

4.04.05 The bentonite slurry and the cuttings, which are carried to the surface by the rising flow of the slurry, shall pass through settling tanks of adequate size to remove the sand and spoils from the slurry before the slurry is recirculated to the

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	boring. The bentonite slurry mixing and recirculation plant shall be suitably designed and installed.	
4.04.06	The bentonite slurry shall be maintained at 1.5m above the ground water level during boring operations and till the pile is concreted. When DMC or RMC method is used the bentonite slurry shall be under constant circulation till start of concreting.	
4.04.07	The size of cutting tools shall not be less than the diameter of the pile by more than 75mm. However, the pile bore shall be of the specified size.	
4.05.00	Chiselling	
4.05.01	Chiselling may be resorted to with the permission of the Engineer below the socketing horizon. The chiselling tool or bit shall be of adequate size and weight so as to reach the desired depth.	
4.06.00	Cleaning of Pile bore	
4.06.01	On completion of the pile bore upto the required depth, the bottom of the hole shall be cleaned very carefully before concreting work is taken up. Cleaning shall ensure that the pile bore is completely free from sludge/bored materials, debris of rock/boulder etc. Necessary checks shall be made as given in clause 5.0 to confirm the thorough cleaning of the pile bore.	
4.06.02	Pile bore shall be cleaned by fresh drilling mud through tremie pipe after placing reinforcement and just before start of concreting.	
4.06.03	Pile bore spoil along with used drilling mud shall be disposed off from site as directed by the Engineer.	
4.06.04	Pile bore bottom shall be thoroughly cleaned to make it free from sludge or any foreign matter before and after placing the reinforcement cage.	
4.07.00	Adjacent Structures	
4.07.01	When working near existing structures care shall be taken to avoid any damage to such structures.	
4.08.00	Concreting	
4.08.01	The Contractor shall carry out concrete mix design in accordance with IS: 10262 and submit mix design calculations and get them approved from the Engineer well in advance for installation of piles. Adequate number of tests on cubes, etc. shall be carried out as mentioned in clause 5.0 to ensure concrete of the	

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	minimum specified strength in accordance with IS: 456 at requisite workability (slump). 4.08.02 Concreting shall not be done until the Engineer is satisfied that the bearing strata (soil/rock) met with at the termination level of pile. 4.08.03 The time interval between the completion of boring and placing of concrete shall not exceed 6 hrs. In case the time interval exceeds 6 hrs the pilebore shall be abandoned. However, the Engineer may allow concreting provided the Contractor extends the pile bore by 0.5 m beyond the proposed depth, and clean the pilebore. The entire cost of all operation and materials for this extra length shall be borne by the Contractor. 4.08.04 Proper placement of the reinforcement cage to its full length shall be ensured before concreting. 4.08.05 Concreting shall be done by tremie method as specified by IS: 2911 (Part I /Sec.2). The level of drilling mud shall be maintained sufficiently above the ground water level. 4.08.06 The concreting operations shall not be taken up when the specific gravity of bottom slurry is more than 1.2 and sand content more than 7%. The drilling mud sample shall be collected from the bottom of pilebore as mentioned in clause 5. 4.08.07 Consistency of the drilling mud suspension shall be controlled throughout the concreting operations in order to keep the bore stabilized as well as to prevent concrete getting mixed up with the thicker suspension of the mud. 4.08.08 It shall be ensured that volume of concrete poured is at least equal to the theoretically computed volume of pile shaft being cast. 4.08.09 The temporary guide casing shall be withdrawn cautiously, after concreting is done upto the required level. While withdrawing the casing concrete shall not be disturbed. 4.09.00 Cut off level (COL) 4.09.01 Cut off level of piles shall be as indicated in drawings released for construction or as indicated by the Engineer. 4.09.02 The top of concrete in pile shall be brought above the COL to remove all laitance and weak concrete and to ensure good concrete at COL for proper embedment in to pile cap. 4.09.03 When the pile cut off level is less than 1.0 metre below the working level, concrete shall be cast to the piling platform level to permit overflow of	

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	concrete for visual inspection. In case COL of pile is more than 1.0 metre below working level then concrete shall be cast to a minimum of one metre above COL.	
4.10.00	Sequence of Piling	
4.10.01	Each pile shall be identified with a reference number.	
4.10.02	The convenience of installation may be taken into account while scheduling the sequence of piling in a group. This scheduling shall avoid piles being bored close to other recently constructed piles.	
4.11.00	Building up of Piles	
4.11.01	If any pile, already cast as per construction drawing, requires any extra casting due to any change in cut off level or the cast pile top level is less than the specified level or for any other reason, then the pile shall be built-up by using atleast one grade higher concrete than that used for concreting of the same pile, ensuring proper continuity with the existing concrete and to the satisfaction of the Engineer. Necessary reinforcement as per design requirement and suitable shuttering shall be provided before casting the concrete. Surrounding soil shall also be built up to the required level by proper compaction to ensure lateral capacity of the pile.	
4.12.00	Breaking off of Piles	
4.12.01	If any pile already cast, requires breaking due to lowering in cut off level or for any other reason, then the same shall be carried out, not before seven days of casting without affecting the quality of existing pile such as loosening, cracking etc. and to the satisfaction of the Engineer.	
4.13.00	Preparation of Pile head	
4.13.01	The soil surrounding the piles shall be excavated upto the bottom of the lean concrete below the pile cap, with provision for working space, sufficient enough to place shuttering, reinforcement, concreting and any other related operations.	
4.13.02	The exposed part of concrete above the COL shall be removed/chipped off and made to a uniform level at COL, but not before seven days of casting of pile.	
4.13.03	The projected reinforcement above COL shall be properly cleaned and bent to the required shape and level to be anchored into the pile cap.	
4.13.04	The pile top shall be embedded into the pile cap by 50mm or clear cover to reinforcement, whichever is higher.	

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4.13.05	All loose material, like debris due to chipping/breaking of pile head to the desired level, shall be removed and disposed off as directed by the Engineer.	
4.14.00	Rejection and Replacement of Defective Piles	
4.14.01	The Engineer reserves the right to reject any pile which in his opinion is defective on account of load capacity, structural integrity, position, alignment, concrete quality etc. Piles that are defective shall be pulled out or left in place as judged convenient by the Engineer, without affecting the performance of adjacent piles. The Contractor shall install additional piles to substitute the defective piles as per the directions of the Engineer, at no extra cost to the Owner.	
4.15.00	Recording of Piling Data	
4.15.01	The Contractor shall record all the information during installation of piles. Typical data sheet for recording pile data shall be as shown in Appendix D of IS: 2911 Part I/Sec.2. The pile data shall also include all the details as in Annexure-D. On completion of each pile installation, pile record in triplicate shall be submitted to Engineer within two days of completion of concreting of the pile.	
5.00.00	SAMPLING, TESTING AND QUALITY ASSURANCE	
5.01.00	Facilities required for sampling and testing of materials, concrete, etc. in field and in laboratory should be provided by the Contractor. The Contractor shall carry out all sampling and testing in accordance with the relevant Indian Standards and this Specification. Where no specific testing procedure is mentioned the tests shall be carried out as per the prevalent accepted engineering practice and as per the directions of the Engineer. Tests shall be done in the presence of the Engineer or his authorized representative. In case the Engineer requires additional tests, the Contractor shall arrange to get these tests done and submit to the Engineer the test results in triplicate within three days after completion of any test.	
5.02.00	The Contractor shall maintain records of all inspection and testing, which shall be made available to the Engineer. The Engineer at his discretion may waive some of the stipulations for small and unimportant concreting operations and other works.	
5.03.00	Materials found unsuitable for acceptance shall be removed and replaced by the Contractor. The work done by this unsuitable material shall be redone as per specification requirements & and to the satisfaction of the Engineer at no extra cost to the Owner.	
5.04.00	Quality Assurance Programme	



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- a) The Contractor shall submit and finalize a detailed Field Quality Assurance Programme within 30 days from the date of award of the contract, according to the requirements of this specification. This shall include setting up of a testing laboratory, arrangement of testing apparatus/equipment, deployment of qualified/experienced manpower, preparation of field quality plan, etc. On finalized field quality plan, the Owner shall identify, customer hold points, beyond which work shall not proceed without written approval from the Engineer. The testing apparatus/equipment installed in the field laboratory shall be calibrated/ corrected by the qualified persons as frequently as possible to give accurate testing results.
- b) Frequency of sampling and testing, etc. and Acceptance Criteria are given in Table - 1. The testing shall be done at field laboratory or any other laboratory approved by the Engineer. However, the testing frequencies set forth are the desirable minimum and the Engineer shall have the full authority to call for tests as frequently as he may deem necessary to satisfy himself that the materials and works comply with the appropriate specifications. The materials shall be tested to meet all the specified requirements before acceptance at manufacturers premises or at independent government approved laboratory. Tests indicated in the table are for cross checking at site the conformity of the materials to some of the specifications.

5.05.00 Testing of Concrete

5.05.01 Concrete and other materials shall be tested for quality, strength and other properties. Details of testing shall be as specified under technical specification for Cement concrete (Plain and Reinforced).

5.05.02 One sample consisting of six test cubes shall be made from the concrete used in each test pile, three to be tested after 7 days and three after 28 days.

5.05.03 For working piles, minimum one sample consisting of six test cubes shall be made from the concrete for the first ten piles, three to be tested after 7 days and three after 28 days. Thereafter, minimum one sample consisting of three test cubes for every 10 piles shall be tested for the 7-days & 28-days cube strength.

5.05.04 In preparation of test cubes or specimens vibrators shall not be used.

5.05.05 Concrete shall be tested for slump at every 1-hour interval during concreting of piles.

5.05.06 The frequency of sampling and testing of concrete and materials shall be done as per technical specification for cement concrete (Plain & Reinforced).

5.05.07 The acceptance criteria shall be as mentioned in Table-1.

5.06.00 Testing for position and alignment

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5.06.01	Each pile shall be checked for its position with respect to specified location. Each pile bore shall be checked for its alignment.	
5.06.02	Permissible limits for deviation shall be as specified under clause no. 4.03.	
5.07.00	Properties of Drilling mud	
5.07.01	Properties of drilling mud shall be checked as per requirement under Annexure C. Prior to the commencement of piling work and thereafter minimum once in a week or as found necessary by the Engineer, one sample consisting of 3 specimens shall be tested. Acceptance criteria applicable are as specified else where with 5% variation. This relaxation is not applicable for properties of drilling mud before concreting.	
5.07.02	Density of the drilling mud shall be checked in each pile before concreting.	
5.08.00	Check for Pile bore	
5.08.01	On completion of boring and cleaning the bottom of each pilebore shall be checked from the sample collected from near the bottom of pile bore or by any other methods as approved by the Engineer, to ensure that it is free from pilebore spoil/debris and any other loose material, before concreting. Concreting shall be done only after the approval of the Engineer.	
5.08.02	For sampling of drilling mud from the pilebore the following method or any other suitable method shall be adopted.	
	a) A solid cone shall be lowered by a string to the bottom of pilebore. A sampler tube closed at top with a central hole (hollow cylinder) is lowered over the cone, and then a top cover shall be lowered over the cylinder. Care shall be taken for proper fittings of assembly to minimize the leakage while lifting the cone assembly to the ground surface. The slurry collected in the sampler tube shall be tested for density and sand content.	
	b) Use of borehole camera for checking the pile bore spoil and strata is acceptable on approval of the Engineer.	
5.09.00	Pile Integrity test	
5.09.01	Low strain integrity test shall be conducted on 50% of the jobs piles and on all test piles or as directed by Engineer. The system shall have the computer readout facility and report on the findings of this shall be furnished to the Owner. This test shall be used to identify the job piles for routine load test.	

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	Piles shall be trimmed to cut off level or sound concrete level. No pile cap blindage work should be undertaken prior to this test. The cast in-situ piles should not be tested before 14 days of casting. 5.09.02 The test shall be undertaken by persons trained and experienced and capable of interpreting the results with specific regard to piling. This test is limited to testing the integrity of the shaft and is not intended to replace the use of static load testing. 5.09.03 Low Strain Integrity Test Methodology: a) In this test, a low stress wave is set up in the pile shaft and is also known as Sonic Integrity or Sonic Echo test. b) A small metal/hard rubber hammer is used to produce a light blow on top of the pile. The shock wave travelling down the length of the pile is reflected back from the toe of the pile and recorded through a suitable transducer/ accelerometer in a computer for subsequent analysis. c) The primary shockwave, which travels down the length of the shaft, is reflected from the toe by the change in density between the concrete and sub strata. However, if the pile has any imperfections or discontinuities within its length these will set up secondary reflections, which will be added to the return signal. d) By analysis of the captured signal and knowledge of the conditions of the ground, age of concrete, etc. a picture of the locations of pile shaft defects can be built up. The observed signals are amplified into digital display as velocity versus length records providing information on structural integrity of piles. e) The stress wave velocity and approximate pile lengths are provided as input for the integrity testing. The stress wave velocity is dependent on the Young's Modulus and mass density of pile concrete. f) More than one recording of signals shall be done until repeatability of signals is achieved on the same pile. g) The tests shall be conducted at 3-6 locations to cover the entire cross section of the pile. 6.00.00 PILE TESTING Pile load test shall be carried out as per IS:2911 Part-4 (latest edition) or as directed by Engineer.	



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6.01.00 INITIAL LOAD TEST

Initial load test shall be carried out on separately cast piles for confirmation of estimated pile capacities and to fix a more accurate driving criteria viz. set/bow, total number of blows and approximate depth etc. of founding level. At least 2 nos. of tests shall be conducted for each mode (vertical compression, pull out and lateral). The maximum test load shall be as mentioned in bill of quantities.

6.02.00 ROUTINE LOAD TEST

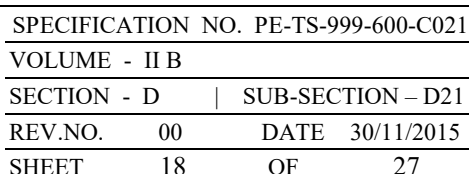
Routine load tests shall be carried out on job (working) piles for 0.5% of total no. of piles (for each mode and type). Maximum test load shall be 1.5 times the design safe load capacity. Piles showing unsatisfactory results as per load test results shall be treated as defective piles. Defective piles shall be removed or left in place and replaced by additional piles as directed by Engineer at no extra cost to the owner. Any additional cost towards design implications, if any, due to above shall be born by the contractor.

7.00.00 CODES AND STANDARDS

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

- IS: 432 - Specification for mild steel and medium tensile steel bars (Part 1 & 11) and hard drawn steel wire for concrete reinforcement.
- IS: 456 - Code of practice for plain and reinforced concrete.
- IS: 1200 - Measurement of Building and Civil Engineering works (Part 23) Piling.
- IS: 1786 - Code of practice for twisted steel high strength deformed bars for concrete reinforcement.
- IS: 1892 - Code of practice for Subsurface Investigation for foundation.
- IS: 2131 - Method of Standard Penetration Test for Soils
- IS: 2911 - Code of practice for design and construction of pile foundations - Bored cast-in-situ concrete piles.
- IS: 2911 - Code of practice for design and construction of pile

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	SPECIFICATION NO. PE-TS-999-600-C021 VOLUME - II B SECTION - D SUB-SECTION – D21 REV.NO. 00 DATE 30/11/2015 SHEET 17 OF 27
	Part IV foundation - Load test on piles. IS: 6926 - Code of practice for Diamond core Drilling for Site Investigation for River Valley Projects. IS: 10262 - Recommended guidelines for concrete mix design. 8.00.00 RATES AND MEASUREMENTS The clauses below shall apply for item rate contracts only. They shall not be applicable to turnkey/lump sum Contracts. 8.01.00 Rates 8.01.01 The items of work in the schedule of items, describe the work in brief. The various items in schedule of items shall be read in conjunction with the corresponding sections in the Technical Specifications, including amendments, and additions, if any. For each item in schedule of items, the unit rate shall include for the activities covered in the description of the item as well as for all necessary operations described in the specification and specific requirements. 8.01.02 The unit rates shall include for minor details which are obviously and fairly intended, and which may not have been included in the description in these documents, but are essential for the satisfactory completion of the work. Unit rates shall also include for all safety measures as required by codal provisions, local regulations, acts, bye-laws, etc. and for execution of work to the satisfaction of the Engineer. 8.01.03 The quoted rate for each item shall be inclusive of mobilization of all plant, equipment, scaffolding, labour, materials, skilled and unskilled labour, and demobilization after completion of work, supervision, establishing the level and coordinates at each work. 8.01.04 The quoted rate for piling for a particular diameter and capacity of pile shall remain valid for the actual lengths provided /to be provided irrespective of the minimum length specified elsewhere in this specification. 8.01.05 The quoted rate for piling as per description of item works shall be inclusive of providing all plant equipment, labour, materials, skilled and unskilled labour, making observations, establishing the ground level and coordinates at each location of pile by carrying levels from one established bench mark and distances from one set of grid lines furnished by the owner.	



8.01.06	The quoted rate for piling shall be inclusive of bailing out all the pile bore spoil from the pilebore, keeping the borehole free from bored material/debris etc. and disposing the bored/chiselled material along with the drilling mud upto 2 Km. beyond plant boundary or as directed by Engineer, flushing the pile bore by fresh bentonite before concreting, collection of samples from bottom of pilebore, transporting to laboratory, testing and reporting of results.
8.01.07	The quoted rate for piling shall include shifting of plant and equipment from one pile location to another pile locations, providing temporary casing pipe and removal of the same after completing, concreting, supply of necessary materials, equipment and manpower, cost of boring by approved method as specified, circulation of bentonite slurry and cleaning of borehole free from sludge, as specified, etc.
8.01.08	The quoted rate for piling shall also include chiselling, if any, required for socketing the pile in rock.
8.01.09	The quoted rate for the piling shall include concreting by termite method, length of pile above COL, withdrawal of guide casing, cost for preparation of pile head and disposal of debris etc., resulting from breaking off of pile upto COL, upto a distance of 2 Km from the plant boundary or as directed by Engineer.
8.01.10	The quoted rate for piling shall also include providing reinforcement and its cleaning, straightening, cutting, bending, binding with annealed wire, welding, tackwelding, providing concrete cover blocks, spacers, placing the reinforcement cage in pile casing/bore and other cost of tools and plants, materials, labours, carting the steel from store to piling site and return of unused steel to the Owners storage point, etc.
8.02.11	Plasticiser/Admixture when used as directed by the Engineer shall be included in piling rates.
8.01.12	The quoted rate for piling shall include for all quality assurance requirements, but not limited to providing for technical inspection, transportation of samples to laboratory, testing samples, maintaining and submitting all test records, etc.
8.01.13	The quoted rate for boring in separate borehole shall be inclusive of performing of SPT at regular intervals as specified and collecting rock cores from boreholes, upto the depth as specified shall be inclusive of transporting to laboratory, testing and reporting of the results.
8.01.14	Unit rate for low integrity test shall be inclusive of mobilization of the entire set of equipment, computer readout, printer, and equipment which may not have been included in the description but are essential for the satisfactory completion of the work as per internationally accepted practice. The rate quoted shall be inclusive of repeatability of test, preparation of pile top surface etc.



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8.02.00 Measurement

8.02.01 Piling length shall be measurement by linear measurement from pile cut-off level to the tip of pile in meters upto second place of decimal separately for each diameter and capacity of pile. The length of pile to be cast above cut off level, as per specification, and as approved by Engineer, shall be considered for cement reconciliation only. Theoretical diameter of piles shall be considered for reconciliation of cement consumption. No extra payment shall be made for the length from existing ground to cut-off level.

8.02.02 Reinforcement steel shall be measured for reconciliation purpose only and the measurement shall be done for providing and placing reinforcement in piles, by weight in tones, up to third place of decimal in the following manner:

- i) The weight shall be arrived at by multiplying the actual length measured alongwith standard hooks, rings or spirals, spacers, cranks, bends, authorized laps, etc. by sectional weight. These shall be submitted with supporting documents giving the schedule of bars with sketches. The sectional weight to be adopted shall be IS code's sectional weight. Nothing extra shall be payable to the contractor on account of difference in weight, if any, due to different methods adopted for issue and measurement.
- ii) Standard hooks, cranks, bend, authorized laps, supports, hangers and chairs which are covered in approved bar bending schedule shall be measured in tones.
- iii) Dowels, neither shown on the drawings nor instructed by the Engineer, but required for construction facilities shall not be measured.

8.02.03 Breaking off of piles, due to subsequent change in design cut off level, shall be measured separately. This shall be measured in cubic metres upto second place of decimal. This will be payable only when the pile is cast and on the basis of written instruction of the Engineer for lowering of COL.

8.02.04 Measurements for the item of boring in a separate borehole shall be measured in metres from ground level upto the depth as specified, upto second place of decimal. Item of work of boring in soil and coring in rock shall be measured separately for the actual length of boring in soil and coring in rock.

8.02.05 The item for pile integrity test shall be measured in terms of no. of piles tested.



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ANNEXURE-A

Specific Requirements for Bored Cast-in-situ RCC Piles

A1.0 Minimum cement concrete grade M-25

Minimum cement content 400 Kg/M³

A1.1 Safe load

Diameter of Pile

Diameter of Pile (mm)	Vertical/ Compression (MT)	Horizontal/ Lateral (MX)	Pul lout/Tension (MT)
*	*	*	*
*	*	*	*

A2. Installation criteria

The installed pile(s) shall satisfy the following criteria.

A2.1 In Soil/weathered Rock

- Minimum length of the pile shall be _____* m below COL.
- The pile shall be terminated after penetrating through the strata having SPT penetration less than ____* cm for ____* blows, for a minimum length of _____* times the diameter of the pile.

A2.2 In Rock

- Piles shall be installed and socketed into the rocks for a length (socketing length) equal to _____* times the pile diameter subject to a minimum of _____* meter below the socketing horizon.
- Socketing horizon shall consist of rock strata having minimum uniaxial compressive strength of _____* kg/sq.cm.

A3. Average cut-off level for tender design and initial load test can be assumed as _____* m below ground level.

A4. A protocol shall be signed between BHEL site and contractor regarding,

Strata at the founding depth



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Installation criteria

Socketing depth

Density of bentonite before concreting

Slump of concrete.

Time interval between end of boring and start of concreting,

* Values shall be indicated separately depending upon subsoil strata of the site.



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ANNEXURE-B

List of Equipments

SI.No	Description	Capacity No.
1.	Piling Rigs	
2.	Chisel	3 T min 6 T max
3.	High pressure Mud Pumps	10 HP min 25 HP max
4.	Bentonite mixing plants	
5.	Concrete batching plant	
6.	Soil testing equipments	

Note:

1. The no. and capacity of the piling equipment varies for each work.
2. Additional equipments shall be mobilized if required as per the directions of the Engineer to match the work schedule at no extra cost to the Owner.



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ANNEXURE-C

Bentonite suspension used for piling work shall satisfy the following requirements

- a) Liquid limit of bentonite when tested in accordance with IS: 2720(Part V) shall be more than 300 percent and less than 450 percent.
- b) Sand content of the bentonite powder shall not be greater than 7 percent.
- c) Bentonite solution should be made by mixing it with fresh water using pump for circulation. The density of the freshly prepared bentonite suspension shall be between 1.034 and 1.10 gm/ml depending upon the pile dimensions and type of soil in which the pile is to be installed. However, the density of bentonite suspension after mixing with deleterious materials in the pilebore may be upto 1.25 gm/ml.
- d) The Marsh viscosity when tested by a Marsh cone shall be between 30 to 60 seconds.
- e) The differential free swell shall be more than 540 percent.
- f) The pH value of the bentonite suspension shall be between 9 and 11.5.



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ANNEXURE-D

PILE DATA

1. Reference No. Location (Co-ordinates) _____ area.
2. Sequence of Piling
3. Pile diameter & Type
4. Working level (Platform level)
5. Cut off level (COL)
6. Actual length below COL
7. Pile termination level
8. Top of finished concrete level
9. Date and time of start and completion of boring.
10. Depth of Ground water table in the vicinity.
11. Type of soil at pile tip
12. Method of boring operation
13. Details of drilling mud as used:
 - i) Freshly supplied mud
 - Liquid limit -
 - Sand content -
 - Density -
 - Marsh viscosity -
 - Swelling index -
 - pH value -
 - ii) Contaminated mud
 - Density -
 - Sand content -



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14. SPT* N values in soil (from the nearest bore hole).
+UCS** value in rock (from the nearest bore hole).

* Standard penetration Test
** Unconfined compression strength
15. Chiseling if any, from..... m to m
16. Date and time of start and completion of concreting.
17. Method of placing concrete
18. Concrete quantity
Actual

Theoretical
19. Ref. Number of test cubes
20. Grade and slump of concrete
21. Results of test cubes
22. Reinforcement details:
Main Reinforcement
No. _____
Dia. _____
Depth _____

Stirrups: Type
No. _____
Dia. _____
Spacing _____
23. Any other information regarding obstructions, delay and other interruption to the sequence of work.

TABLE -1

FREQUENCY OF SAMPLING AND TESTING

SI. No	Type of material work	Nature of Test/ characteristics	Method of Test & frequency	No. of test	Acceptance Criteria
1.	Pilebore size a) diameter b) length		Physical measurement	each pile	as per specification
2.	Founding level	to establish socketing horizon/ and or founding level & upto depth 5m below founding level.	in separate borehole meant for the purpose a) SPT in soils/ weathered rock b) Core & UCS value of rock	1 borehole for 100-150 piles or group of 150 Sqm	Annexure - B
3.	Bentonite (Mud) properties. a) Basic properties of bentonite before use. b) Contaminated mud from pile bore bottom before concreting	Liquid Limit, Marsh Viscosity, Specific gravity, sand content, swelling index, pH value. Density, sand content	in lab in lab	As per Cl. 5.7 Each Pile	As per Annexure C As per annexure C
4.	Position and Alignment	-	Physical or any Approved method	Each Pile	As per Cl. 4.3
5.	Cleaning of pilebore	-	As per Cl. 5.8	Each Pile	Pilebore be free from bored material cuttings debris/sludge
6.	Reinforcement (R/F) Spacing of longitudinal R/F cover laps binding of laterals		Physical inspection and measurement	each cage	As per approved design
7.	Concrete a) Workability b) Cubes	Slump cone test Compressive Strength test	Each pile As per spec.	As per Cl. 5.5 As per Cl. 5.5	As per specification. As per IS: 456
8.	Materials like aggregate, sand etc.	As per technical specification for concrete and relevant IS codes			
9.	Pile head		Physical	each pile	



TITLE:

**TECHNICAL SPECIFICATION FOR
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WORKS**

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SITE LEVELLING & GRADING WORKS

SPECIFICATION NO. PE-TS-999-600-C022



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



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**GENERAL TECHNICAL SPECIFICATION
FOR
SITE LEVELLING AND GRADING**

1.00 GENERAL

This specification cover the works to be carried out for “**Site Levelling and Grading Works including Slope Protection**” etc for the entire plant and associated areas. The specified formation level(s) shall be achieved either by excavation or by raising with controlled fill with excavated/borrowed earth as the case may be.

2.00 SCOPE

2.01 The scope include all works involved in levelling the site to the lines, grades, cross sections and dimensions as shown on the approved drawings and/or as directed by the engineer including site clearance, setting out, earth work in excavation, stacking, loading, transportation, unloading, dewatering, drainage, filling, watering, compaction, turfing on slopes (if required), lighting, disposal of residual/surplus earth etc. It also include supplying and providing all labour, materials, supervision, services, equipments, tools and plants, testing and all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work etc.

2.02 All tools and plants, equipments and machineries to be used in this work shall be of standard quality and manufactured by reputed concerns conforming to Indian Standard (IS) codes or equivalent thereof.

2.03 Work to be provided by the Contractor

The works to be provided by the contractor unless specified otherwise shall include but not be limited to the following.

a) Supplying and providing all labour, supervision, services including as required under statutory labour regulations, materials, equipments, tools and plants, approaches, transportation etc required for the completion of the work.

b) Preparation and submission of detailed scheme of all operations required for executing the work (material handling, placement, services, approaches etc) to the engineer for approval.

c) Carrying out sampling and testing on fill materials/fills to assess the quality/moisture content/degree of compaction and submission of the test results whenever required by the engineer.

d) Design, construction and maintenance of Magazine of proper capacity for storage of explosives for blasting work and removal of the same after completion of the work etc.



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2.04 Work to be provided by others

No work under this specification will be provided for by any agency other than the contractor unless specifically mentioned elsewhere in the contract.

2.05 Codes and Standards

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) codes unless specified otherwise.

IS: 1200 Methods of measurement of building and civil engineering works,
Part-1: Earthwork

IS: 2720 Method of test for soils (Relevant parts)

IS: 3764 Excavation work- Code of safety

IS: 4081 Safety code for blasting and related drilling operations

IS: 4701 Code of practice for earthwork on canals

IS: 6922 Criteria for safety and design of structures subject to underground
Blasts

In case of conflict between this specification and those (IS codes) referred to herein, the former shall prevail. In case any particular aspect of work is not covered specifically by the specification or/and by the IS codes, any other standard practice as may be specified by the engineer shall be followed.

2.06 Conformity with Designs

The contractor shall carry out the work as per the approved drawings, specification and as directed by the engineer.

3.00 MATERIALS

All materials required for the work shall be of best variety and approved by the engineer.

3.01 Materials for Excavation

For the purpose of identifying the various strata met during the course of excavation, the following classification is to be followed.



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a) Soil

It include all type of soil including laterite, moorum etc with/without any percentage of kankars which can be excavated by normal means such as shovel, pick axe, crow bar, spade etc and those which do not fall under **clause 3.01 (b) and (c) etc.**

b) Soft Rock

It include the rocks (including weathered rock) which are removable by splitting with the help of crow bar, pick axe, wedges, pavement breakers, pneumatic tools, hammers or such implements etc and not requiring blasting (for excavation) in the opinion of the engineer.

c) Hard Rock

It includes the rocks, which require blasting for excavation in the opinion of the engineer. Where blasting is prohibited for any reasons, the excavation shall be carried out by chiselling or any other method as approved by the engineer. The mere fact that the contractor resorts to blasting shall not classify the soft rock under hard rock.

However, the engineer's decision on the type of strata encountered during excavation shall be the final and binding on the contractor.

3.02

Materials for Filling

Any coarse grained or fine grained low plastic soil free from vegetation, roots, shingle, salts, organic matters, sod and any other harmful chemicals shall be used for filling. The contractor shall test the fill material to establish its suitability and submit the results to the engineer for approval. Fill material shall be got approved by the engineer. The following type of materials shall not be used for filling.

- a) Materials from swamps, marshes and bogs
- b) Expansive clays
- c) Peat, logs, sod and perishable materials
- d) Materials susceptible to combustion
- e) Any material or industrial and domestic produce which will adversely affect other materials of work
- f) Materials from prohibited areas

The earth available by cutting the high grounds within the project site and the materials (if) available from the road excavation or any other excavation under the same contract shall be used for filling depending upon its suitability as fill



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material. Filling with excavated rock (in the project site) shall be done only with

the written permission of the engineer in the following manner. The boulders shall be broken into pieces not exceeding 150mm size in any direction and mixed with fine materials consisting of decomposed rock, moorum or any approved earth to fill the voids as far as possible and the mixture shall then be used for filling. In case the earth required for filling is over and above the earth available from the compulsory excavations within the project area, then borrow areas for obtaining suitable fill material shall be arranged by the contractor himself from outside the plant boundary limits and all expenses including royalties, taxes, duties etc shall be borne by him. He shall obtain and submit the necessary clearances/permissions from the concerned authorities to the engineer for the borrow areas/materials acquired.

4.00

QUALITY CONTROL

All works shall conform to the lines, levels, grades, cross sections and dimensions shown on the approved drawings and/or as directed by the engineer. The contractor shall establish and maintain quality control for the various aspects of the work, method of construction, materials and equipments used etc. The quality control operation shall include but not be limited to the following.

Sl. No.	Activity	Check
1	Lines, levels & grades	a) By periodic surveys b) By establishing markers, boards etc
2	Filling	(a) On quality of fill material (b) On moisture content of fill material (c) On degree of compaction achieved

5.00

EXECUTION

The contractor shall prepare and submit the detailed drawings/schemes for excavation and filling works as proposed to be executed by him showing the dimensions as per the construction drawings and specification adding his proposal of approaches, dewatering (if any), drainage and compaction etc within 15 days of award of the contract to the engineer for approval.

5.01

Site Clearance

Before the commencement of earthwork, the entire area of cutting and filling shall be cleared of all trees, stumps, bushes, grasses, vegetation etc with their roots, fences, logs, rubbish, water, slush etc. It is not necessary to remove all the soil containing fine hair like roots but only the rather heavy mats are to be removed. Cutting of trees shall include trees having girth of any size and removing roots upto a depth of 600mm below the existing ground level or 300mm below the formation level whichever is deeper. After the removal of

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roots of trees, the pot holes formed shall be filled with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the engineer. The trees shall be cut in to suitable pieces as instructed by the engineer. Before earthwork is started, all the spoils, unserviceable materials and rubbish shall be burnt or removed and disposed off to the approved disposal area(s) as specified by the engineer. Useful materials, saleable timbers, fire woods etc shall be the property of owner and shall be stacked properly at the worksite in a manner as directed by the engineer.

5.02**Setting Out**

On receiving the approval from the engineer with modifications and corrections if any, the contractor shall set out the work from the control points furnished by the engineer and fix permanent points and markers for the ease of periodic checking as the work proceeds. These permanent points and markers shall be fixed at the interval as prescribed by the engineer and shall be got checked and certified by the engineer after whom the contractor shall proceed with the work. It should be noted that this checking by the engineer prior to the start of the work will in no way relieve the contractor of his responsibility of carrying out the work to true lines, levels and grades as per the drawings and specification. If any errors are noticed in the contractor's work at any stage, the contractor at his own risk and cost shall rectify the same. The contractor shall take spot levels of the area (with respect to the bench mark/ available source as provided by the engineer) to be excavated or to be filled at an interval of not more than 10m or as directed by the engineer before starting any earth work and shall be submitted to the engineer for prior approval.

5.03**Excavation**

Levelling by excavation shall be carried out where the existing ground levels are higher than the specified formation level. Excavation shall include removal of all materials whatever nature as may be and whether wet or dry shall be carried out exactly in accordance with the line, levels, grades and curves shown on the approved drawings and/or as directed by the engineer. All excavations shall be done to the minimum dimensions as required. The contractor shall obtain prior approval of the engineer for the method he proposes to adopt for excavation in different types of strata including dimensions, side slopes and dewatering if any, stacking or disposal etc. This approval however shall not in any way make the engineer responsible for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. The work shall be carried out in a workmanlike manner without endangering the safety of nearby structures/services or works and without causing hindrance to any other activities in the area. **Prior to starting the excavation, the ground level at the location shall be checked jointly with the engineer.**

The rough excavation may be carried up to a maximum depth of 150mm above the final formation level. The balance shall be excavated with special care and the final surface shall be compacted by rolling with 6 passes of 8 to 10 tonne roller. If directed by the engineer, soft and undesirable spots shall be removed

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even below the final level. The extra excavation shall be filled up with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the engineer. The contractor shall be paid for the extra excavation and filling at the appropriate items of work.

If the excavation is done to a depth greater than that shown on the drawing or as directed by the engineer due to the contractor's fault, the excess depth shall be filled up to the required level with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the engineer at the own risk and cost of the contractor.

Suitable slope in cutting as per the requirements and as directed by the engineer shall be adopted to withhold the face of earth. The contractor shall be held responsible for any damage to any part of the work caused by the collapse of the side of excavations.

5.03.01 Excavation in Hard Rock

Excavation in hard rock shall normally be done with blasting. In case where blasting is prohibited for any reasons, the excavation shall be carried out by chiselling or any other approved method as directed by the engineer. Personnel deployed for rock excavation shall be protected from all hazards such as loose rock/boulder rolling down and from general slips of excavated surfaces.

5.03.02 Blasting**a) General**

Storage, handing and use of explosives shall be governed by the current explosive rules/regulations laid down by the Central and the State Governments. The contractor shall ensure that these rules/regulations are strictly adhere to. The following instructions are also to be strictly followed and the instructions wherever found in variance with the above said rules/regulations, the former (instructions) shall be superseded with the later (above said rules/regulations).

No child under the age of 16 and no person who is in a state of intoxication shall be allowed to enter the premises where explosives are stored nor they shall be allowed to handle the explosives. The contractor shall obtain licence from the District Authorities for undertaking the blasting work as well as for obtaining and storing the explosives as per Explosives Rules, 1940 corrected upto date. The contractor shall purchase the explosives, fuses, detonators etc only from a licensed dealer and shall be responsible for the safe custody and proper accounting of the explosive materials. The engineer or his authorized representative shall have the access to check the contractor's store of explosives and his accounts at any time. It is the full responsibility of the contractor to

transport the explosives as and when required for the work in a safe manner to

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the work spot.

Further, the engineer may issue modifications, alterations and new instructions to the contractor from time to time. The contractor shall comply with the same without these being made a cause for any extra claim.

b) Materials

All materials such as explosives, detonators, fuses, tamping materials etc proposed to be used in the blasting operation shall have the prior approval of the engineer. Only explosives of approved make and strength are to be used. The fuses known as instantaneous fuse must not be used. The issue of fuse with only one protective coat is prohibited. The fuse shall be sufficiently water resistant as to be unaffected when immersed in water for 30 minutes. The rate of burning of the fuse shall be uniform and shall be not less than 4 seconds per inch of length with 10% tolerance on either side. Before use, the fuse shall be inspected. Moist, damaged or broken ones shall be discarded. When the fuses are in stock for long, the rate of burning of fuses shall be tested before use. The detonators shall be capable of giving an effective blasting of the explosives. Moist and damaged detonators shall be discarded.

c) Storage of Explosives

The current Explosive Rules shall govern the storage of explosives. Explosives shall be stored in a clean, dry and well-ventilated magazine to be specially built for the purpose. Under no circumstances should a magazine be erected within 400m of the actual work site or any source of fire. The space surrounding the magazine shall be fenced and the ground inside shall be kept clear and free from trees, bushes etc. The admission to this fenced space shall be through a single gate only and no person shall be allowed without the permission of the officer-in-charge. The clear space between the fence and the magazine shall not be less than 90m. The magazine shall be well drained. Two lightning conductors, one at each end shall be provided to the magazine. The lightning conductors shall be tested once in every year.

Explosives, fuses and detonators shall each be separately stored. Cases of explosives must be kept clear of the walls and floors for free circulation of air on all sides. Special care shall be taken to keep the floor free from any grains of explosives. Cases containing explosives shall not be opened inside the magazine and the explosives in open cases shall not be received into a magazine. Explosives which appear to be in a damaged or dangerous condition are not to be kept in any magazine but must be removed without delay to a safe distance and be destroyed.

Artificial light, matches, inflammable materials, oily cotton, rag waste and articles liable to spontaneous ignition shall not be allowed inside the magazine.

Illumination shall be obtained from an electric storage battery lantern. No

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smoking shall be allowed within 100m distance from any magazine. Magazine shoes without nails shall be used while entering the magazine. The persons entering the magazine must put on the magazine shoes which shall be provided at the magazine for this purpose and should be careful

* not to put their feet on the clean floor unless the magazine shoes on.

* not to touch the magazine shoes on ground outside the clean floor.

* not to allow any dirt or grit to fall on the clean floor.

Persons with bare feet shall dip their feet in water before entering the magazine and then step directly from the tub to the clean floor. No person having article of steel or iron with/on him shall be allowed to enter the magazine. Workmen shall be examined before entering the magazine to check none of the prohibited articles are with them. A brush broom shall be kept in the lobby of the magazine for cleaning the magazine. Cleaning shall be done immediately after each occasion whenever the magazine is opened for receipt, delivery or inspection of the explosives.

The mallets, levers, wedges etc for opening the barrels or cases shall be of wood. The cases of explosives are to be carried by hand and shall not be rolled or dragged inside the magazine. Explosives which have been issued and returned to the magazine are to be issued first; otherwise those which have been stored long in the store are to be issued first. Neither the magazine shall be opened nor any person shall be allowed in the vicinity of the magazine during any dust storm or thunderstorm. All magazines shall be officially inspected at definite intervals and a record of such inspections shall be kept.

d) Carriage of Explosives

Detonators and explosives shall be transported separately to the blast site. Explosives shall be kept dry and away from direct rays of the sun, artificial lights, steam pipes or heated metal and other sources of heat. Before explosives are removed, each case or package shall be carefully examined to ascertain that it is properly closed and shows no sign of leakage.

No person except the driver shall be allowed to travel on the vehicle conveying explosives. No explosive shall be transported in a carriage or vessel unless all iron or steel therein the carriage or vessel which are likely to contact the package containing explosives are effectually covered with lead, leather, wood, cloth or any other suitable material. No light shall be carried on the vehicle carrying explosives and no operation connected with the loading, unloading and handling of explosives shall be conducted after sunset.

e) Use of Explosives

The contractor shall appoint an agent who shall personally superintend the

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firing and all operations connected therewith. The contractor shall satisfy himself that the person so appointed is fully acquainted with his responsibilities. Holes for charging the explosives shall be drilled with pneumatic drills and the drilling pattern shall be so planned that the rock pieces after blasting will be suitable for handling. The hole diameter shall be of such a size that the cartridges can easily pass down through them and any undue force is not required during charging. Charging operation shall be carried out by or under the personal supervision of the shot firer. Wrappings shall never be removed from the explosive cartridges. Only one cartridge at a time shall be inserted in a hole and wooden rods shall only be used for loading and stemming the shot holes. Only such quantities of explosives as are required for a particular work shall be brought to the work site. Should any surplus remain when all the holes have been charged shall be carefully removed to a point at least 300m away from the firing point.

The authorized shot firer himself shall make all the connections. The shot firing cable shall not be dragged along the ground to avoid any damage to the insulation. The shot firing cable shall be tested each time for its continuity and possible short circuiting. The shot firer shall always carry the exploder handle with him until he is ready to fire shots. The number of shots fired at a time shall not exceed the permissible limits. Before any blasting is carried out it shall be ensured that all workmen, vehicles and equipment on the site are cleared from an area of minimum 300m radius from the firing point or as required by the statutory regulations at least 10 minutes before the time of firing by sounding a warning siren and the area shall be encircled by red flags.

The explosives shall be fired by means of an electric detonator placed inside the cartridge. For simultaneous firing of a number of charges, the electric detonators shall be connected with the exploder through the shot firing cable in a simple series circuit. Due precautions shall be taken to keep the firing circuit insulated from the ground, bare wires, rails, pipes or any other path of stray current etc and keep the lead wires short circuited until it is ready to fire. Any kink in the detonator leading wire shall be avoided. For simultaneous firing of a large number of shot holes, use of cordtex may be done. An electric detonator attached to its side with adhesive tape shall initiate cordtex connecting wire or string. Blasting shall only be carried out at certain specified times to be agreed jointly by the contractor and the engineer.

At least five minutes after the blast has been fired in case of electric firing or as stipulated in the regulations, the authorized shot firer shall return to the blast area and inspect carefully the work and satisfy himself that all the charged holes have exploded. Cases of misfired unexploded charges shall be exploded by drilling a parallel fresh hole at a distance of not less than 600mm from the misfired hole and by exploding a new charge. The authorized shot firer shall be

present during the removal of debris as it may contain unexploded explosives near the misfired hole. The workmen shall not return to the site of firing until at

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least half an hour after firing.

Where blasting is to be carried out in proximity of other structures, controlled blasting by drilling shallow shot holes and proper muffling arrangements with steel plates loaded with sand bags etc shall be used on top of the blast holes to prevent the rock fragments from causing any damage to the adjacent structures and other properties. Adequate safety precautions as per building byelaws, safety codes, statutory regulations etc shall be taken during blasting operations.

5.03.04 Restrictions on Blasting

- a) Blasting which may disturb or endanger the stability, safety or quality of the adjacent structures/foundations shall not be permitted.
- b) Blasting within 200m of a permanent structure or construction work in progress shall not be permitted.
- c) Progressive blasting shall be limited to two third of the total remaining depth of excavation.
- d) No large scale blasting operations will be resorted to when the excavation reaches the last one metre and only small charge preferably black powder may be allowed so as not to shatter the parent rock.
- e) The last blast shall not be more than 0.50 m in depth.
- f) In rocky formations, at locations where specifically indicated or ordered in writing by the engineer, the use of explosives shall be discontinued and excavation shall be completed by chiselling or any other suitable method as approved by the engineer.

5.04 Sorting of Excavated Materials

The excavated material shall be carefully sorted for use in filling the areas in the project site by removing roots, grasses, organic matters and other objectionable materials and be sorted out into different types of materials for use and as directed by the engineer. The excavated material which is not considered fit for filling purpose shall be immediately removed and disposed at such a place and in such a manner as will be directed by the engineer. The material found unusable should be got approved by the engineer before actually disposing it off. The useful materials that cannot be used directly shall be heaped in separate area as stock piles. Stockpiles shall be of regular size as far as possible for ease of measurement. The materials heaped shall be utilised as and when required and as directed by the engineer. The cost of complete item of earthwork includes the cost of rehandling of the materials and temporarily heaped and reused.

5.05 Disposal of Surplus/ Waste Materials

Surplus and other waste materials shall be removed and disposed of from the construction site to the area demarcated by the engineer. No material shall be wasted unless approved by the engineer.



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5.06

Earth Work in Filling

Levelling by raising with controlled fill of approved excavated/borrowed earth shall be carried out where the existing ground levels are lower than the specified formation level. After clearing site as per clause 5.01, the original ground shall be compacted by rolling subject to a minimum 6 passes of 8 to 10 tonne roller. The approved earth/fill material shall then be spread in horizontal layers not exceeding 300mm in compacted thickness. Each layer shall be watered and thoroughly compacted with proper moisture content and such equipments as may be required to obtain a minimum of 95% of its maximum dry density as determined by standard Proctor's test as per IS: 2720 part-VII or 85% of relative density as per IS:2720 part-XIV as specified. Moisture content of the fill material shall be controlled near optimum moisture content during compaction.

The fill material shall be tested for its optimum moisture content and maximum dry density as per IS: 2720, part-VII. Moisture content shall be checked at the source of supply in accordance with IS:2720 part- II and if found less than that required for proper compaction, the same shall be made good either at the source or after spreading the soil in loose thickness for compaction. In the latter case, water shall be sprinkled directly from the hose line or from the truck-mounted water tank etc making due allowance for evaporation losses and the fill material be thoroughly mixed by means of harrows, rotary mixers or by any other suitable approved method until the layer is uniformly wet. **Flooding shall not be permitted for watering purpose under any circumstances.** If the material delivered is too wet, it shall then be dried by aeration and exposure to the sun till the moisture content is suitable for compaction. Should circumstances arise owing to wet weather the moisture content cannot be reduced to the required amount by the above procedure, the work on compaction shall be suspended. Clods or hard lumps of earth shall be broken to have a maximum size of 150mm when being placed in the layers before compaction. For each of the above tests on the fill material, one sample for every 10,000cu.m shall be tested. Additional samples shall be tested whenever there is a change of source or type of material.

Before start of filling, the contractor shall submit the engineer his proposal for the methodology to be adopted for compaction. The compaction equipments as approved by the engineer shall only be employed to compact the different type materials encountered during construction. If directed by the engineer, the contractor shall demonstrate the efficacy of the plant he intends to use by carrying out compaction trials. Moisture content of the fill material shall be controlled near optimum moisture content during compaction.

The compacted layer shall be tested for its dry density as per IS:2720, part-XXVIII or XXIX as directed by the engineer. Samples shall be taken at the rate of one sample for every 10,000sq.m area of each compacted layer. In addition random checks shall be carried out in compacted layers by means of Proctor needle penetration test. Contractor shall submit all the test results to the engineer immediately after completion of the tests. A sample shall be deemed to have passed the test when the dry density of the compacted fill is equal to or more



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than 95% of its maximum dry density. When field density measurements reveal any soft areas in the fills, further compaction shall be carried out as directed by the engineer. If in spite of that, the specified compaction is not achieved, the material in the soft areas shall be replaced with approved material compacted to the density requirements and satisfaction of the engineer.

Subsequent layers shall be placed only after the finished layer has been tested and accepted by the engineer.

Where the filling is to be done across low swampy ground that will not support the weight of trucks or other hauling equipments, the lower part of the fill shall be constructed by dumping successive loads in a uniformly distributed layer of a thickness not greater than that necessary to support the hauling equipment while placing subsequent layers.

5.07

Dewatering and Drainage

It shall be ensured that the area to be excavated/filled shall be free from water. The contractor shall remove the water (if any) by pumping or by any other means as approved by the engineer. At all times, the surface of cutting/filling during execution shall be maintained at such a cross fall as will shed water and prevent ponding. All existing drains/channels (if any) in the work area shall be suitably diverted by the contractor before taking up any excavation or filling. These diversions shall be such that it shall ensure effective disposal of water without any accumulation or flooding within the project site and in adjoining areas.

5.08

Finishing Operations

Finishing operation shall include the work of shaping and dressing the excavated/filled ground to the required grades, levels, lines, side slopes, crosssections and dimensions as shown on the approved drawings or as directed by the engineer.

5.09

Turfing

Turfing shall be provided at the slopes and other locations as shown on the drawings or as directed by the engineer. The turf shall be of approved quality of grass. The sod shall consist of dense, well rooted growth of permanent and desirable grasses indigenous to the locality where it is to be used and shall be practically free from weeds or other undesirable matter. The grass on the sod shall have a length of approximately 50mm and the sod shall be free of any

debris. Thickness of the sod shall be as uniform as possible with 50 to 80mm of soil covering the grass roots depending on the nature of the sod so that all the dense root system of the grasses are retained in the sod strip. The sods shall be cut in rectangular strips of uniform width not less than about 300mm x 250mm size but not so large so that it is convenient to handle and transport without



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damage.

The area to be sodded shall be previously constructed to the required slope and cross section. Prior to placing the sods, the slopes shall be **roughened** and wetted in order to have a satisfactory bond. The strips of sod shall be laid in close contact with each other and be tamped firmly in place so as to fill and close the joints between them. The turfing so laid shall be well watered and protected until final acceptance.

5.10 Approaches

The contractor shall provide proper approaches for workmen and inspection.

5.11 Lighting

Full scale lighting are to be provided if night work is permitted or directed by the engineer. If no night work is in progress, red warning lights should be provided at the edges of excavations and fills.

6.00 RATES AND MEASUREMENTS

6.01 Rates

a) The item of work in the schedule of quantities describe the work very briefly. The various items of the schedule of quantities shall be read in conjunction with the corresponding sections in the technical specification including amendments and additions if any. For each item in the schedule of quantities, the bidder's rate shall include all the activities covered in the description of the items as well as for all necessary operations in detail as described in the technical specification.

b) No claims shall be entertained if the details shown on the released for construction drawings differ in any way from those shown on the tender drawings.

c) The unit rate quoted shall include minor details which are obviously and fairly intended and which may not have been included in these documents but are essential for the satisfactory completion of the work.

d) The bidder's quoted rate shall be inclusive of supplying and providing all labour, men, materials, equipments, tools and plants, supervision, services, approaches, schemes etc.

6.02 Measurements

Method of measurements are specified in the proceeding sections. Where not so

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specified, the latest version of IS:1200, Part-1 shall be applicable.

a) The length, breadth and depth shall be measured correct to the nearest centimetre if measurements are taken by tape. Rounding of numericals shall be as per relevant IS Codes. If the measurements are taken with staff and level, the levels shall be recorded correct to 5mm. The area and volume shall be worked out in square meter and cubic meter correct to the nearest of two decimal places.

b) For earth work in excavation, the ground levels shall be taken before and after completion of the work in the actually excavated area. The quantity of earth work in cutting shall be computed from these levels in cubic meter.

c) Where soft rock and hard rock are mixed, the measurement shall be done as follows. The two types of rock shall be stacked separately and measured in stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in the stacks. If the sum of net quantity of the two types of rock so arrived exceeds the total quantity of excavation then the quantity of each type of rock shall be worked out from the total quantity (from excavation) in the ratio of net quantities in stack measurements of the two types of rock. If stacking is not feasible, the method as suggested by the engineer shall be followed.

d) Where soil, soft rock and hard rock are mixed, the measurement shall be done as follows. The soft and hard rock shall be removed from the excavated material and stacked separately and measured in stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in stacks. The difference between the entire excavation and the sum of the quantities of soft and hard rocks so arrived shall be taken as soil.

e) For earth work in filling, the actual measurements of fill shall be calculated by taking levels of the original ground before start of the work but after site clearance and after compaction of fills. The quantity of earth work in filling shall be computed from these levels in cubic meter.

f) For turfing, the measurement shall be made on the finished work in square meter.



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ANTI-TERMITE TREATMENT

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Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



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TECHNICAL SPECIFICATION
FOR
ANTI-TERMITE TREATMENT

1.00.00SCOPE

The scope of work is to set up a chemical barrier against attack by subterranean termites while the building is under construction.

2.00.00EXECUTION

2.01.00General

All work shall in general be executed as specified in IS: 6313 Part II-1981 and as per approved specification of the agency having special know-how for the job.
All necessary work to ensure uniform distribution and proper penetration of treatment of treating solution shall be done according to the instruction of the Engineer.
Soil treatment shall not be done when it is raining or when the soil is wet with rain or subsoil water. Once formed, the treated soil barrier shall not be disturbed.

2.02.00Chemicals and Rate of Application

Any of the following chemicals (conforming to relevant Indian Standards) in water emulsion shall be applied by pressure pumps, uniformly over the area treated.

Chemicals	Concentration by Weight, Percentage
Chlorpyrifos Emulsifiable (IS 8944 - 1978)	: 1.0
Heptachlor Emulsifiable Concentrate (IS: 6439 - 1978)	: 0.5
Chlordane Emulsifiable Concentrate (IS: 2682 - 1984)	: 1.0

2.02.01Treatment of Column Pits, Wall Trenches and Basement Excavations

Foundations, basements etc. may either be fully enveloped by the chemical barrier or the treatment may start 500 mm below ground level. The bottom surface and sides of excavation (upto a height of about 300 mm) for column pits, walls trenches and basements shall be treated with chemicals at the rate of 5 litres / M² of surface area. Backfills around columns, walls etc. shall be treated at the rate of 7.5 litres / M² of the vertical surface. Chemical treatment shall be done in stages following the compaction of earth in layers. The treatment shall be carried out after the ramming operation is done by

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	rodding the earth at 150 mm centres close to the wall surface and spraying the chemicals in the specified dose. 2.02.02 Treatment of Top Surface of Plinth Filling Holes 50 mm to 75 mm deep at 150 mm centres both ways shall be made with crowbars on the surface of compacted plinth fill. Chemical emulsion at the rate of 5 litres / M² of surface shall be applied prior to laying soling or sub-grade. Special care shall be taken to maintain continuity of the chemical barrier at the junction of vertical and horizontal surfaces. 2.02.03 Treatment of Soil Surrounding Pipes, Wastes and Conduits Special care shall be taken at the points where pipes and conduits enter the building and the soil shall be treated for a distance of 150 mm and a depth of 75 mm at the point where they enter the building. 2.02.04 Treatment of Expansion Joints These shall receive special attention and shall be treated in a manner approved by the Engineer. 2.02.05 Treatment at Junction of the Wall and the Floor Special care shall be taken to establish continuity of the vertical chemical barrier on inner wall surfaces from ground level up to the level of the filled earth surface. A small channel 30 x 30 mm shall be made at all the junctions of wall and columns with the floor. Rod holes made in the channel up to the ground level 150 mm apart and the chemical emulsion poured along the channel at the rate of 7.5 litres per square meter of the vertical wall or column surface. The soil should be tamped back into place after this operation. 3.00.00 ACCEPTANCE CRITERIA The Contractor shall give a 10-year service guarantee in writing supplemented by a separate and unilateral guarantee from the specialised agency for the job to keep the building free of termites for the specified period. 4.00.00 RATES Rates shall be of complete work per unit area as stated in the Schedule. 5.00.00 METHOD OF MEASUREMENT Complete work of anti-termite treatment shall be measured for plinth area treated.	



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This includes treatment, to foundations, walls, trenches, basements, plinth, buried pipes, conduits etc. The extended portions of foundation and like beyond plinth limit shall be the part of complete work.

6.00.00

I.S. CODE

Relevant code applicable for this Specification.

IS: 6313 (Part-II) 1981 : Code of Practice of Anti-Termite Measures in Buildings
Pre-constructional chemical treatment measures.



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DEPARTMENT

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VOLUME – VI A

**TECHNICAL SPECIFICATIONS FOR
CIVIL, STRUCTURAL AND ARCHITECTURAL
WORKS**

CONSULTANT

PROCON ENGINEERS

(DIV. OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)

Venus Building, 2nd Floor, Opp. Digha Talao,
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Digha, Airoli, Navi Mumbai - 400 708.

2011



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1.0 <u>INTRODUCTION</u> Two volumes VI A & VI B of this specification cover site survey, soil investigation, site development works, complete design engineering and construction of Civil, Structural and Architectural works associated with all Plants Turnkey Package. The scope of works covers complete Civil, Structural and Architectural Works including supply of all materials, labour, tools and plants as required for successful execution of the turnkey package. This section – I of Volume VI A lists Codes and Standards to be adopted and the principal structures of the plant and briefly describes the basic concept, requirements and features pertinent to each. Documents to be submitted have also been brought out in this section along with the procedure to be followed for the same. Volume VI B covers technical specification for different items of work. If there is any ambiguity and/or contradiction between Volumes – VI/A and Volumes – VI/B, the provisions/requirements laid in Volumes – VI/A shall prevail. In case of any contradiction between any part of the Bid Document with the other, requirement of most stringent one shall be applicable. 2.0 <u>CODES AND STANDARDS</u> Following is a general listing of Codes and Standards to be used in the design of the Plant. Specific applicable codes and standards will be identified in System Design Descriptions/Technical Specifications as appropriate. The latest editions/revision of following codes and standards along with addendums/amendments, if any, shall be followed: 2.1 <u>GENERAL</u> (a) Indian Codes OR Internationally accepted design Codes and Standards (American codes, British codes, German codes, Japanese codes only), where Indian Codes are not available.		

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	(b) Indian Codes OR Internationally accepted design Codes and Standards (American codes, British codes, German codes, Japanese codes only), which are stringent or at least equivalent to Indian Standards. (c) National Building Code of India. "Accepted Standards" and "Good Practice" listed in the appendix to National Building Code of India. (d) IS-1200 : Method of measurement of Building and Civil Engineering Works. (e) IS-1256 : Code of Practice for Building Byelaws.	
2.1.1	Earthwork (a) IS-1498 : Classification and identification of soils for General Engineering purposes. (b) IS-3764 : Safety Code for excavation work. (c) IS-7293 : Safety Code for working with construction machinery. (d) IS-9759 : Guide lines for dewatering during construction (e) IS-10379 : Code of practice for field control of moisture and compaction of soils of embankment and sub grade (f) IS-4701 : Code of practice for earthwork on canals	
2.1.2	Concrete (a) IS-269 : Ordinary and low heat Portland cement (b) IS-383 : Coarse and fine aggregate from natural sources for concrete (c) IS-432 : Mild Steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement	

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(d) IS-455 : Portland Slag Cement (e) IS-456 : Code of Practice for Plain and reinforce concrete. (f) IS-460 : Test Sieves (all parts). (g) IS-516 : Methods of test for strength of concrete (h) IS-1199 : Methods of sampling and analysis of concrete (i) IS-1566 : Specification for Hard-drawn Steel Wire Fabric for Concrete Reinforcement (j) IS-1786 : High strength deformed steel bars and wires for concrete reinforcement (k) IS-1834 : Hot applied sealing compounds for joints in concrete. (l) IS-2386 : Methods of test for aggregates for concrete (all parts). (m) IS-2502 : Code of practice for bending and fixing of bars for concrete reinforcement. (n) IS-3370 : Code of practice for concrete structures for storage of liquids (all parts). (o) IS-3414 : Code of practice for design and installation of joints in buildings. (p) IS-4948 : Welded steel wire fabrics for general use (q) IS-6452 : High Alumina Cement for Structural use (r) IS-7320 : Concrete slump test apparatus (s) IS-7861 : Code of practice for extreme weather concreting (all parts).			

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(t) IS-8041 : Rapid Hardening Portland Cement (u) IS-8112 : High strength ordinary Portland Cement. (v) IS-10262 : Recommended guidelines for concrete mix design (w) IS-12269 : Specification for 53 grade ordinary Portland cement (x) IS-1489 : Portland-pozzolana cement. (Fly ash based) (Part-I) (y) IS-1542 : Sand for Plaster (z) IS-4082 : Recommendation on stacking and storage of construction materiel and components at site (aa) IS-13757 : Burnt clay fly ash building bricks (bb) IS-457 : Code of practice for general construction of plain and reinforced concrete for dams and other massive structures. (cc) IS-280 : Mild steel wire for general engineering purpose. (dd) IS-1791 : General requirement for batch type concrete mixers (ee) IS-1838 : Preformed fillers for expansion joints in concrete pavement and structures (ff) IS-2438 : Specification for roller pan mixers (gg) IS-2505 : Concrete vibrators - immersion type (hh) IS-2506 : General requirements for screed board concrete vibrators. (ii) IS-2722 : Specification for Portable Swing weigh batchers for concrete (single and double bucket type).			

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	(jj) IS-2750 : Steel scaffoldings (kk) IS-2751 : Recommended practice for welding of mild steel plain and deformed bars for reinforced construction. (ll) IS-3150 : Hexagonal wire netting for general purposes (mm) IS-3558 : Code of practice for use of immersion vibrators for consolidating concrete. (nn) IS-4014 : Code of practice for steel tubular scaffolding (oo) IS-4656 : Form vibrators for concrete (pp) IS-4925 : Concrete batching and mixing plant (qq) IS-4990 : Plywood for concrete shuttering work (rr) IS-5256 : Code of practice for sealing expansion joints in concrete lining on canals (ss) IS-5525 : Recommendations for detailing of reinforcement in reinforced concrete works (tt) IS-6461 : Glossary of terms relating to cement concrete (uu) IS-6494 : Code of practice for water proofing of underground storage tank and swimming pools. (vv) IS-6509 : Code of practice for installation of joints in concrete pavements (ww) IS-9012 : Recommended practice for shotcreting (xx) IS-9103 : Admixtures for concrete. (yy) IS-9417 : Recommendations for welding cold worked bars for reinforced concrete construction (zz) IS-11384 : Code of practice for composite construction in	

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structural steel and concrete. (aaa) IS-12118 : Two parts polysulphide based sealants (bbb) IS-12200 : Code of practice for provision of water stops at transverse construction joints in masonry and concrete dams. (ccc) IS-13311 : Non destructive testing of concrete - methods of test. (Part 1) : Ultrasonic pulse velocity. (Part 2) : Rebound hammer (ddd) SP-16 : Design codes for reinforced concrete to IS: 456 1978. (eee) SP-23 : Handbook of concrete mixes. (fff) SP-24 : Explanatory handbook on Indian standards code for plain and reinforced concrete. (IS: 456) (ggg) SP-34 : Hand book on concrete reinforcement and detailing. (hhh) ACI-318 : American Concrete Institute code for structural concrete. 2.1.3 Foundations (a) IS-1904 : Code of practice for structural safety of buildings Shallow foundations (b) IS-2950 : Code of practice for design and construction of raft foundations (c) IS-2974 : Code of practice for design and construction of Machine foundations (all parts).		

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(d)	IS 2911	:	Code of practice for Design and Construction of Pile Foundation
(e)	IS:1080	:	Code of practice for design and construction of shallow foundations on soils.
(f)	IS:2314	:	Steel sheet piling sections
(g)	IS:4091	:	Code of practice for design and construction foundations for transmission line towers and poles.
(h)	IS:6403	:	Code of practice for determination of Bearing capacity of Shallow foundations.
(i)	IS:8009	:	Code of practice for calculation of settlement of foundation.
	(Part-1)	:	Shallow foundations
	(Part-2)	:	Deep foundations
(j)	IS:12070	:	Code of practice for design and construction of shallow foundations on rocks.
(k)	VDI:2056	:	Criteria for assessing mechanical vibrations of machines
(l)	VDI:2060	:	Criteria for assessing the st of balance of rotating rigid bodies.
(m)	DIN:2089	:	Helical compression spring made of round wire and rod calculation and design of compression.
(n)	DIN:2096	:	Helical compression spring out of round wire and rod : Quality requirements for hot formed compression spring.
(o)	DIN:4024	:	Flexible supporting structures for machine with rotating machines.

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2.1.4 Precast Concrete Works (a) SP:7 : National Building Code – Structural Design of prefabrication and system building. (b) IS:10297 : Code of practice for design and construction of floors and roofs using precast reinforced Prestressed concrete ribbed or cored slab units. (c) IS:10505 : Code of practice for construction of floors and roofs using pre- cast reinforced concrete 2.1.5 Loading (a) IS-875 : Code of practice for Structural safety of buildings - loading standards (b) IRS : Bridge Rules of Government of India, Ministry of Railways (Railway Board). (c) IS: 4091 : Code of practice for design and construction of foundation for transmission line towers and poles. 2.1.6 Masonry (a) IS-712 : Building limes. (b) IS-1077 : Common Burnt Clay Building Bricks. (c) IS-1127 : Recommendations for dimensions and workmanship of natural building stones for masonry work. (d) IS-1528 : Methods of sampling and physical tests for refractory materials (e) IS-1597 : Code of practice for construction of stone masonry (all parts).		

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	(f) IS-2212 : Code of practice for brickwork. (g) IS-2116 : Sand for masonry mortars (h) IS-2185 : Concrete masonry units. (All parts - Hollow and Solid concrete blocks). (i) IS-2250 : Code of practice for preparation and use of masonry Mortars. (j) IS-2572 : Code of practice for construction of hollow concrete block masonry. (k) IS-2691 : Burnt clay-facing bricks. (l) IS-3414 : Code of practice for design and installation of joints in buildings. (m) IS-3495 : Methods of tests of burnt clay building bricks. (n) IS-4441 : Code of practice for use of Silicate type chemical resistant mortars. (o) IS-4860 : Acid Resistant Bricks. (p) SP-20 : Hand book on masonry design and construction (q) IS – 12894 : Fly ash lime bricks (r) IS:1905 : Code of practice for structural use of unreinforced masonry	
2.1.7	Doors, Windows and Ventilators (a) IS-399 : Classification of commercial timbers and their zonal distribution. (b) IS-883 : Code of practice for design of structural timber in building.	

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(c)	IS-1003	:	Timber paneled and glazed shutters (all parts).
(d)	IS-1038	:	Steel doors, windows and ventilators
(e)	IS-1081	:	Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators.
(f)	IS-1361	:	Steel windows for industrial buildings.
(g)	IS-2835	:	Transparent sheet glass for glazing and framing purposes.
(h)	IS-1948	:	Aluminum doors windows and ventilators.
(i)	IS-1949	:	Aluminum windows for industrial building
(j)	IS-2191	:	Wooden flush door shutters (Cellular and hollow core type).
(k)	IS-2202	:	Wooden flush door shutters (solid core type).
(l)	IS-3103	:	Code of practice for Industrial ventilation
(m)	IS-3548	:	Code of practice for glazing in buildings
(n)	IS-3614	:	Fire check doors
(o)	IS-4021	:	Timber door, windows and ventilator frames
(p)	IS-4351	:	Steel door frames
(q)	IS-6248	:	Metal rolling shutters and rolling grills.
(r)	IS-204	:	Tower Bolts.
	(Part 1)	:	Ferrous metals
	(Part 2)	:	Non - ferrous metals
(s)	IS-208	:	Door Handles
(t)	IS-281	:	Mild steel sliding door bolts for use with padlocks.

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(u) IS-362 : Parliament Hinges. (v) IS-451 : Technical supply conditions for wood screws (w) IS-733 : Wrought aluminium and aluminium alloy bars, rods and sections (for general engineering purposes) (x) IS-1285 : Wrought aluminium and aluminium alloy extruded round tube & hollow section (for general engineering purposes). (y) IS-1823 : Floor door stoppers. (z) IS-1868 : Anodic coatings on Aluminium and its alloys. (aa) IS-2209 : Mortice locks (vertical type). (bb) IS-2553 : Safely glass (cc) (Part-1) : General purposes. (dd) IS-3564 : Door closers (Hydraulically regulated). (ee) IS-5187 : Flush bolts. (ff) IS-5437 : Figured, rolled and wired glass. (gg) IS-6315 : Specification for floor springs (Hydraulically regulated) for heavy doors. (hh) IS-7196 : Hold fast (ii) IS-7452 : Hot rolled steel sections for doors, windows and ventilators. (jj) IS-10019 : Mild steel stays and fasteners. (kk) IS-10451 : Steel sliding shutters (top hung type). (ll) IS-12823 : Wood Products – Pre laminated Particle Boards			

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2.1.8 Roof and Flooring (a) IS-2204 : Code of practice for construction of reinforced concrete shell roof. (b) IS-3201 : Criteria for the design and construction of precast concrete trusses. (c) IS-2210 : Criteria for Design of R.C. shell structures and folded plates. (d) IS-809 : Rubber flooring materials for general purposes. (e) IS-1195 : Bitumen mastic for flooring. (f) IS-1196 : Code of practice for laying bitumen mastic flooring. (g) IS-1198 : Code of practice for laying, fixing and maintenance of linoleum floors. (h) IS-1237 : Cement concrete flooring tiles. (i) IS-1443 : Code of practice for laying and finishing of cement concrete flooring tiles. (j) IS-2114 : Code of practice for laying in situ terrazzo floor finish. (k) IS-2571 : Code of practice for laying in situ cement concrete flooring. (l) IS-5491 : Code of practice for laying in situ granolithic concrete floor topping. (m) IS-5766 : Code of practice for laying burnt clay brick flooring. (n) IS-1197 : Code of practice for lying of rubber floors.		

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- (o) IS-2441 : Code of practice for fixing ceiling coverings.

(a)	IS-3037	:	Bitumen mastic for use in waterproofing of roofs
(b)	IS-3067	:	Code of practice for general design, details and preparatory work for damp proofing and water proofing of buildings.
(c)	IS-3384	:	Bitumen primer for use in water proofing and damp proofing.
(d)	IS-4365	:	Code of practice for application of bitumen mastic for waterproofing of roofs.
(e)	ASTM C836-89a	:	Standard specification for high solid content cold liquid applied electrometric water proofing membrane for use with separate wearing course.
(f)	ASTM	:	Standard guide for high solid content cold.
(g)	C898-89	:	Liquid applied elastomeric water proofing membrane for use with separate wearing course.

(a)	IS-5318	:	Code of practice for laying of flexible PVC sheet and tile flooring.
(b)	IS-8042	:	White Portland cement.
(c)	IS-13801		Chequered cement concrete tiles.

- (a) IS-1498 : Classification and identification of soils for general engineering purposes.

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	(b) IS-1892 : Code of practice for sub-surface investigation for foundations. (c) IS-2131 : Method for standard penetration test for soils. (d) IS-2720 : Methods of test for soils (all parts). (e) C898-89 : Liquid applied elastomeric water proofing membrane for use with separate wearing course.	
2.1.12	Water Supply, Drainage and Sewerage	
	(a) IS-404 : Lead pipes (b) IS-458 : Concrete pipes (c) IS-651 : Salt glazed stoneware pipes and fittings (d) IS-771 : Glazed fire-clay sanitary appliances (all parts). (e) IS-774 : Flushing cisterns for water closets and urinals other than plastic cisterns. (f) IS-783 : Code of practice for laying of concrete pipes. (g) IS-1172 : Code of basic requirements for water supply, drainage and sanitation. (h) IS-1626 : Asbestos cement building pipes, gutters and fittings (all parts). (i) IS-1742 : Code of practice for building drainage. (j) IS-2064 : Code of practice for selection, installation and maintenance of sanitary appliances. (k) IS-2065 : Code of practice for water supply in buildings. (l) IS-2470 : Code of practice for installation of septic tanks (all parts). (m) IS-3114 : Code of practice for laying of Cast Iron pipes	

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(n)	IS-4127	:	Code of practice for laying of glazed stoneware pipes.
(o)	IS-12251	:	Code of practice for Drainage of Building Basement.
(p)	IS-1200 [Part-XVI]	:	Method of measurement: Laying of water and sewer lines including appurtenant items
(q)	IS-1536	:	Centrifugally cast (spun) iron pressure pipes for water, gas and sewage.
(r)	IS-1537	:	Vertically cast iron pressure pipe for water, gas and sewage.
(s)	IS-3486	:	Cast iron spigot and socket drain pipes
(t)	IS-5329	:	Code of practice for sanitary pipe work above ground for buildings.
(u)	IS-3076	:	Low density polyethylene pipes for potable water supplies.
(v)	IS-1538	:	Cast iron fittings for pressure pipes for water, gas and sewage.
(w)	IS-1230	:	Cast iron rainwater pipes and fittings
(x)	IS-1729	:	Sand cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories
(y)	IS-784	:	Pre-stressed concrete pipes.
(z)	IS-1726	:	Cast iron manhole covers and frames
(aa)	IS-5961	:	Cast iron grating for drainage purposes
(bb)	IS-5219 [Part-I]	:	"P" and "S" traps

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(cc)	IS-772	:	General requirements for enamelled cast iron sanitary appliances.
(dd)	IS-775	:	Cast iron brackets and supports for wash basins and sinks.
(ee)	IS-777	:	Glazed earthenware wall tiles
(ff)	IS-2548	:	Plastic water closet seats and covers (all parts).
(gg)	IS-2527	:	Code of practice for fixing rainwater gutters and down pipes for roof drainage.
(hh)	IS-554	:	Dimensions for pipe threads, where pressure tight joints are required on the thread
(ii)	IS-778	:	Copper alloy gate, globe and check valves for water works purposes.
(jj)	IS-781	:	Cast copper alloy screw down bib taps & stop valves for water services
(kk)	IS-782	:	Caulking lead.
(ll)	IS-1703	:	Copper alloy float valve for water supply fitting
(mm)	IS-2326	:	Automatic flushing cisterns for urinals.
(nn)	IS-2556	:	Vitreous sanitary appliances (vitreous china).
(oo)	IS-3311	:	Waste plug and its accessories for sinks and wash basins.
(pp)	IS-3438	:	Silvered glass mirrors for general purposes
(qq)	IS-3989	:	Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
(rr)	IS-4111	:	Code of practice for ancillary structure in sewerage system. (Part 1 to 5)

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	(ss) IS-5382 : Rubber sealing rings for gas mains, water mains and sewers. (tt) IS-5822 : Code of practice for laying of electrically welded steel pipes for water supply. (uu) IS-7740 : Code of practice for construction and maintenance of road gullies. (vv) IS-8931 : Copper alloy fancy single taps combination tap assembly and stop valves for water services. (ww) IS-9762 : Polyethylene floats for float valves. (xx) IS-10592 : Industrial emergency showers eye and face fountains and combination units. (yy) IS-12592 : Specification for precast concrete manhole covers and frames (zz) IS-12701 : Rotational moulded polyethylene water storage tanks. (aaa) IS-13983 : P Stainless steel sinks for domestic purposes. (bbb) SP-35 : Hand book on water supply and drainage with special emphasis on plumbing. (ccc) CPH&EEO : Manual on sewage and sewage treatment Publication- as updated.	
2.1.13	Paving and Road works (a) IS-73 : Paving bitumen (b) IS-702 : Industrial Bitumen (c) IS-1201 : Method of testing tar and bituminous materials thru' 1220	

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(d) IRC:58 -2002 : Guidelines for the design of pain jointed rigid pavements for highways (second revision). (e) IRC:15- 2002 : Standard specifications and code of practice for construction of concrete roads (third revision). (f) IRC:37 - 2001 : Guidelines for the design of flexible pavements (Second revision) (g) Practice followed by Indian Road Congress (all parts).		
2.1.14	Earthquake Resistant Design	
(a) IS-1893 : Criteria for earthquake resistant design of structures. (b) IS-4326 : Code of practice for earthquake resistant design and construction of buildings.		
2.1.15	Chimney	
(a) IS-4998 : Criteria for Design of R.C. Chimneys (all parts). (b) IS-6533 : Code of practice for design and construction of steel chimneys. (c) ACI-307 : Specification for the design and construction o reinforced concrete chimneys (d) BS-4076 : Specification for steel chimneys (e) CICIND : Model Code for concrete chimneys Model code for steel chimneys. (f) ASCE Code : Design and construction of steel chimney liners prepared by Task committee on steel chimney liners Fossil power committee, Power division published by ASCE – 1975.		

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	(g) IS-2606 : Alloy lead anodes for chromium plating (h) IS-9537 : Rigid steel conduits for electrical wiring The Indian Electricity Rules The Indian Electricity Act The Indian Electricity (Supply) Act The Indian Factories Act (i) IS-2309 : Practice for protection of buildings and allied structures against lightning.	
2.1.16	Structural Steelwork	
	(a) IS-800 : Code of practice for general construction in steel. (b) IS-806 : Code of practice for use of steel tubes in general building construction. (c) IS-808 : Rolled steel beams, channels and angle sections. (d) IS-813 : Scheme of symbols for welding. (e) IS-814 : Covered electrodes for manual metal arc welding of carbon and carbon manganese steel. (f) IS-816 : Code of practice for use of metal arc welding for general construction in mild steel. (g) IS-817 : Code of practice for training and testing of metal arc welders. (h) IS-818 : Code of practice for safety and health requirements in electric and gas welding and cutting operation. (i) IS-819 : Code of practice for Resistance spot welding for light assemblies in Mild Steel. (j) IS-919 : Recommendations for limits and fits for engineering.	

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(k)	IS-1024a	:	Code of practice for use of welding in Bridges and Structures subjected to Dynamic loading.
(l)	IS-1161	:	Steel tubes for structural purposes.
(m)	IS-1182	:	Recommended practice for Radiographic Examination of Fusion Welded Butt joints in steel plates.
(n)	IS-1200 [PartVII]	:	Method of measurement of steelwork and ironwork.
(o)	IS-1239	:	Mild steel tubes, tubulars and other wrought steel fittings (all parts).
(p)	IS-1363	:	Black hexagonal bolts, nuts and locknuts (dia. 6 to 39 mm) and black hexagon screws (dia.6 to 24 mm). [all parts]
(q)	IS-1364	:	Precision and semi-precision hexagon bolts, screws, nuts and locknuts (dia. range 6 to 39 mm). [all parts]
(r)	IS-1365	:	Slotted counter sunk head screws (dia range 1.6 to 20 mm).
(s)	IS-1367	:	Technical supply conditions for threaded steel fasteners.
(t)	IS-1443	:	Code of practice for laying and finishing of cement concrete flooring tiles.
(u)	IS-1608	:	Method for tensile testing of steel products.
(v)	IS-1730	:	Dimensions for steel plate, sheet and strip for structural and general engineering purpose.
(w)	IS-1731	:	Dimensions for steel flats for structural and general engineering purposes.

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(x)	IS-1852	:	Rolling and cutting tolerances for hot rolled steel products.
(y)	IS-1977	:	Structural steel (Ordinary quality)
(z)	IS-2016	:	Plain Washers
(aa)	IS-2062	:	Steel for General structural purposes.
(bb)	IS-2074	:	Ready mixed paint, air-drying, red oxide zinc chrome, and priming.
(cc)	IS-2633	:	Methods of testing uniformity of coating of zinc coated articles.
(dd)	IS-3613	:	Acceptance tests for wire-flux combinations for submerged-arc welding of structural steels.
(ee)	IS-3664	:	Code of practice for Ultrasonic Pulse echo testing by contact and immersions methods.
(ff)	IS-3757	:	High strength structural bolts.
(gg)	IS-4000	:	High strength bolts in steel structures.
(hh)	IS-4759	:	Hot dip zinc coatings on structural steel and other allied products.
(ii)	IS-5334	:	Code of practice for Magnetic Particle Flaw detection of welds.
(jj)	IS-7215	:	Tolerances for fabrication of steel structures.
(kk)	IS-7280	:	Base-wire electrodes for sub-merged arc welding of structural steels.
(ll)	IS-7318 [Part-I]	:	Approval test for welders when welding procedure approval is not required.
(mm)	IS-8500	:	Structural steel - micro alloyed (medium and high

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strength qualities). (nn) IS-9595 : Recommendation for metal arc welding of carbon and carbon manganese steels. (oo) AWS D.1.1 : Structural Welding Code. (pp) IS-802 : Code of practice for use of structural steel in Overhead Transmission Line. (qq) Part-I : Load and permissible stresses (rr) Part-II : Fabrication, Galvanizing, Inspection and Packing (ss) IS-2595 : Code of practice for Radiographic testing. (tt) IS-3658 : Code of practice for liquid penetrate flaw detection (uu) IS-4353 : Sub merged arc welding of mild steel and low alloy steel Recommendation (vv) IS-5369 : General requirements for plain washers and lock washer (ww) IS -6623 : High strength structural nuts (xx) IS-6649 : Hardened and tampered washers for high strength structural bolts & nuts. (yy) IS-6911 : Stainless steel plate, sheet and strip (zz) IS-7307 : Approved test for welding procedures (aaa) (Part - I) : Fusion welding of steel (bbb) IS-7310 : Approval test for welders working to approval welding procedure Fusion welding of steel. (ccc) IS-9178 : Criteria for design of steel bins for storage of bulk material. (Part-1to 3)		

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(ddd) IS-12843 : Tolerances for erection of steel structures (eee) SP-6 : ISI Hand book for structural Engineers (Part 1 to 7) 2.1.17 Painting (a) IS-348 : Specification for French Polish (b) IS-427 : Specification for Distemper, dry colour as required. (c) IS-428 : Specification for Distemper, oil emulsion, colour as required. (d) IS-1477 : Code of practice for painting of ferrous metal in buildings. [I & II] (e) IS-2338 : Code of practice for finishing of wood and wood based materials. [I & II] (f) IS-2339 : Specification for Aluminium Paints for general purposes in dual containers. (g) IS-2395 : Code of practice for painting concrete, masonry and plaster surface. (h) IS-2932 : Specification for enamel, synthetic, exterior Undercoating Finishing (i) IS-2933 : Specification for enamel, exterior Undercoating Finishing. (j) IS-5410 : Specification for cement paint (k) IS-627 : Washable Distemper		

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	(l) IS-1650 : Specification for colours for building and decorative materials (m) IS-2524 : Code of practice for painting of nonferrous metals in buildings (n) IS-6278 : Code of practice for white washing and Colour washing. (o) IS-10403 : Glossary of term related to building finish. (p) IS-12027 : Silicone based water repellent. (q) IS-13238 : Epoxy based zinc phosphate primer (2 pack) (r) IS-13239 : Epoxy surface (2 pack) (s) IS-13467 : Chlorinated rubber for paints (t) IS-14209 : Epoxy enamel, two components glossy. (u) BS-5493 : Code of practice for protective coating of iron and steel structures against corrosion	
2.1.18	Sheeting Works (a) IS-277 : Galvanized steel sheets (Plan & corrugated). (b) IS-730 : Hook bolts for corrugated sheet roofing (c) IS-801 : Code of practice for use of cold formed light gauge steel structural member's in general building construction. (d) IS-7178 : Heat Treated steel tapping screws-Mechanical properties. (e) IS-8869 : Washers for corrugated sheet roofing. (f) IS-12093 : Code of practice for laying and fixing of sloped roof covering using plain and corrugated	

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	galvanised steel sheets (g) IS-12436 : Preformed rigid Polyurethane (PUR) and Polyisocyanurate (PIR) foams for thermal insulation. (h) IS-12866 : Plastic translucent sheets made from thermosetting polyester resin (glass fibre reinforced). (i) IS-14246 : Continuously pre-painted galvanised steel sheets and coils. (j) BS-5950 (Part-6) : Code of practice for design of light gauge profiled steel sheeting	
2.1.19	Acid and Alkali Resistant Lining (a) IS-412 : Expanded metal steel sheets for general purpose. (b) IS-443 : Code of practice for use of resin type chemical resistant mortars. (c) IS-4456 : Method of Test for chemical resistant tiles. (Part I & II) (d) IS-4832 : Specification for chemical resistant mortars (Part - 1) : Silicate type (Part - 2) : Resin type (Part - 3) : Sulphur type (g) IS-9510 : Bitumastic acid resisting grade.	
2.1.20	Safety (a) IS-1641 : Code of practice for fire safety of buildings General principles of fire grading and classification.	

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	(b) IS-1642 : Code of practice for fire safety of buildings Details of construction (c) IS-4081 : Safety code for blasting and related drilling operations. (d) IS-4130 : Demolition of buildings - code of safety (e) IS-5121 : Safety code for piling and other deep foundations (f) IS-5916 : Safety code for construction involving use of hot bituminous materials (g) IS-7969 : Safety code for handling and storage of building materials. Indian Explosives Act 1940 (As updated)	
2.1.21	Miscellaneous (a) IS-7969 : Safety code for handling and storage of building materials. (b) IS:10430 : Criteria for design of lined canals and for selection of type of lining (c) IS:12867 : PVC handrails covers (d) CIRIA : Design and construction of buried thin- pipes. Publications (e) Indian Road Congress (IRC) Bridge Codes (f) Indian Railway Standard Bridge Rules	
2.1.22	Environmental Protection Charter on Corporate Responsibility for Environmental Protection (CREP) published in Gazette of India dated 27.08.2003.	

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3.0 SCOPE OF CIVIL WORKS

The scope of civil work comprises all necessary investigations, survey, foundations, building, superstructures and infrastructure required for the complete power station.

All Civil /Structural works of this package, related to (Mechanical, Electrical and others) new 1 X 660 MW Unit are in the scope of bidder. The bidder shall visit the site to acquaint himself regarding all site features and existing facilities and scope & extent of Civil/Structural works to be carried out for this purpose to amalgamate with the new facilities in consultation with Owner. Financial impact due to these works shall be included in the offer. Any claim by the bidder of any ignorance, whatsoever in this regard will not be entertained by MSPGCL at later stage.

3.1 The work under this Section consists of Civil, Structural and Architectural works, but not limited to items mentioned below.

Refer Prebid
no... slope is
1:2

- (a) Area Grading, levelling & dressing (finished grade levels shall be as mentioned in Plot plan and Area Grading Drawings. UCR/RCC retaining wall shall be provided as per requirement to retain the soil. If space permits, slope (1:3) shall be provided between two different grade levels. However slopes shall be protected with stone pitching with cement mortar (1:4).

- (b) Preliminary geo-technical investigation work is carried out at site by the Owner. However, for soil characteristics and parameters to be adopted in final design, the contractor is required to do detail geotechnical investigation work as part of the contract to verify/ generate data so required.

It should be noted that nothing extra whatsoever on account of variation between soil data annexed in this specification and that found by detailed geotechnical investigation to be carried out by bidder shall be payable.

- (c) Demolition of existing over ground structures (including foundation)/ facilities, if any, and site clearance.

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(d) Piling work if necessary. (e) Boundary walls around any buildings/area, if required from statutory point of view. (f) The UCR compound walls along with gates wherever required shall be provided as per attached bid drawing and/or as directed by Engineer-in-charge as per site requirements. The scope under this includes as below (i) Dismantling of existing compound walls shown in the drawing or as directed by Engineer-in-charge. (ii) Providing new UCR compound wall with anti-climbing arrangement as per drawing and /or as directed by Engineer-in-charge. Wherever required, retaining wall below compound wall shall also be included in the scope of the contract. (iii) Providing chain link fencing between 2 x 500 MW and 1 x 660 MW plant as per clause no. 4.20 of Section I and as per Bid drawing or as directed by Engineer in-charge. (iv) The suitable arrangement at crossing of compound walls with pipe lines, drains nallas, railway lines etc. shall also be provided by the bidder. (v) The gate of suitable size alongwith compound wall on either sides at grid N'400 across existing 10.0 m wide road The scheme should be submitted for approval of the owner before execution at site. (g) In plant Roads and Culverts within this specification and as shown in the plot plan bid drawing shall be provided by the bidder. (h) Drainage network (storm water drains, oils/effluent & sewage water) (i) Foot over bridge for railway crossing near wagon tippler.		

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	(j) Road over bridge (ROB) for Railway siding including approaches on both sides upto existing roads as shown in bid drawing shall be provided as per railway norms. The engineering of bridge, clearances and permission of railway authorities, construction, erection of bridge & approaches etc are included in the scope of bid. (k) Complete railway siding facilities for the project. The brief scope of railway siding consists of following works. (i) In Railway siding area Grading, levelling & dressing (finished grade levels shall be as mentioned in Plot plan and Area Grading Drawings) but in the rail track portion if required necessary excavation, filling shall be carried out for base formation below rail track, toe wall, retaining wall, drain and other foundation etc and other related activity as per prevailing standard engineering practices of Railways. (ii) Scope also includes coordination with Railway Department & preparation of design & drawings for construction of all buildings such as TNC building, Central panel building etc station works such as cabins, relay rack, battery rooms, DG room, signaling and telecommunication room, drain works, cross drainage works goomties etc. along with electrification works and with all materials, equipments machineries etc. The works not elaborated specifically but are essential for supply, installation, testing and commissioning the BG railway siding are deemed to have been included in the scope and the same will be as per prevailing standard engineering practices of Railways. (iii) All works related to Railway siding facility (including feasibility study, soil investigation, system study, basic Engineering, Detail Engineering, necessary labour, all materials, plants/ equipments, construction, erection, testing and commissioning.) (iv) Modification/alteration works such as tapping point of rails & at dry ash silo locations, if any. (v) Engineering of railway siding as per railway norms.	

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	(vi) Obtaining necessary approvals/permission/clearances of railway authorities before and during execution as well as after completion of railway works as per requirements of Railway department and/or Mahagenco required for commissioning well in advance so as to start the railway traffic in schedule time frame. However delay on this account shall be to the contractor's account (vii) Obtaining permission for block on running traffic including necessary charges of railway department. (viii) Execution of earth work in formation, cutting in soil, rocks, earth filling, murum blanketing, drains etc. (ix) Formation included in the work and the same will be as per prevailing standard engineering practices of Railways (x) Providing rail structure including Ballast, PSC slippers, steel slippers, Rails, points & crossings and other required P-way fittings and fixtures, etc (xi) Construction of ROB, Bridges, concrete or UCR Retaining wall & concrete drains, culvert, pitched drains, concrete apron etc. (xii) Construction of level crossing, height gauge etc. (xiii) Dismantling of plain tracks and existing turnouts, P-way linking supply and spreading of ballast etc. (xiv) Structural steel works, linking of rail, civil work, OHE, electrification, signaling & telecommunication works including supply of materials, plants /equipments, labours, construction, erection, testing and commissioning of railway siding facility. as per prevailing standard engineering practices of Railways (xv) Any ancillary building such as TNC building, Central panel building, staff rooms ,railway cabins etc as per requirement is also included in the scope of bid.	

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(l) The existing Two (2) numbers RCC culverts below existing railway lines shall be suitably extended as passage for disposal of storm water drainage & for laying of Raw water pipe lines as per railway rules and regulation as shown in the plot plan bid drawing shall be provided by the bidder. (m) Supporting arrangement for auxiliary steam line to be tapped from the existing 2x500MW units is in bidders scope 3.2 <u>TURBINE AND AUXILIARIES</u> (a) Foundation for TG and auxiliaries. (b) Vibration isolation system: Steel spring/viscous dampers for Steam Turbine Generator (STG), Boiler Feed Pumps, ID, FD, PA fans and Coal mills. (c) The scope shall also include all necessary civil work (mainly civil foundation) pertaining to Erection of stator/any other equipment (if reqd.). (d) Power house building sub structure and super structure with E.O.T. crane. (e) Lift and supporting structure. (f) Transformer yard including transformer foundations, Fire-walls, Rail track (embedded in concrete), transformer oil collection drain pit with sump pump and intermediate pits as required. (g) Gravel filling in the transformer area along with the anti-weed treatment of the top layer of the soil. Chain link/barbed wire fencing, wherever required. (h) One N.D. Cooling Tower including cold water Basin, covered approach channel up to CW pump house, gates and screen, maintenance facilities, CW & ACW Pump House, switch gear /MCC rooms. Cooling water pipes and return pipes including their supports		

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and foundations, thrust blocks etc, wherever required including earth mat/lightening protection. (i) CW treatment with ozonisation building structure & foundation, side stream filtration plant area equipment & pipe support structure & foundation. (j) Electrical Grounding mat for all equipment foundations. 3.3 <u>BOILER, WATER SYSTEM, CHEMICAL PLANT, CHP AND ASH PLANT.</u> (a) Mill Buildings including bunker and bunker stainless steel lining. (b) Boiler & Boiler Auxiliary foundations and super structure. (c) ESP foundations and super structure. (d) Coal Mill, fan (PA, FD, ID) foundations. (e) Two nos Passenger cum Goods lift with supporting structure. (f) Pipe/Cable Support, Cable/pipe racks, trenches, duct-banks etc (g) Paving including plinth protection of all buildings. (h) Mill reject storage bins or silos and handling system. (i) Condensate Storage Tank foundation. (j) ESP Control buildings (k) C.P.U. regeneration area complete with neutralizing pit. (l) Flue gas and air duct foundation. (m) Civil works & foundations for all electrical auxiliaries (n) Slag ash/fly ash disposal system, all structure and Ash handling building, foundations for all auxiliaries along with earth mat as		

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	necessary including ash disposal pipeline upto VELHALA. The existing ash bund is about 10 Kms from the proposed power station. The bidder shall visit the site to acquaint himself regarding all site features and scope & extent of Civil /Structural works to be carried out for this purpose to amalgamate with the new facilities in consultation with Owner. (o) Remote dry fly ash silo utility room. (p) Ash slurry disposal pipe lines shall be routed above overhead trestles within Plant area. Pipe lines shall be routed supporting on pedestals upto ash disposal area. A 5.0 m wide WBM service road along with drains wherever required shall also be provided for maintenance purpose of these Ash slurry disposal pipe lines. The required cross drainage works for crossing these pipe lines & service roads are also to be provided. (q) All buildings, foundations & structures for coal handling plant along with earth mat, as necessary. (r) R.C. Chimney with single steel flue and with elevator. (s) Raw water storage tank, raw water Pump House, Raw water Pipe Line supporting structure & Equipment foundation (t) Raw water pre-treatment plant covering Clarifloculators, Gravity Filters, chemical house, filtered water tanks & pump house, equipment, pipe support foundations along with earth mat etc (u) Raw water/Fire water pump house with gates and stop logs, trash racks maintenance facilities, switch gear/MCC rooms, equipment foundations along with earth mat including incoming water pipe line from Raw water tapping from proposed water line for 2 x 500 MW unit to Raw water storage tank which is about 1 Km away from RWST. The bidder shall visit the site to acquaint himself regarding all site features and scope & extent of Civil/Structural works to be carried out for this purpose to amalgamate with the new facilities in consultation with Owner.	

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(v) Filter water storage tank for D M & Non DM. (w) Post water treatment plant including DM plant building, Equipment foundation along with earth mat, DM water storage tanks and foundations, neutralization pit, chemical lab, including all necessary piping. (x) Centralized Effluent Treatment Plant including central monitoring basin, coal pile runoff settling pond, oil water separator including complete plant waste water collection and disposal system. (y) Complete Compressed Air system with Air Compressor & DG building, Equipment foundation, DG foundation etc with earth mat. (z) The HFO & LDO will be transferred from the Oil tanks of existing 500 MW units with help of HFO & LDO transferring pumps and stored in the fuel oil Day tanks. The oil will be supplied to boiler with the help of pressurizing pumps. The system downstream of Oil Tanks of 500 MW units including Oil Transfer Pump House, Day tank, pressurizing pump House, piping etc shall be in the scope of bidder. (aa) Complete fire water/foam Pipe networking system (bb) Centralized sewage treatment plant including complete sewage water collection and disposal system. (cc) Plant Rain Water Harvesting Scheme. Rain water harvesting scheme which is statutory requirement mandated by MOEF is to be executed as per the recommendations of the Central Ground Water Authority/Board. Obtaining the necessary statutory approvals for the Rain water harvesting scheme to be implemented shall be in the scope of EPC contractor. Rain water harvesting scheme shall be designed for reuse as well as recharge of ground water.		

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3.4 <u>NON PLANT BUILDING/STRUCTURES INCLUDES</u> (a) Service Building Sub structure and super structure along with interconnections to main plant building, Centralised A.C. Plant and passenger lifts. (b) Fire Station, Work Shop, Construction/Fabrication Yard (temporary/permanent structure if any) (c) Watch Tower (d) Canteen (e) Gate office with parking facilities. (f) Time office cum security office. (g) Car & Scooter stand. (h) Lube oil storage shed along with empty barrel storage yard (i) Check post (j) Coal sampling room and Processing room in CHP area. (k) Fencing & gates wherever required including ash gate. (l) Major Store complex with Weigh Bridge (m) Unloading platform. (n) Gas cylinder storage building (o) FOPH foam shed Architectural finishing including flooring, paving, Side cladding with coloured coated Galvalume non -Insulated metal cladding, brick masonry/fly ash brick in fill walls, plastering, painting, false ceiling, doors & windows,		

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plumbing, roof treatment, etc., for plant/non plant building, auxiliary & ancillary building. The scope shall also include setting up by the Contractor a complete testing laboratory in the field to carry out all relevant tests required for the civil works for the project. Grading level of entire plant area and extent of area grading under this package is shown in bid area grading drawings. Construction and drinking water will be supplied by the Owner at a single point within the battery limit of existing plant and the Bidder shall have to construct storage tanks at supply points. Pumping arrangement and distribution system shall be in the scope of bidder. A list of Civil Field Quality Assurance Plans and List of Laboratory Apparatus is enclosed in ANNEXURE-II of Section II. The Bidder shall visit the site and assess the involvement of demolition and site clearance, if required, within the plant area to construct the project & accordingly the cost is to be considered in his offer. The work shall have to be carried out both below and above the ground level. The work shall be executed in accordance to the relevant Indian Standard Code, and in its absence, the work shall be executed according to the best prevailing local Public Work Department (PWD) practices or as per the recommendations of relevant American and British Standards or as per the instructions of the Owner's Engineer. This shall prevail in respect of civil works for which no specification has been prescribed in this section. The work shall be carried out according to the design/drawings to be developed by the Contractor and approved by the Owner/Owner's authorised Consultant. For all building, structures, foundations, etc., necessary terraced layout and details are to be developed by the Contractor keeping in view the statutory & functional requirement of the plant & facilities and providing enough space & access for operation, use and maintenance. The land for project will be handed over to the Contractor by the Owner		

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as is where basis. Additional site investigations, surveys, grading and levelling and other additional works shall be carried out by the Contractor, if necessary. The layout and levels of all structures shall be made by the Contractor at his own cost from the general grid of the plot and the nearest GSI bench mark or other acceptable bench mark of Govt. Dept. The Contractor shall be solely responsible for the correctness of the layout and levels. All necessary statutory clearances/any other body i.e. railway etc. shall be obtained by the Bidder prior to execution of work under scope of this specification. The necessary expenses shall be borne by the bidder. All the quality standards, tolerances, welding standards and other technical requirements shall be strictly adhered to by the Contractor. 4.0 <u>PLANT STRUCTURES/COMPONENTS:</u> The description of some of the major structures/components of system covered under the Package is given below: 4.1 <u>POWER HOUSE BUILDING:</u> The Turbine Hall is an enclosed insulated, weather-tight steel framed structure which houses the turbine generator and related equipments. The building consists of an operating floor, mezzanine floor and a ground floor as per layout. The roof is supported by steel trusses. The structure is braced in the direction of the crane travel but provided with suitably designed rigid joints at roof level and framing at other floor levels. Two (2) E.O.T. Cranes (capacity shall be as specified elsewhere in this specification) will operate in the Turbine Hall for handling equipments. For rigging and positioning of the Turbo-Generator and condensers, building frame shall not be of any hindrance and temporary openings in the building claddings and cladding supporting structures shall be maintained till completion of the rigging and positioning of the condensers and TG. Within the building, the concrete pedestal for supporting the turbine generators and Boiler Feed Pumps/motors will be completely isolated from the building floors for vibration control. The foundation for Turbo generator		

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and Boiler Feed Pumps/motors shall rest on suitable vibration isolation system consisting of springs and visco dampers. The concrete operating floor will be designed for construction and maintenance loadings of TG. Hatchways with removable chequered plates or grating floor covers will provide access to equipment on lower floor and will be within turbine hall crane access. The intermediate floors will be of concrete with hatchways as necessary. All front external sides shall generally be cladded with factory assembled double skin insulated metal cladding made up of 0.50mm TCT colour coated profiled galvalume steel sheets. The outer skin profile depth is 28 mm and the inner skin shall be slightly ribbed steel sheet. The core in between the outer profiled sheet and the inner profiled sheet shall be polyurethane foam in 30 mm thickness having a density of 40 – 45 kg/cum. The foam shall be filled in between the outer and inner sheet at factory using highly dedicated foaming machine. The fasteners to be used for these factory made panels shall be of adequate sizes, self-drilling and self-tapping type, compatible with galvalume steel sheets. This shall be used from 3M (approx) above ground floor up to roof. Brickwork shall generally be provided from ground floor to 3M (approx) height. Permanently colour coated single metal cladding sheet (non-insulated) shall be provided over fly ash brickwork above 3M (approx) from ground floor only when brickwork is technically required and unavoidable. All internal walls shall be of fly ash brickwork. Windows, doors, claddings and finishing shall be as laid down in Volume VI/A Section – IV of this specification. The roof over Turbine Hall shall be flat with a gentle slope of about 1 in 100 towards the transformer yard. The roofing will be done by cast-in-situ RCC slab over permanently colour coated (on exposed face) galvanized M.S. troughed metal decking of approved profile supported by steel purlins which are spanning between two adjacent roof trusses. The thickness of sheet shall as per the design requirement considering worst load combination subject to a minimum thickness of 0.8mm. The roof will be insulated by providing 75 mm thick foam concrete. Roof water proofing treatment shall be done as per Architectural Part Cl. No. 2.24 of Vol. VI/A Section – IV. All floors except roofs of Turbine Hall will be cast-in-situ RCC over removable shuttering with hatchways as required. RCC slab-on-grade (200 min.) on ground floor shall rest on well-compacted		

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earth-fill with approved quality earth as specified elsewhere in this specification. Ground floor slab will have drainage trenches covered with steel grating. Stairs and platforms shall be provided as required for maximum utility and safety. Stairs shall have to be provided as per TAC regulations and any other statutory requirements. Troughed Metal decking sheet for roof shall consist of permanently colour coated galvanized M.S. sheet and silicon modified polyester paint of approved make shall be used for permanent coating on exposed surface. The galvanization shall be 275gm/sqm and DFT of permanent colour coating shall be 20 micron (approx). Primer coat shall be provided on inner side. 4.2 MILL BUILDINGS These buildings house coal pulverisers, coal bunkers, tripper conveyors, Coal feeders, ducts and piping. The bunker shall be circular in plan and cylindrical at top portion and conical at sloped hopper portion. Bunker shall be designed as per capacity specified elsewhere. A comprehensive flow ability study shall be conducted by the Bidder for the coalbunker hopper to ensure smooth flow of coal in all seasons with different moisture contents and different percentage of fines. Geometric parameters of hopper shall be decided considering the findings of flowability study. 5 mm stainless steel liner plates conforming to 304M Grade, fitted without allowing any projections in coal flow path shall be provided for conical hopper portion only. On sides of the bunker, necessary openings shall have to be provided for bunker ventilation/dust extraction. Minimum thickness of M.S. skin plate for both conical and cylindrical portion shall be 12 mm. Specification for Liner Material (a) Material : 304M grade stainless steel plates manufactured by SAIL. (b) Thickness : 5 mm		

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Fastening System: The edges of stainless steel plates shall be ground smooth after cutting. The inner plate should be plug welded to the mother plate. The plug welding shall be done by drilling 20 mm diameter holes @300 mm c/c both ways without puncturing the mother plate. The welding is to be done by using specialized stainless steel electrodes such as 308L / 309L. Shielding gas shall be Argon + Oxygen mixture or Argon + Hydrogen mixture. CO₂ mixture shall be avoided. Testing: The stainless steel 5 mm thick, 304M grade, test samples shall satisfy the following mechanical and chemical properties. 4.2.1 Mechanical Properties (Annealed) <table border="0"> <tr> <td>(a)</td><td>Hardness R'B'</td><td>90</td></tr> <tr> <td>(b)</td><td>Yield Strength (Min.) (0.2% proof stress)</td><td>300 N/mm²</td></tr> <tr> <td>(c)</td><td>Ultimate Tensile Strength (Min.)</td><td>515 N/mm²</td></tr> <tr> <td>(d)</td><td>Percentage Elongation (Min.)</td><td>40</td></tr> </table> 4.2.2 Chemical Composition (%) <table border="0"> <tr> <td>(a)</td><td>Carbon</td><td>0.08% Max</td></tr> <tr> <td>(b)</td><td>Manganese</td><td>2.0%</td></tr> <tr> <td>(c)</td><td>Silicon</td><td>0.75% Max</td></tr> <tr> <td>(d)</td><td>Phosphorus</td><td>0.045 Max</td></tr> <tr> <td>(e)</td><td>Sulphur</td><td>0.03% Max</td></tr> <tr> <td>(f)</td><td>Chromium</td><td>20% Max</td></tr> <tr> <td>(g)</td><td>Nickel</td><td>10.5% Max</td></tr> <tr> <td>(h)</td><td>Titanium</td><td>0.10% Max</td></tr> </table>			(a)	Hardness R'B'	90	(b)	Yield Strength (Min.) (0.2% proof stress)	300 N/mm ²	(c)	Ultimate Tensile Strength (Min.)	515 N/mm ²	(d)	Percentage Elongation (Min.)	40	(a)	Carbon	0.08% Max	(b)	Manganese	2.0%	(c)	Silicon	0.75% Max	(d)	Phosphorus	0.045 Max	(e)	Sulphur	0.03% Max	(f)	Chromium	20% Max	(g)	Nickel	10.5% Max	(h)	Titanium	0.10% Max
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Due to constant development, the above properties are liable to change. Hence, the clarification from the Engineer regarding the exact properties shall be required to be taken before placement of order for procurement in case of any change only.

Before commencing regular fabrication of the bunker, trial assembly of the bunker including hopper shall be made at least for one bunker.

The framing shall be of structural steel. This shall be designed as a moment connected framing in the transverse direction and braced in the longitudinal direction. These structures primarily support coal bunkers, coal feeders and tripper arrangement to feed the coal into coal bunker. Supporting structure for Mill maintenance arrangement are connected to this structure. Handrails shall be provided on all sides of Feeder floor. Slit openings are to be provided in Tripper floor for entry of coal from Tripper into bunkers. Framing arrangement for structural steel platform at various levels around the bunkers shall be provided, as required, with proper access ladder for poking, striking and attending to air cannons.

All floors will be of reinforced concrete with hatchways as required. Ground floor slab will have drainage trenches covered with steel grating.

Building roof will be of Cast-in-situ R.C.C. over permanently colour coated (on exposed face) galvanized M.S. troughed metal decking of approved profile supported on steel beams/girders and the sides will be cladded with permanent colour coated sandwiched insulated metal cladding system from Tripper floor to roof. The remaining portion of the building below Tripper floor up to ground floor shall generally be uncladded. However, brick cladding shall have to be provided, if required, as per TAC and any other statutory requirements.

Floors shall be of cast-in-situ RCC over removable shuttering.

Stairs and platforms shall be provided as required for maximum utility and safety as per TAC regulations and any other statutory requirements. Stair should be provided from ground up to roof. Minimum two (2) stairs shall be provided in each Mill Building. Proper toilets and drinking water

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arrangement shall be provided over tripper and feeder floor. Arrangement for disposal of waste coal from all floors shall be provided. 4.3 <u>FLUE GAS DRAUGHT SYSTEM STRUCTURES</u> Flue gas draught system structures include electrostatic precipitators, ID fans, ductwork and chimney. The equipment structures are outdoor construction type supported by exposed steel structures consisting of beams, columns and bracings. The precipitators will be elevated to allow a good arrangement of gas ducts from the air heaters and to facilitate removal of fly ash in the event of equipment breakdown. Minimum clearance for truck (small) entry below hopper shall be provided as per requirements described elsewhere in the specification. Precipitator control room will be housed in a building with R.C. column and beam framing. At the paved ground level, drainage trenches covered with steel grating at intervals shall be provided for final discharge into the drainage system/sump pit. 4.4 <u>ASH HANDLING PLANT</u> Ash handling system shall comprise of bottom ash, coarse ash and fly ash handling systems, ash slurry pump house, ash water pump house, HCSD Pump House, ash pipe supports including pipe racks, pipe trenches, culverts, bridges etc. Works shall include bottom ash slurry pipe supports, bottom ash extraction equipment supports, ash slurry pipe supports from ash slurry pump house to existing ash dyke area at VELHALA, dry fly ash pipe supports from ESP to remote fly ash silo via HCSD fly ash silo, remote fly ash silos, development of silo area (including paving, fencing, access roads, office block and watchman cabin), pump and equipment foundations, compressor house, MCC room, ash water pump house, ash water pipe supports, RCC thrust blocks, sump, miscellaneous tanks supporting structures, One (1) in plant Tube settler to receive water from bottom ash overflow pump discharge vacuum pump drain water , & any other drains the contractor intends to route to this plant for clarification & feeding the cleaner water to Ash water sump for reuse in		

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Ash handling system & the supporting structure, facilities required etc. to complete the system. Civil work shall also include HCSD pipe supporting structure from HCSD Silo area upto ash disposal area & HCSD related foundation & structure. Fly ash remote silo storage area shall be provided with the sump, for collection of ash water. The compressor house and ash water pump house shall be provided with toilet facility. Structural arrangement, foundation system, cladding interior and exterior finishes, area paving etc., shall be as per total plant building design and finish schedule furnished elsewhere in the specification. Pipelines shall generally be supported on saddle type RCC pedestals and foundations. A suitable pad play in between pipe and pedestal shall be provided to prevent for wearing of pipe bottom surface due to thermal expansion. The top level of the pipe pedestals shall be 600 mm (minimum) above the formation level. Pipes shall be suitably anchored with RCC pedestals to resist lateral and vertical movements. The compressors and their associated equipments shall be housed in RCC building along with requisite MCC room. Crane / monorail of adequate capacity shall also be provided in all pump / compressor house. Ash Slurry Disposal Pipe line: The bidder shall visit the site to acquaint himself regarding all site features and scope & extent of Civil/Structural works to be carried out for this purpose to amalgamate with the new facilities in consultation with Owner. Scope include site survey, soil investigation, site development works, complete design engineering and construction of Civil, Structural. obtain necessary various approvals from Railways, other Departments/agencies well in advance including necessary charges for permission part born by the EPC contractor Pipe lines shall be routed supporting on pedestals up to ash disposal area. A 5.0 m wide WBM service road along with drains wherever required shall also		

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be provided for maintenance purpose of these Ash slurry disposal pipe lines. The required cross drainage works for crossing these pipe lines & service roads , permanent approaches to farmer over pipe lines on existing and new proposed lines wherever required as per requirement of Owner are also to be provided For crossing of the pipe lines and maintenance road with nallahs, canals, lake etc and/or for road/rail crossings, pipe shall be laid through RCC box culverts/bridges. In railway crossing and high way crossing RCC box culverts by push back method shall be use. 4.4.1 Following shall be considered for laying of the pipe lines: (a) All the specials such as bends, tees, laterals etc. shall be of cast basalt lined. (b) The sleeves coupling shall be provided at every 30 M Centre line with twin supports. (c) The unsupported length of the all pipelines shall not be more than 6.0 meters. (d) Minimum thickness of the M.S. Pipe line shall not be less than 9.50 mm. (e) The ash disposal pipeline shall be painted with 2 coats of epoxy paint of approved make over a coat of epoxy primer. Total DFT shall not be less than 240 microns. (f) The pipe lines shall be provided with all specials such as bends, tees, lateral etc., and appurtenances such as sluice valves, air/vacuum release valves, drain valves with isolation sluice valve as per design and functional requirements. (g) Thrust blocks to resist the thrust at bends/tees etc. shall be provided for full load. (h) Pipe support shall be designed considering pipe dragging force in addition to all other forces.		

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(i) The pipelines shall be laid in down ward gradient as far as possible irrespective of ground formation level, so as to avoid the ash deposition in the pipelines. (j) For supporting ash pipelines in the power plant area, pipe rack along with 750 mm wide walkway shall be provided. 4.4.2 The following buildings shall be provided to accommodate the equipments: (a) Ash slurry sump & ash sludge sumps with pump house. (b) Ash water sump with pump house (c) Compressor room (d) Ash handling system main control room. (e) AHP tube setter with associated Civil Works as applicable (f) Silo utility cum control room near HCSD silo & remote fly ash silo, ash silos and related civil work. (g) HCSD pump house. Pipe Rack/trenches/pedestals etc in the plant area and upto ash disposal area.		
4.5 <u>COAL HANDLING PLANT</u> The work to be performed under this specification for civil, arch. and structural items include works for sub-structures and super structures for the entire coal handling plant including auxiliary system/services and shall generally comprise (but not limited to) detailed design and preparation of design and detailed drawings including getting the same approved by owner consultant/railway authorities for construction, fabrication, erection as per approved drawings and specification, supply of materials and labour etc, for the following. The Coal Handling Plant shall consist of crusher house, transfer towers, tunnels, pent houses, conveyor galleries, trestles, main		

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control building with MCC room, stacker reclaimer foundation, coal stock pile, stack yard, water sprinkler system, Wagon tippler complex etc. (a) All transfer towers, crusher house, drive house shall be provided with RCC foundation with steel frame and RCC floor/roof. Fly ash brick wall cladding up to first floor for crusher house and up to 3 M from finish floor level for all junction towers and drive house shall be provided. Remaining portion of the towers/drive house/crusher house shall be clad with permanently colour coated metal sheeting. All external staircases shall be provided with permanently colour coated metal sheeting. Steel doors, louvers window and staircase shall be provided for access and ventilation. Two number staircases (one internal and one external) shall be provided for crusher house. Flooring for crusher house shall be RCC with 40 mm thick cement concrete flooring with ironite topping. The crusher shall be RCC deck supported on steel helical spring units and viscous damper, which in turn shall be supported on steel frame. The thickness of top RCC deck shall not be less than 1.0 M. Dynamic analysis shall be done for the top deck and the natural frequencies and amplitudes of vibration shall be determined. A mathematical model of the top deck shall be formulated with three-dimensional beam/plate finite element for the purpose of analysis with the springs idealized with vertical and horizontal stiffness. The mass of the machine together with that of the top plate shall be considered for the analysis. Single degree of freedom systems may be used for evaluating the rigid body nodes. Natural frequencies up to at least 20% above the operating frequencies shall be checked. Forced response dynamic analysis shall be carried out for the operating condition unbalanced forces using sinusoidal forcing function. The vibration isolation system shall be designed for at least 90% isolation efficiency. A ratio of at least 10 (ten) shall be ensured between the stiffness of the supporting structure and the stiffness of the spring system in each supporting structure (the stiffness of the spring system being lower). This ensures that the supporting structure is relatively "Rigid" with respect to the springs and the vibration isolation system can be conveniently assumed to be rigidly supported for the purpose of dynamic analysis.		

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In addition the first bending mode frequency of the top deck shall be at least 20% above the operating speed of the motor. (b) All over ground and on ground conveyor gallery shall be enclosed type steel structure with two lattice girder having rigid jointed portal frame at both ends. The lattice shall be braced together in plan at top and bottom and roof truss shall be provided at regular interval. The gallery shall be covered in sides and top with permanently colour coated metal sheeting as per system requirement. (c) All electrical buildings shall be of RCC frame structure with RCC roof and floor and plastered fly ash brickwork. Glazed aluminum door, windows, false ceiling, partition wall shall also be provided. The roof water proofing as per civil and architectural work specification shall be provided as given elsewhere. Outdoor transformer foundation with oil pit & fencing with gate shall be provided. The control room building shall be complete with toilet, drains, plumbing, sanitary drainage, painting etc. (d) Wagon tippler hopper shall be under ground RCC construction (Concrete Grade M30). Wagon tippler hopper shed shall be covered with steel framed structure shed for the full length with roof and side cladding with permanently color coated metal sheeting. Steel stair shall be provided as required. The WT hopper and conveyor tunnel shall be provided with adequate slopes and sumps at suitable locations, fitted with pumps for dewatering. (e) Stacker Reclaimer shall rest on RCC foundation and grading with drainage shall be as per system requirements. Proper slope and drainage system shall be provided for track of stacker / reclaimer area. Underground cross tie beam shall be provided to avoid settlement of supporting columns of stacker / reclaimer. (f) Coal Stock Yard: Entire area shall be excavated to average 250 mm depth and given slope of 1 in 100 in suitable directions as approved. Entire excavated area shall be watered and rammed and compacted with 10 tonne roller. 100 mm thick river sand cushion layer shall be placed over compacted sub grade and consolidated by flooding 150		

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	mm thick boulder soling shall be laid over sand cushion, joints filled with river sand. Over boulder soling, 75 mm thick lean concrete (1:4:8) shall be spread. Final layer shall be minimum 150 mm thick RCC slab M20 with double layer reinforcement. Slope is to be maintained through all layers. The coal stack area shall be graded with suitable slope for draining the surface by longitudinal drains that shall be of RCC trenches with graded gravel packets at about 1.5 m intervals on the sides to trap coal dust. Weep holes shall be provided in the trench walls at the locations of filter pockets for collecting surface water in the longitudinal drains for discharging into the mains surface drain by the side of the road. Retaining wall, 1m height shall be provided around the crushed coal pile to prevent coal spillage into the drain. Necessary control joints in the grade slab shall be considered to avoid temperature and shrinkage cracks in the slab. The design of coal stack area should take care of loads arising due to dozer movement and shall be designed to sustain coal water pressure. (g) All main roads in CHP area shall be as per road layout drawing. Roads shall be of WBM with bituminous topping as per specification given else where. Covered drains/pipe drains with adequate number of manholes shall be provided in dust prone areas. RCC box culverts / pipe culverts with dead wall and aprons shall be provided at road and drain crossings as required. (h) Steel structures shall be designed by working stress method as per IS: 800 (latest). However, the connection of vertical bracings with connecting members and diagonals of truss members shall be designed for full tensile capacity of the bracing member. (i) The various materials for structures shall conform to the following Indian Standards (Latest): (i) Rolled Section – IS – 2062 (ii) Plates of various thickness – IS – 2062 (iii) Chequered plate of various thicknesses – IS – 3502 and min. thickness shall be 6 mm O/P.	

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	(j) Factor of safety of foundation/structure during and after construction shall be as under: (i) Sliding and overturning As per IS: 456 (latest) Minimum F.O.S. shall be 1.20 considering dead weight of structure as 0.9 times the actual value. (ii) Uplift of shallow foundations due to tension in building column Minimum F.O.S. shall be 2.0. (k) For design purpose the ground water table shall be considered at 1.00m depth below F.G.L. (l) For design of RC structures, Bulk density and angle of repose for coal shall be considered as 1.20 MT/Cu.M, 37° for (crushed coal) and 35° for (uncrushed coal) respectively. However for storage volume consideration, density 0.8 MT/Cu.M shall be considered. (m) All reinforced concrete work shall be M-25 as per IS 456-2000 with a minimum cement content 300 Kg/cum and maximum free water cement ratio shall be 0.5. Wagon tippler, under ground tunnels shall be constructed with minimum M-30 grade concrete. (n) All hoppers shall be designed under the following load conditions. (i) The hopper is full up to its full capacity with top surface horizontal at grating level. (ii) The hopper is partially empty with the highest level of coal at grating level and making an angle as specified elsewhere. The above conditions are to be analyzed for the case where the whole content of coal within the hopper is supported by the hopper only without taking support from any other structures below.	

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	The hopper shall also be designed for lateral coal pressure, frictional forces during filling and emptying and forces due to impact and failing of arches of coal within the hopper, etc. (o) In addition to dead load, live load, wind/seismic loads all steel structures specially conveyor galleries and trestles shall be designed for thermal loads for a difference of temperature of 40⁰ C and transverse deflection of trestle shall be as per IS: 11592 (latest). (p) Vertical bracing members which are connected to the beam shall be analyzed for all the vertical loads which the beam is subjected to along with lateral loads. (q) Shear force in steel columns shall be transferred to the pedestals/ foundations exclusively either through foundations bolts or through shear key arrangement. (r) All underground RCC structures shall be provided with acrylic based polymer modified cementations composite coating system 'Tapecrete' of CICO or equivalent on exterior and interior both faces of walls, raft, slabs etc. Concrete surfaces of sub-structure exposed to earth shall be painted with two coats of bitumen paint of approved make. Water proofing shall be provided as per requirement. (s) Wagon Tippler structure shall be analyzed and designed for the worst load combinations. However, it shall be analyzed for the following load combination also : Combination -1 (i) Hopper full. (ii) Maximum load from railway track. (iii) Earth pressure without surcharge and sub-soil water pressure. (iv) Maximum load from steel column for shed. (v) Maximum load from paddle feeder support.	

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(vi) Maximum load from coal tray. Combination- 2 (i) Hopper full. (ii) Maximum load from railway track. (iii) Earth pressure with surcharge and sub-soil water pressure. (iv) Maximum load from steel column for shed. (v) Maximum load from paddle feeder support. (vi) Maximum load from coal tray. Combination- 3 (i) Hopper full. (ii) No load from railway track. (iii) Earth pressure with surcharge and sub-soil water pressure. (iv) No load from steel column for shed. (v) DL only from paddle feeder supporting structure. (vi) DL only from coal tray. Wagon Tippler Hopper shall have removable type steel grating cover. The opening size for grating shall be as per mechanical requirement. Bar grid shall be fabricated and made of rolled sections and flats of minimum thickness of 20 mm. (t) Load considered for grating design: Wagon Tippler: 1.0 M high of coal and wheel loader operating with bucket carrying boulders/oversize ROM coal.		

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Fire and Noise proofing shall be taken care as per applicable TAC and environmental regulations. 4.6 <u>CHIMNEY</u> 4.6.1 (a) General Arrangement A single flue reinforced concrete chimney shall be provided. The flue gas emission point shall be minimum 275 meters above the plant grade level. The chimney shell (wind shield) shall be constructed using slip form shuttering. Flue shall be of M.S. conforming to IS 2062 Gr.A and of hung type with multiple supports and expansion compensator. Openings shall be provided in windshield to accommodate the flue supporting platform beams. The liner shall have resin bonded mineral wool type thermal insulation. The liner portion above rooftop shall be constructed from stainless steel. Internal platforms of structural steel shall be provided for enabling access to various elevations of the stack and to support the steel liners. Platforms with minimum clear width of the platforms as 1.0 M, shall be spaced at a minimum spacing of 40.0 M. The platform beams shall rest on electrometric bearing blocks, supported on concrete shell in the pockets provided for the purpose. Openings in the concrete shell for flue duct entry, access doors at platform levels, access door & truck entry door at the bottom of the chimney, air ventilation etc shall be provided. Hand railing shall be provided all around the external platforms, internal staircase & around the ventilation voids in the internal using min. 32 mm galvanized pipes medium grade of IS:1239/ IS:1161. Spacing of railing posts shall not be more than 2000 mm centre to centre with a minimum height of 1250 mm. The thermally insulated transition duct, supported from bottom, to be connected to horizontal rectangular duct outside the chimney shall be suitably profiled to circular shape up inside the chimney through suitable (nonmetallic) fluoroelastomeric fabric expansion joints. External platforms shall be of RCC with pipe-galvanized handrail. Chimney roof shall be of RCC slab with rainwater drainage system over a grid of structural steel beams. An internal structural steel staircase with grating floor panels and handrails of tubular section shall be provided for full height of the chimney and internal ladder for a small height, over last staircase		

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landing, to access the chimney roof through a roof access hatch. The inside surface of the chimney shell above roof, horizontal surface of the shell at top, underside of roof slab, inside and outside surfaces of mini-shell, top exposed surface of external platforms etc shall be painted with acid & heat resistant black bituminous paint conforming to IS:158 (not less than four coats). Total dry film shall not be less than 150 micron. The entire outside surface of chimney shell shall be painted with alternate bands of signal red and bright white colours, out of which top 50 M shall be painted with acid & heat resistant polyurethane paint and rest of the outside surface shall be painted with synthetic enamel paint. The other components of the chimney include cast iron caps, liner test ports (for continuous pollution monitoring), liner hatches, grade level slab of RCC with metallic hardener floor finish, a large electrically operated grill type rollup door at grade level and personnel access metallic doors at all floors, roof drain basin, rain water down comer pipe (150 mm dia galvanized pipe), connection to plant drains, louvers with bird screens for ventilation openings and all gaps in the wind shield, galvanized mild steel discrete strake embedments, painting of balance chimney shell surfaces and painting/coating of all structural steel works and miscellaneous ferrous components (for a maintenance free life of at least ten years), all finishing works, electrical power distribution boards, lighting panels, power and control cabling and wiring systems. stair and platforms lighting, socket outlet, lightning protection and grounding system, aviation obstruction lighting, communication system, a rack and pinion elevator, chimney emission monitoring system analyzer panel room and other items of work, though not specifically mentioned but reasonably implied and necessary to complete the job in all respects. (b) Design Requirements (i) Design and construction of various components and systems of the chimney shall be in accordance with relevant Indian Standard and where provisions are not covered in IS, reference shall be made to ACI, BS, CICIND and other international standards. In case of any conflict between this document and the Indian and International Standards, the stipulations of this document shall prevail. Imposed loading for design of all		

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	chimney components shall not be less than 5 KN/Sqm. Additional 25% of liner load shall be taken as impact loading for liner erection. Deflection of girders shall not exceed span/ 325. The min. thickness of web for girders carrying the load of steel flues shall be kept as 12 mm. Seismic forces on the chimney system shall be as per site specific seismic information & IS : 1893-2002. Wind forces on the chimney system shall be determined in accordance with IS: 875 (relevant part). The chimney and its components shall be designed to resist the most onerous forces resulting from all the possible combinations of the various loadings. Design of all chimney components shall be based on working stress method. Design check by the limit state method may be carried out additionally, if so desired by the supplier and/or asked for by the Owner/Owner's Consultant. (ii) Wind Shield The windshield shall be designed for vertical loading, cross wind loading, seismic loading, circumferential wind loading, thermal gradients. The various loading combinations shall be as detailed in IS: 4998 (Part-I) 1992 & the permissible stresses shall be as per IS: 4998 (Part-I), 1975. The windshield shall be analyzed for cases with and without flue liner loads. Forces/ stresses in the wind shield due to eccentricity effects of local (e.g. corbel) loadings, insulations effects, rotation of chimney foundations, construction tolerances and moments of second order shall also be considered. Seismic response of the chimney shall be computed by the response spectrum method. At least, the first five modes of vibrations shall be used for this analysis. The crosswind analysis of the chimney shall be carried out irrespective of the value of the Scruton Number for the chimney and other empirical considerations, which suggest structural immunity to cross wind oscillations. The effect of the openings/ cut-outs in the shell wall shall be duly considered in the design of the windshield. The minimum vertical reinforcement shall be 0.3% of the concrete area. The maximum spacing of the reinforcement bars shall not be more than 250 mm on each face. The minimum circumferential reinforcement shall be 0.2% of the concrete area. The circumferential reinforcement in the top 3	

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	meters of the windshield shall be twice that required from design forces. The maximum spacing of the reinforcement bars shall not be more than 200 mm on each face. The clear cover to shell reinforcement shall be 50 mm & for raft it shall be 75mm. Grade of concrete for chimney shell, and other super structure shall be minimum M 30. The final design will be checked & verified by 'Wind Tunnel Test' and shall be conducted at a reputed institution. Dynamic interference effects due to additional chimney (s) located in the area or in the future expansion shall be determined along with the other topographical features of the local area through model test. (iii) Steel Liners The flue diameter shall be so sized to ensure that the flue gas exit velocity meets the environmental regulation requirements. Two manholes placed diametrically opposite shall also be provided in the flue at all platform levels. The supporting/restraining arrangements of the liners should be such that expansion of the liners longitudinally or circumferentially is not restrained. The liner thickness shall be determined from structural and corrosion potential considerations. However, the minimum thickness of the liner, determined from structural conditions alone shall not be less than 6 mm and the corrosion allowance adopted shall not be less than 2 mm. Therefore, minimum installed thickness of the mild steel liners shall not be less than 8 mm in any case. The portion of liner with stainless steel shall be provided with a grade of steel conforming to the requirements of AISI type 316 L or equivalent and the minimum thickness of the stainless steel liner shall be 8 mm. The bidder shall test all welds in the presence of OWNER to meet the following requirements	

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a. The bidder shall test at random at least 10% of the butt-weld by radiographic/ultrasonic testing method. b. At least 10% of the fillet welds shall be tested at random by dye penetration tests. c. 10% of the root welds for butt-welding shall be tested at random by dye penetration tests. All tests shall be conducted in the presence of the ENGINEER- IN -CHARGE. If any test fails, the weld shall be cut out, remade and retested to the Engineer's satisfaction. (iv) Miscellaneous systems The other electrical components/systems of the chimney like electrical power supply system, distribution boards, lighting panel/transformers, socket outlets, power & control cabling, cabling raceway systems, normal & emergency lighting system in stair, platform & shell, lighting protection system, grounding system, stack elevator, gas sampling ports for measuring concentration of particulate matters, NO_x & SO_x in the flue gas etc. shall be supplied & installed as per the approved Drawings /Documents. (v) Transition Ducting The duct work profile and the guide vanes shall be so configured and sized to achieve the desired flue gas flow characteristics and to minimize flue gas pressure losses. The duct work and its supporting structures shall be designed for the most onerous of the possible combinations of gravity loading (accounting for ash accumulation), seismic loading, flue gas pressure loading and thermal loading. Like in the case of steel liners, the minimum thickness of duct plates shall not be less than 10 mm in any case from structural condition and corrosion allowance point of view. Clean-out door shall be provided below the each flue for the removal of ash.		

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(vi) Stainless steel Liners Stainless steel liners shall be provided up to a minimum height of 5 m above the roof top. (vii) Internal Platforms The interior platforms shall be provided at intermediate levels. Distance between two platforms shall not be more than 40M. The platforms for the steel flue chimney include a grillage of M.S. beams provided for supporting the roof slab, supporting the flue cans, restraint platforms for flues and for access within the shell. Except for the roof slab, all the platforms shall be provided with M.S grating. The platforms shall be designed for self weight vertical/horizontal liner loads and a live load of 5 kN/m². The members of the beams grillage shall be assembled by high precision bolted connections only. The member dimensions shall be made to suit with the as built conditions within the wind shield. The grating shall be fabricated from M.S. flats comprising of 25x5 thick bearing bars spaced at 25mm c/c and 12x5 thick space bar. The grating shall be hot dip galvanized and shall be procured by the contractor. The Hand railing shall be of medium quality 32 mm NB GI pipe conforming to IS 1161 in 3 rows with railing post of 40 mm NB GI pipe spaced at approximately 1300 centre to centre. Hand railing shall be provided for all platforms. Handrails shall be provided with kick plates along the platform edges. Hand rails shall be provided at all staircase ladder access points.		

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(viii) External Platforms External Platforms, with a clear walking space of not less than 1000 mm, shall also be provided along the chimney height to match the levels of the internal platforms. Suitable provisions shall be made in the shell for enabling access to the external platform for inspection and maintenance of external surface of the chimney. 32 mm dia GI drainage spouts shall be provided in external platforms for drainage of rainwater. (ix) Internal Staircase The staircase shall have a clear passage way width of not less than 900 mm. The risers and treads shall not be more than 150 mm and 225 mm respectively. The staircase shall be supported on steel frame work independent of shell with all members connected with suitable bolted connection only. (x) Soot Hopper Soot Hopper shall be of MS and lined with acid resistant brick work of minimum 75mm thick in acid-resistant mortar. Only shaped acid-resistant bricks shall be used. Laying and joining shall conform to the requirements laid down for acid-resistant brick lining. In addition to the above, insulation layer of minimum thickness 50 mm shall be provided on the external face of the hopper and suitably covered with aluminum foil of minimum thickness of 1 mm. The acid resistant bricks shall conform to Class-I of IS-4806 and the mortar for this brickwork shall conform to IS: 4832 part-I Silica type with potassium silicate liquid binder. Curing of mortar joints with 25% dilute HCl shall be done for a minimum thickness of 1 mm. The acid resistant bricks shall conform to Class-I of IS-4806 and the mortar for this brickwork shall conform to IS: 4832 part-I Silica type with potassium silicate liquid binder. Curing of mortar joints with 25% dilute HCl shall be done for a minimum		

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of three days and as per Manufacturers recommendation after which exposed face shall be thoroughly cleaned. At the bottom of the hopper, a flanged pipe of specified diameter and length shall be welded. Inside of this pipe sleeve shall be coated with sodium silicate. (xi) Foundation and Shell The chimney foundation shall be designed for the most critical combination of forces and moments, resulting from all possible combinations of the various loadings from the chimney system during all stages of constructions. However the following minimum requirement shall be adhere to: - Minimum of depth of top of foundation shall be based on geotechnical report. - Minimum thickness of raft shall neither be less than 0.09 times dimension of raft or 0.3 times the overhang of the foundation beyond shell whichever is greater. - The raft/pile cap shall be designed as rigid member with uniform thickness and no tapering of this shall be allowed. A circular raft/pile cap foundation, preferably annular shall be provided. The effect of water table shall be considered and the foundation shall be checked for overturning for minimum and maximum vertical loads. There should be no uplift under any portion of the foundation for any loading condition. Since chimney is a wind sensitive structure, no allowance shall be made in the load carrying capacity of the bearing strata/piles under wind loading. No allowance shall be made in the stresses for design of foundation in seismic loading. The design conditions for the concrete shell shall be as follows:		

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	a. The concrete shell shall be designed for natural phenomena and loads combinations as specified. Working stress method shall be used for design of shell. The modular ratio shall be calculated as per Annexure –B of IS 456-2000. b. The concrete shell shall support all platforms, which in turn provide support for three independent liners. The beams supporting the platform shall be made to rest on the shell by making a pocket in the shell. Below steel beam and above concrete surface, electrometric bearing pads are to be provided. Individual pads for separate floors are to be designed against temperature load and horizontal shear due to seismic loads. c. The permissible stress in concrete and reinforcement shall be limited to as specified. The stress in concrete at the junction of shell and foundation will be limited to $0.32 F_c$ where F_c is the characteristic compressive strength of weaker concrete between shell and foundation. d. The thickness of RCC shell shall be provided as required by stress calculations, however, the thickness of shell has also to be determined on the basis of wind tunnel model studies and any increase in the thickness of shell or quantities required to be made as per report shall be followed without any extra cost. e. The maximum deflection at the top of the chimney for both static and dynamic cases shall not be more than $H/500$ where H is the total height of the windshield above top of the pile cap. f. The dynamic modulus of elasticity of concrete for various concrete grades shall be taken as lower values in the range of values specified in IS: 4998 (part –I) –1992.	

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	g. The static modulus of elasticity of concrete shall be taken as under: $5000 \sqrt{F_{ck}}$ for instantaneous loadings where F_{ck} is the characteristic compressive strength of concrete as per clause 6.2.3 of IS: 456-2000. h. Minimum thickness of the shell shall not be less than 400 mm. Reinforcement in the shell shall be provided as per IS: 4998 (Part – I) – 1975. However, the maximum spacing of reinforcement shall not be more than 250 mm both ways in the shell. (xii) Thermal Insulation The insulation shall be semi-rigid, resin bonded type, in the form of slabs and shall conform to IS: 8183. Blanket type insulation shall not be used. The density of insulation shall not be less than 80 kg/cu.m for resin bonded glass wool insulation and 100 kg/cu.m for resin bonded rock wool. The insulation thickness shall be determined based on the maximum ambient temperature, surface air velocity worked out based on the draught of ventilation air in the annular space between the flue liner and chimney shell, insulation surface emissive of 0.3 and the insulation cold face maximum temperature not exceeding 55° C. The draught of air in the annular space shall be the natural draught created by the heating of air by the flue liner and the air being vented out through the openings in the chimney shell. The increase in the annulus air temperature due to the rising heated air shall be taken into account while calculating the insulation thickness. The insulation thickness shall not be less than 100 mm, in any case, and shall be provided in two layers with the second layer of insulation covering the joints of the first layer. The insulation shall be wrapped on the outer-most surface with galvanized wire mesh.	

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The design of the steel flue shall be as per the requirement of "Task committee report on steel chimney liners, ASCE, New York 1975" and the insulation shall be adequate to ensure the temperature rise in the annular space is less than 5 °C above outside air temperature. 4.6.2 Codes and Standards (a) IS:456-2000 : Code of practice for plain and Reinforced Concrete (b) IS:4998 (Part 1-1992) : Design Criteria for Reinforced Concrete Chimney (Read in-conjunction with IS 4998 Part-I -1975.) (c) IS:875 (Part 1 & 3-1987 : Code of Practice for Wind Load (d) IS:1893,2002 (Part-1 & IS : Criteria for Earthquake Resistant Design of Structures. 1893 - 2005 Part-4) (e) IS:432 (Part-I) : Mild steel and Medium steel Bars (f) IS:1786 : Cold twisted steel bars for Concrete Reinforcement (g) IS:800 : Use of Structural steel in general Building Construction (h) ACI Standards (i) Reference may also be made to ACI: 307 "Specification for design and construction of R.C. Chimney" if some items are not covered in India Codes. 4.6.3 Materials To Be Used Chimney foundation shall be in concrete grade M-25 with minimum cement content of 365 kg/m³. Chimney shell shall be of min. concrete grade M-30 with minimum cement content of 400 Kg/m³. The cement shall be 43 grade		

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OPC. Reinforcement shall be Fe- 500 steel. Only one grade of concrete shall be used throughout the height of the shell. 4.6.4 Loading on the Structure and their Combination (a) Dead Load All permanent loads due to the weight of chimney shell, internal platforms and linings supported on them, flue ducts, staircases, ash hopper, elevators & other accessories, etc. (b) Imposed Loads (i) Imposed load on service platform around Chimney shell, shall be taken as 500 kg/m². Design live load during construction/ erection shall be considered as 1000 kg/m². (ii) Imposed loads from duct joining the Chimney shall be considered. (c) Wind Load The wind loading shall conform to IS: 875 (Part-3): 1987. Dynamic analysis shall be carried out and stability ensured under such condition. The details shall be as per the design basis. Wind parameters shall be considered for calculating design wind speed and pressure shall be as follows: Basic wind speed = 39 m/s (Up to 10m above normal ground level) K1 = 1.07 as per IS: 875 Table-1 K2 = (Table 2, Category-2, Class-C) The final design will be checked and verified, as per wind tunnel test, by a reputed institute and if needed, modifications to be carried out at no extra cost.		

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(d) Seismic/Earthquake Load Earthquake forces acting on the Chimney and analysis for the same shall be carried out as per IS: 1893 (Part 1 & 4) using the Response Spectrum Method and 5% damping shall be considered for the analysis. The importance factor of 1.75 shall be used. The analysis shall be furnished for a combination of five modes (minimum). (e) Thermal Effect The vertical and circumferential thermal stresses are developed. These stresses induced in the concrete shall not exceed values given in IS: 4998. (i) Flue Gas Data: To be supplied by Boiler manufacturer and got approved from the owner before starting chimney engineering. Recommended Exit gas velocity at top of the Chimney (Total height of the Chimney above grade level shall be 275m) = 25 m/s Parameters : (a) No. of Boilers : One (1) (b) Maximum ambient temperature : 47.8° C. (c) Minimum ambient temperature : 3.9° C. (d) Top of foundation : 2.0m below grade level (min) (e) Allowable Soil Bearing capacity (NETT) (Additional soil investigation to be carried out) : Ref : Soil Report (f) Minimum top internal shell diameter : To suit exit velocity (25m/s)		

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(g) Minimum bottom internal : Bidder to decide shell Diameter The temperature gradient ΔT across the shell thickness will be calculated as per IS: 4998 (Part-I) – 1975 but subject to a minimum of 30°C. Temperature stresses will be calculated according to the procedures given in ACI-307 and IS: 4998 (Part-1) - 1975. Vertical and circumferential reinforcement shall be provided for temperature stresses. (f) Local Loads The effect of following local loads is considered: (i) Local moment produced by corbels (if any). (ii) Local moment due to platforms. (iii) Local moment due to occurrence of ovaling. (iv) Local moment produced by thermal gradient. (g) Load Combination Various load combinations for calculation of stresses shall be as under: (i) Dead load + Wind load (ii) Dead load + Earthquake forces. (iii) Dead load + Temperature effect. (iv) Dead load + Wind load + Temperature effect. (v) Dead load + Earthquake force + Temperature effect. (vi) Circumferential stresses due to temperature effect.		

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(vii) Circumferential tensile stresses due to wind inducing ring moment. (viii) Circumferential compressive stress due to wind induced ring moment combined with temperature In Load combinations (i) to (v) above, dead load considered shall be with or without the weight of lining, whichever condition is more critical, shall be adopted for design. Across wind loads shall be combined with co-existing along wind loads. The combined design moment at any section shall be taken as SRSS of the moments due to across wind loads and co-existing along wind loads. 4.6.5 Permissible Stresses For Chimney Shell The stresses in steel reinforcement and concrete shall not exceed the limits as prescribed in clause 7.0 of IS 4998 (Part I)-1975 for various combinations of loads. Except for case of dead load + wind load the maximum permissible stress in concrete in this case shall not exceed 0.32 FC where FC= Characteristic compressive strength of concrete in kg/cm². 4.6.6 Analysis 4.6.6.1 Free Vibration Characteristics of Shaft Calculation of Natural Frequencies and mode shapes shall be carried out. For this purpose the chimney shaft shall be idealized as a vertical cantilever with lumped masses at different nodes. The nodes shall be provided at each platform level. Minimum 5 mode shapes shall be considered. 4.6.6.2 Wind Analysis (a) Along Wind or Static Analysis The basic wind speed V_b at Bhusawal according to IS 875 (Part-3) – 1987 is 39 m/sec. The terrain category is 2 with K₁ = 1.07, K₂ as per		

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table 2 of IS-875 (Part-3) 1987 for class C structure and K3 shall be determined by taking into near by plant. The “gust factor” will be calculated according to the method given in IS-4998 (Part-1) – 1992. Dynamic modulus of Elasticity of concrete as recommended in IS: 4998 (Part-1) 1992 will be used for calculating the natural frequencies of the chimney. C_d will be taken as 0.8 for the concrete shell in general. It will be increased as per table-1 of IS: 4998 over the portion covered with strakes, if required. Along wind response of chimney shall be calculated both by gust factor method in A-5.1 and simplified method in A-4.1 of IS: 4998 part-1, 1992. For design, higher of the along wind loads shall be used. (b) Across Wind The across wind response of the Chimney will be evaluated as per the method given in Section A-4 as well as A-5 of IS: 4998 (Part-I)-1992. C_L will be taken as 0.16 and $S=0.2$. Higher of the two moments shall be considered for design of the Chimney. (c) Ring Moments Due to Wind The circumferential ring moment due to wind will be calculated in accordance with clause 5.4 of IS: 4998 (Part-1) –1992. The wind induced stresses in concrete and steel shall be calculated in accordance with cl no D-2.2.7, D-2.2.8 and D-2.2.9 of IS 4998 (part 1) –1975. 4.6.6.3 Seismic Analysis The Seismic Analysis will be carried out using the response Spectrum Method according to IS: 1893 taking the first 5 modes of vibration into account. Bhusawal is in Zone III of IS 1893. The importance factor of 1.75 and 5% damping shall be considered for the analysis.		

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4.6.7	Soil Data and Bearing Capacity All recommendations for soil data are to be considered as per soil report and specifications.	
4.6.8	Galvanised Steel Strakes Based on actual parameters, arrived at after detailed analysis and design, aerodynamic studies shall be carried out. The arrangement of the galvanized steel strakes, if needed, shall be decided, based on these studies.	
4.6.9	Outer Platforms	
4.6.9.1	Number of outer platforms to be provided are governed as per the requirements of aviation obstruction lights which are required to be provided at various levels so as to meet the requirements of IS: 4998 (latest edition). I.C.A.O. regulations and instructions issued by the Director General of Civil Aviation.	
4.6.9.2	The minimum clear width of the platforms shall be 1000 mm and a live load of 500 kg/m ² shall be considered for their design.	
4.6.9.3	At 270 m level platform, on upper surface 20 mm thick acid resistant tiles conforming to IS: 4457 over water proofing shall be provided, using acid resistant mortar conforming to IS 4832 Part-I. The average thickness of mortar bed shall be 10 mm and it shall be sloping outwards.	
4.6.9.4	Hand railing shall be provided all around external platforms, including hood platform using 32 mm G.I. pipes. The spacing of railing posts shall not be more than 2000 mm centre to centre. The height of hand railing shall not be less than 1250 mm. There shall be three handrails at about 450 mm and 850 mm & 1250 mm respectively above platform level.	
4.6.9.5	32 mm dia. G.I. drainage spouts shall be provided in platforms for drainage of rain water.	
4.6.9.6	150 mm dia MS (galvanized) RWDC pipe conforming to IS 4985 shall be provided to carry rainwater from Hood platform to discharge point at ground level. The number of down take pipe shall be decided as per design.	

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4.6.10 Enclosure Walls 4.6.10.1 Reinforced concrete walls shall be provided at grade level around staircase and elevator to make the enclosed space airtight and free from ash and dust for the comfort and safety of personnel who are required to go inside the chimney for maintenance and inspection purposes. 4.6.10.2 All materials to be used and design of wall shall be as per relevant I.S. Codes. 4.6.11 Roll-Up Door 4.6.11.1 A rolling steel chain operated door of size 4.0m x 5.0m shall be installed at the base of the chimney shell so that a truck could go inside the chimney in case of emergency. The door shall be installed complete with guides hood hardware, weather baffles combination end locks and wind locks mechanisms and accessories, as required for proper operation and weather protection. The complete details of rolling shutter shall conform to IS: 6248 (latest edition) "Metal Rolling Shutters & Rolling Girds" and to these specifications. 4.6.11.2 The door shall be installed in accordance with the details and the manufacturer's directions. When installed, the door shall be free from warp twist, or distortion and shall be lubricated and adjusted to operate freely and smoothly. 4.6.12 Personnel/ Access Doors 4.6.12.1 A steel personnel door of size 1200 x 2100 shall provide access to the chimney at grade level. 4.6.12.2 Personnel doors of size 1200 x 2100 shall be provided for access to each airtight enclosure at grade level inside the chimney (i.e. enclosures for staircase and elevator) and also in chimney shell at external platforms levels so that civil aviation lights mounted on these platforms could be approached for maintenance and replacement purposes. 4.6.12.3 The doors shall be hinged and provided with positive locking device. The hinges required for connecting the door with door frame shall be either heavy		

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	weight. Butt Hinges conforming to IS: 1341 (latest) "Steel Butt Hinges & Strap Hinges". The size and number of hinges required for each door shall be decided as per the overall weight of the door and it shall be ensured that door shall remain in its perfect position after installation under service conditions. The minimum size of the hinges shall not be less than 150 mm. 4.6.13 Inspection/ Maintenance Doors 4.6.13.1 Two steel leak proof doors of size 750 x 1000 mm and 750 x 600 mm shall be provided diametrically opposite in each steel liner at all those levels where external platforms are provided. 4.6.13.2 Proper sealing arrangement using asbestos ropes shall be provided in the doors so that there is no leakage of flue gases from steel flues into the annular space between liners and shell through these doors. 4.6.13.3 The doors shall be constructed of two outer sheets not less than 6 mm thick mild steel, reinforced inside with steel stiffeners not more than 600 mm centers. Hollow space between two plates shall be filled up with insulating material such as bonded glass wool/ mineral wool. The doors shall be hinged and shall be provided with locking device such as swivel studs with wing nuts. 4.6.13.4 All surfaces of doors & frames internal as well as external shall be painted with one coat of primer and finish painted with two coats of acid and heat resistant paint. 4.6.14 Hatches 4.6.14.1 A mild steel hatch shall be provided as an access to the hood of the chimney. 4.6.14.2 The hatches shall be constructed of two outer sheets not less than 3 mm thick mild steel, reinforced inside with steel stiffeners not more than 600 mm center. In addition, they shall also be designed to withstand a live load of 300 kg/m². 4.6.14.3 Hatches shall be painted with one coat of primer and finish painted with two coats of acid and heat resistant paint on both sides.	

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4.6.14.4	Other requirements with regard to design and construction shall be same as for Personal/access doors.	
4.6.14.5	The hatches shall be flat type and shall be operational upwards. They shall be provided with locking arrangements from under side for the hatch for hood.	
4.6.15	Bearings A fully moulded electrometric bearing shall be provided to accommodate thermal movements and to provide a suitable distribution of load between liner support platform beams and the platforms.	
4.6.16	Elevator It is required to accommodate the elevator and staircase within the R.C.C. shell. The travel of the lift shall be upto the last but one platform which shall be about +270 m from 0.0 m level. Detail specification of elevator in chimney structure is mentioned in relevant volume.	
4.6.17	Flue Openings And Duct Work The concrete shell at flue duct entry shall be adequately protected against high temperature by cast able refractory lining and the gap between the shell and duct shall be properly sealed off by asbestos/or any other suitable seal. The openings in the windshield shall be sufficiently reinforced to withstand design loads. Similarly the openings in steel flues shall be properly reinforced for receiving the flue ducts. The R.C.C. shell shall provide support for duct work from the expansion joint to the chimney liner. Exposed ductwork shall be insulated and lagged to protect equipment & prevent injury to personnel. The insulation and wire mesh shall be secured to the lagging by means of pins or prongs welded to the exterior sheet and spaced on intervals not exceeding 450 mm in both the directions. The insulation shall be impaled over the pins or prongs, wire mesh applied over	

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the insulation and the insulation and mesh shall be held in place with speed clips. 4.6.18 Chimney Painting The entire inner surface of shell for full height shall be painted with acid and heat resisting black impregnated bit mastic paint(not less than four coats)to give a paint DFT not less than 150 micron. The entire outside surface of concrete shell shall be painted with alternate bands of signal red & white colour, out of which top 50m shall be painted with acid heat resistant paint and rest of the outside surface, shall be painted with synthetic enamel paint conforming to IS: 5410. All structural steel works inside chimney such as internal platforms, stair case, ladders etc. excluding grating, flue, treads of stair shall be painted with 2 coats of zinc phosphate 2 pack epoxy primer, DFT 50 microns per coat, applied on dry surface cleaned by sand blasting & two coats of two pack Epoxy finish with micaceous iron oxide pigments having DFT 75 microns for each coat. 4.6.19 Specific Construction Requirements 4.6.19.1 Concrete (a) Batching of concrete For controlled concrete, only weigh batching shall be allowed. All concrete ingredients except water shall be batched by weight, using an approved make of weigh batcher. Batching shall be accurate to 1/2 Kg. The batcher shall be tested for accuracy of calibration, first before commencement of work and at least once a fortnight or as directed by the Engineer thereafter. Water shall be batched by weight or by volume measures, as approved by the Engineer. (b) Construction Joints In concreting the chimney shell, one full ring lift shall be completed in a day's pour. Before the formwork for the following pour starts, the		

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horizontal surface of the Chimney shell shall be chipped, cleaned and washed with water, and when the formwork is complete, the surface shall be cleaned and washed again and covered with 1:2 sand cement slurry before fresh concrete is placed. The horizontal construction joints shall be so arranged and made that they are regular and neat. No vertical joint shall be allowed. No separate payment shall be allowed to the Contractor for forming joints or chipping and cleaning them or cover with slurry prior to concreting. The number of construction joint shall be kept minimum and the spacing should not exceed three (3) meters. The Contractor shall submit to the Engineer, any proposal of providing construction joints to facilitate his work, for the study and approval of the Engineer well in advance. 4.6.19.2 Construction by Slip-Form Method (a) Slip Form The RCC shell of the chimney shall be constructed by using slip form technique. The slip form shall consist of a central ring and tower system. Normally the slip form shall be of radial beam system having two levels of beams, upper and lower level beams, radiating out from the central ring beams to the slip form yokes equally spaced around the circumference of the structural wall. The lower beams shall be made up of hand able standard unit trusses bolted together to make up the required start diameter. To accommodate the wall taper the beams are shortened by removing units as the slide proceeds. The bottom beams shall be further supported by under trussing. A Radial Control gear by which the radius of the concrete shell is controlled shall be attached to the outer ends of the upper and lower beams. This shall be activated automatically or manually linked to the upward movement. The slip form shall preferably have at least two working platforms at lower radial beam level as a main working deck and for access to the hoist cage and at the upper radial beam level as a control point for the radial and batter adjustments at the yoke positions.		

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	Access to the shutters and to the concrete surface shall be provided by a circular platform under the lower radial beam for the inner surface and by a three level circular platform supported from the outer yoke post for the outer surface. A special safety net consisting of man carrying mesh with a smaller mesh for materials shall be provided to envelope both the outer platforms and the inner hung platform. Shuttering shall be of standard lap sheets hung from high tensile steel rod walers, threaded through holes drilled in the yoke posts. Steel embedment, chases and openings as per approved drawings shall be fixed or formed in the shell where steel frames are used for openings, they shall be rigid, reassembled and fixed in position. For small openings wooden frames may be used. The spacing of jack rods shall not be more than 1 m or as approved by Engineer. The jack rods shall be left (no retrieval of jack rods is allowed) in concrete and they shall not be figures as reinforcement. Jacks used in Hydraulic Jacking system for slip form shall conform to relevant Indian Standards. An accurate height measure shall be installed. The Contractor shall furnish with his bid complete details and literature of the slip form he proposes to use for the concreting of the shell. The Contractor shall be responsible for the safe operation of the slip form and the safety of the labour, supervisory staff, others during the concreting of the shell by providing hand railing around the platforms, lighting (500 to 1000 lamps with reflectors shall be provided, fixed on scaffold tubes attached to the yokes, 3m to 4.5 m above the working deck and 4.5m to 6 m apart), Intercom arrangement, etc. In case of power failure, battery operated emergency lights on working deck shall be provided.	

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The Contractor shall also provide all arrangements like hoists, winches, chutes etc. required for the transport of the materials to the working platforms. Ambient temperature and the resultant impact on the concrete temperature at the time of placement shall be taken into account while deciding the speed of the slip form. If slip forming is to be carried out in summer, (May to September) slip-forming speeds up to 250 mm per hour may be used. In case lesser values are contemplated, retarders conforming to relevant Indian Standard Codes and approved by the Engineer shall be used. The Contractor shall ensure that no dragging of concrete with the upward movement of the slip form shall occur. Twisting in the horizontal plane of the slip form assembly and tilting. In the vertical plane of the slip form assembly shall not be allowed. The Contractor shall be responsible for any such occurrences and he shall have to make good for these as per the directions of the Engineer at no extra cost. The minimum compressive strength of concrete immediately below the bottom of the form panel as the slip form proceeds shall under no circumstances be less than 1.5 kg/cm². The Contractor shall submit to the Consultant/Owner within two months after the award of the work, a construction methods statement indicating the following in his statement: (i) Description of equipment for slip forming and for concreting operation. (ii) Structural analysis regarding the adequacy of slip form equipment. (iii) Standby arrangements for equipment. (iv) Requirement of quantity of materials for each stage of construction.		

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(v) Planned manpower for operation and supervision. (vi) Planned rate of slip forming and details of concrete mix. (vii) Planned interruptions. (viii) Description and frequency of dimensional and verticality checks. (ix) Description and frequency of tests for concrete and raw materials. (x) Methods of preparing, transporting, pouring and vibrating and finishing concrete. (xi) Contingency solutions for rectification of probable defects during slip forming. (xii) Plan of operation during planned interruptions including retrieval of jack rods, resetting of from panels etc. (b) Tolerances The permissible tolerances should be as per IS specification. (c) Precision instruments using laser beams (minimum 2 nos.) shall be used for maintaining the formwork in required axis and for carrying out various checks. (d) Precision instruments like optical plummet to monitor the tilt and twist in the vertical plane and horizontal plane respectively shall also be provided. (e) Sufficient anchorage shall be provided for the slip form structures in the initial stages of work against wind pressure till the jack rods are embedded enough to take grip.		

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4.6.19.3 Chimney Steel and Metal Work All workmanship shall be of best practice in modern structural shops, and shall conform to the provisions of the IS: 800 and other relevant IS Specifications, unless otherwise specified. 4.6.19.4 Galvanizing All steel including threaded bolts, nuts and washers, unless specified otherwise in contract, shall be hot dip galvanized in accordance with IS Specification or American Society for Testing and Material Specification ASTM 123. All members to be galvanized shall be cleaned thoroughly, to the satisfaction of the Engineer, by the process of pickling. Pickling shall be carried out in an acid bath containing sulphuric or hydrochloric acid of suitable and adjusted concentration and temperature. Pickling process shall be completed by rinsing the members thoroughly in warm water. Galvanizing shall be carried out by hot dip process in a proper and uniformly heated bath and it shall meet all the requirements when tested in accordance with IS: 2633. The zinc coating shall be of uniform thickness with an acceptable minimum value of 610 gms/m² for structural steel. If the galvanizing of any member is damaged, the Engineer shall be shown the extent of damage and if so directed, the galvanizing may have to be redone in the similar manner stated above. 4.6.19.5 Erection Erection of structural members and C.I. Chimney caps shall be done as per requirement of IS: 800. The Contractor shall submit to the Engineer a programme of erection for his approval. All plant, equipment, tools, tackle and any other accessories required for the erection shall be provided by the Contractor. Storing and handling of fabricated materials for erection, setting out of members, providing temporary supports, bracing, fasteners, bolts, nuts etc. shall be the responsibility of the Contractor and shall be taken into account in quoting the rate.		

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4.6.19.6 Insulation and Packing All packing and insulation material shall be of thickness, diameter and type as per design requirement. The packing and insulating material shall be made of asbestos rope, vermiculite concrete, slag or mineral wool and asbestos mill-boards. (a) Asbestos Rope The diameter of the rope shall be as per drawing. The material shall be of best quality available in the market and shall be purchased after a sample is approved by the Engineer. The rope shall be plain, Grade-I, conforming to IS: 4687-1968. The strand shall be long, well twisted and no torn thread shall stick out. The rope shall be firmly packed so as to prevent gas leakage. (b) Slag or mineral wool The thickness of packed slag wool shall be as shown in the drawing. The packed density of the wool shall be within the range of 175 to 200 Kg/m³ and the co-efficient of thermal conductivity shall be within the range of 0.025 to 0.035 kcal/hr.m.°C at a mean temperature of 150°C. The material shall be well packed in position where possible. IS: 3677 for Rock and Slag wool mats for thermal insulation may be referred for guidance. The co-efficient of thermal conductivity and packed density shall be tested according to IS: 3677 and IS: 3346. (c) Vermiculite Concrete Vermiculite concrete shall be made by mixing exfoliated vermiculite, Portland cement and water. It shall be of Grade-B, having a density of 210 Kg/m³. The vermiculite aggregate size shall be maximum 6 mm. The mix shall be 1 cement and 8 vermiculite by volume. (d) Asbestos Mill Board Asbestos mill board shall be of thickness as per design requirement. It shall be of best quality of standard make available in the market and samples shall be submitted to the Engineer for approval. It shall be		

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plain, dense and homogeneous texture, without cracks, flaw and any other manufacturing defect. It shall be laid directly onto the concrete bed after removing any loose material or any aggregate. The concrete shall be prepared without mortar so that the board can have a good seating. 4.6.19.7 Information to be Submitted (a) After Award The following information and data including samples where necessary shall be submitted by the Contractor, progressively during the execution of the Contract. (b) Design Mix Design mix as per details of this specification giving proportions of ingredients, sources of aggregates and cement along with accompanying test results of trial mixes as per relevant IS Specifications shall be submitted to the Engineer, for his approval, before it can be used on the work. (c) Detail Drawings Following items shall be provided by the Contractor, which are to be approved by the Owner. (i) Detail drawings and designs of formwork including scaffolding to be used. If slip form method of construction is adopted, then detail drawings showing all the arrangements for slip form technique including methods for reducing internal diameter and providing required slopes on outer diameter. (ii) Detail drawings and bar bending schedules for concrete components. (iii) Shop drawings for steel and metal work, including inserts etc. (iv) Detail drawings for templates and temporary supports for		

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embedment. 4.7 <u>NATURAL DRAUGHT COOLING TOWER</u> 4.7.1 Intent of Specification A single Natural Draught Cooling Tower (NDCT) with dedicated cooling water basin, outlet channel, sludge removal sump and valve pit, etc. shall be provided for the 1 x 660 MW unit. This specification covers the requirements of design and construction of natural draught reinforced concrete hyperbolic cooling tower. This section of bidding document deals with the technical specifications for the design and preparation of detailed working drawings and getting them approved by the owner and civil construction works. The provisions of these technical specifications are general in nature and cover broad aspects. Technical specifications outline the minimum requirements. However, it would be the absolute responsibility of the contractor to collect, interpret, analyze all necessary information/data for the successful design and construction of the cooling tower. Structural safety and successful operation of the tower shall be the total responsibility of the contractor notwithstanding the approval of the owner. 4.7.2 Scope of Work The scope of this work shall consist of, but not limited to, the design and construction of reinforced concrete double curvature hyperbolic shell, raker columns, ring beams, foundations including piling work if necessary, cold water basin with partition walls, hot water ducts, drain sumps, external drain chamber with associated pipe work, cold water channels with slide gates and removable screens as specified elsewhere, hoists & monorails, primary and secondary hot water distribution troughs, fill support systems including columns & beams, drift eliminators (if required), testing of cold water basin for water tightness, external stairs, cage ladders, handling facilities at tower top with walkway platform and CW channel, platforms, walkways as specified or required for operation and maintenance, access doors, MS handrails, steel fittings, fixtures, inserts including fabrication, galvanizing and erection of associated steel work and other chemicals on the completed		

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structures etc. all complete as per functional requirements and as per directions of Owner. The scope of work under this specification shall include providing thermal design, structural engineering design and drawings, all labour, supervision, materials, shuttering and scaffolding, construction equipments including tower cranes, hoists, batching plants etc, tools and plant, supply and transportation of all incidental items not shown or specified but reasonably implied for successful completion of the work. The nature of the work shall generally involve foundation/piling, excavation, dewatering, shoring and strutting, backfilling around underground structures and plinth filling, sand filling, disposal of surplus soil outside plant boundary, concreting of grade as specified, formwork including automatic climb form, laser beam instruments, fabrication, galvanizing and erection of steel structures and inserts, finishing anchor bolts, RCC sump/duct, laying and testing of hot water pipe line, water proofing, providing PVC water stops and joint filters, drainage and other ancillary items connected with cooling towers as approved. The surface protection that would include all inner face of hyperbolic shell, raker column faces, inner faces of cold water basin, fill support structures, hot water distribution ducts & channels, cold water channels etc. This list is indicative and the scope shall also include the preparation and supply of all working drawings required for this work. 4.7.3 Cooling Tower Structure 4.7.3.1 The minimum clear distance between the two NDCT's shall be 0.5 times the base diameters as per BS 4485 (not applicable). 4.7.3.2 The cooling tower shell shall be hyperbolic paraboloid. The shell of the cooling tower shall be supported by a set of diagonal columns, which shall be supported by piles and a peripheral pile cap or open foundation as the case may be. 4.7.3.3 Hot water inlet shall be through a pair of MS pipes separately for each compartment of basin, suitably protected. The pipes shall have butterfly valves and also required numbers of thermowell with RTD, pressure and flow measuring instruments. Blow-down shall be tapped from the HW piping.		

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4.7.3.4 4.7.3.5 4.7.3.6 4.7.3.7 4.7.3.8 4.7.3.9 4.7.3.10 4.7.3.11 4.7.3.12	Separate piping for hot water inlet from ACW circuit into the NDCT shall be provided by the side of hot water inlet piping for CCW circuit. The ACW piping shall also have butterfly valves. Painting and protection of hot water piping shall be done as per relevant IS codes. By pass arrangement alongwith isolation valve for approximately 20% of total circulating water flow shall be provided from main Hot water C.W.Pipeline @ G.L to cold water channel including horizontal base plate at bottom of cold water channel. By pass arrangement alongwith isolation valve for 50% water flow from ACW pipe line to cold water basin shall be provided for each compartment of cold water basin. To control the hydraulic forces at the change of alignment of the hot water (HW) inlet pipe, a RCC thrust block shall be provided at ground level near the cooling tower along with suitable other supports for pipes above ground level including structural steel works. The hot water distribution shall be by RCC main and secondary ducts which carry the lateral distribution pipes fitted with nozzles for uniform distribution through the fill. The concrete main distribution ducts shall be accessible and are to be provided with non-corroding, pressure-sealed inspection openings. Cleaning and sludge-removal openings are to be included on each run at the end of the duct in the main distributor. The HW distribution arrangement shall be supported independent of the shell by internal columns supported on the floor of the cold water basin. The hot water main and secondary distribution ducts shall be designed for minimum 120% of design flow indicated in the specification with at least 150 mm free board. The profile of the drift eliminators is to be selected to ensure a maximum degree of precipitation and a minimum of air pressure loss. Access to the hot water distribution platform and further access to the shell top should be provided with two Galvanized Steel cage ladders.	

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4.7.3.13 The material used for access facilities including steel components for steps, ladders, platforms, catwalks, railings, doors, base frames, mountings, etc must be galvanized and resistant to corrosion. 4.7.3.14 All bolted connections and attachments to concrete must be made out of suitable stainless steel material. 4.7.4 The basin shall be designed with a free board of at least 0.3 m above maximum water level. The cooling tower basin shall be divided into two equal parts by watertight RCC partition for the cleaning and maintenance of one half while the other half is in service. Arrangements for water drainage shall also be provided. Suitable overflow arrangement (Vent of minimum width 600 mm), to maintain the maximum water level at 300 mm below the sill in both the compartments, shall be provided. Minimum 500 mm dead storage shall be considered above invert level of the basin i.e. minimum water level in the basin shall be at least 500 mm above invert level of basin bottom slab. The basin holding capacity shall be minimum 16 minutes between maximum & minimum water level. The bottom of the basin shall be provided with minimum slope of 1:500 towards periphery. The basin shall be provided with the peripheral drain of width 0.50 m with 1:400 slope towards drain sump. The size of drain sump shall not be less than 1.0 m x 1.0 m with required depth. 4.7.5 The cold water from the basin shall be taken out through an opening connected to the main CW closed Channel/duct, which in turn leads to a fore-bay of the CW sump. The cold water from the basin shall flow by gravity to open approach channel leading to the fore-bay. The cold water channel shall be provided with a slide gate. Suitable handling arrangements with a monorail and a chain-operated hoist with a travelling trolley shall be provided for handling of the slide gate. In front of the outlet structure, provision shall be made for de-sludging facilities so that sediments can be withdrawn from the basin. In order to clean the cooling tower basin, sludge drain are to be provided along its perimeter with suitable sludge sump of minimum size 1.0 M x 1.0 M, from where the sludge will be taken out to sludge box/chamber outside the basin for pumping out. The size of Box		

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	chamber out side shall not be less than 4.5 m x 2.0 m and shall be provided with suitable sump pits for sludge pumps. The chamber shall be provided with man hole cover not less than size 0.50 m x 0.90 m. Two number sluice gates of suitable size for 300 mm dia opening shall also be provided in the chamber to control the draining from the basin with hand wheel to be operated from the top. Two submersible sludge pumps shall be provided for the removal of sludge from the NDCT to ETP drain. All the drains shall be terminated in the ETP. Out side drain chamber bottom level shall be at least 1.00 m below the bottom level of the inside drain sump bottom level. The necessary drainage opening of at least 300 mm dia shall be provided on both the sides of partition wall. The bottom of the basin shall be provided with at least 1.0 m depression for the area not less than 15.0 m x15.0 m on each side of partition wall of the basin before the basin opening leading to cold water channel. Paving of minimum 2.0 m width with 150 mm thick RCC slab of M20 grade all around the cooling tower with gutter leading to drain chamber shall be provided. 4.7.6 Fill Supporting Arrangement The supporting of the fill is to be achieved by a series of RCC columns arranged in suitable grid spacing and RCC beams in orthogonal directions. Loads from fills, hot water ducts, pipes including water load, wall blocks, etc. shall be considered for column-beam design. To take care of horizontal loads due to seismic and thrust from hot water header, a suitable system of vertical bracings is to be designed and provided in either direction. 4.7.7 Concrete, which is impermeable to water, is to be used for all components, including reinforced concrete components. The composition of the concrete and the cement are to be chosen depending on the chemical analysis of the cooling tower water/cooling tower make-up water.	

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4.7.8 Aviation Obstruction Lights In accordance with ICAO regulations, aviation warning lights are to be installed on top of NDCT along its perimeter. Operating and reserve aviation warning lights are to be positioned next to each other. They are to be connected to completely separate power circuits and to be monitored by relays. Suitable photo-electric sensors, alarm and annunciation systems, etc. shall also be provided along with the required auxiliaries for completing the system in all respects. 4.7.9 Earthing and Lightning Protection A suitable system of earthing and lightning protection, including required hook-up with the plant grid/system, etc. shall be provided completely. All the electrical requirements, including cables shall be as per plant electrical specifications/ Drawings. 4.7.10 Guaranteed Particulars The contractor shall guarantee the following parameters: 4.7.10.1 Cold water temperature At the design point of the cooling tower, the cold water temperature guaranteed by the Contractor in accordance with the performance curve (cooling tower characteristic curve) shall be achieved. The fundamental parameter for the design value of the cold water temperature during acceptance measurement shall be that measured at the cooling tower basin outlet. 4.7.10.2 Drift losses At the design point, the total water mass flow entrained in the air shall not exceed 0.01% of the mass of water circulating. In case the drift eliminator packing is to be used for achieving the specified drift loss then, the same shall be provided by the bidder. If drift eliminators are provided then the drift shall be measured at the top of the drift eliminators.		

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4.7.11 Material resistance All materials (including building materials) are to be chosen and geared to each other such that no damage will be occurred as a result of operational exposure to cooling water. 4.7.12 Latest versions of the following codes and standards shall be used for conducting the performance tests: (a) DIN 1947 – VDI : Acceptance test code for water cooling towers (b) BS: 4485 : Specification for Water Cooling towers (c) BS: 1042 : Methods for the measurement of fluid flow in pipes (d) BS: 3435 : Measurement of electrical power and energy in acceptance testing (e) ASME – 19.5 : Supplements on Instruments and Apparatus 4.7.13 Contractor shall arrange for all the test instrumentation required for conducting the performance guarantee tests. All instruments used for testing shall be calibrated before the tests as per the relevant codes. Should the acceptance tests not produce the guaranteed values, the Contractor shall be granted the right to make improvements. The repeated acceptance measurements shall then be carried out at the Contractor's expense. 4.7.14 Materials All materials including cement, reinforcement steel & structural steel required under this bid shall be provided by the bidder. No materials shall be issued by the Owner.		

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4.7.15	Materials of Construction (a) Cooling tower basin : RCC (b) Cooling tower shell : RCC (c) Internal supporting structure, stair cases, etc. : RCC (d) Louvers / Baffles : RCC (e) Film Fill : PVC (f) Fill supports : RCC (g) Nozzles : Polypropylene (h) Drift eliminators, if any : PVC (i) Hot water inlet pipes : Mild Steel to IS 2062 (j) Hot water distribution system : AC/PVC (k) Distribution trough : RCC (l) Sluice gates : MS Galvanized (m) Side guides and mountings : SS 316 (n) Miscellaneous steel structures : MS Galvanized (o) Screens : SS-304	
4.7.16	General Requirements All Foundations shall be designed in accordance with provisions of relevant parts of the latest revisions of Indian Standards and according to geotechnical investigation report, approved by Owner. However for soil characteristics and parameters to be adopted in final design, the contractor is requested to do detail geotechnical investigation work as a part of the contract to verify/generate data so required.	

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4.7.17 It should be noted that nothing extra whatsoever on account of variation between soil data provided by MSPGCL & that found by detailed geotechnical investigation to be carried out by bidder shall be payable. General Design Criteria 4.7.17.1 Design data: (a) Quantity : One (1) (b) Type of tower : Counter flow with PVC film fill (c) Design inlet wet bulb Temperature : 27°C (d) Relative humidity : 40% 4.7.17.2 Design Consideration The cooling tower shall be designed for continuous operation. The hot water distribution system shall be designed to ensure equal distribution of heat load and flow all over the fill area. Wood/timber material shall not be used in any part of the cooling tower. 4.7.17.3 Loading The following loads shall be considered for the design of cooling towers: (a) Dead loads (b) Wind loads (c) Earthquake forces (d) Loads due to temperature and shrinkage effects. Temperature effects due to solar radiation shall also be considered.		

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(e) Construction load (f) Foundation settlement etc. (g) Any other load likely to come on cooling tower.		
4.7.17.4 Dead Load For assessing the self weight of the structure, the specific weight of the concrete shall be taken as 2500 kg/m³. All other dead loads shall be assessed in accordance with relevant codal provision. Dead load shall include the self weight of structure, weight of fill material, weight due to plugging/chocking of fills, weight of falling water, weight of hot water pipe, weight of water in hot water channel and distribution system including the self weight of channel and distribution system, weight of drift eliminators etc. Secondary stresses, if any, due to permanent fixtures on the shell shall also be considered. In addition, live load on the supporting structure due to maintenance activities related to fills/ducts/distribution system shall be considered. 4.7.17.5 Wind Pressure The wind pressure on the towers shall be assessed on theoretical basis as well as with the help of AERO elastic Model tests in a wind tunnel of turbulent boundary layer as per stipulations of BS 4485:1996 (Part 4). All the theoretical methods outlined hereunder for estimating wind load on cooling tower shell shall be valid only if the towers spaced at clear distance of greater than 0.5 times the base diameter at the finished graded ground level. The theoretical method outlined herein forms the basis only for assessing lowest limit of wind forces and shell structure interaction. For conducting model tests, bidders should survey the whole terrain and make their own assessment of likely critical wind forces & wind structure interaction. It would be the responsibility of the bidder to collect necessary meteorological data duly vetted from the recognized govt. agencies/institutions. After collection of necessary meteorological data, most critical wind speed, wind pressure distribution and other necessary parameter shall		

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be determined by the bidder and get the same vetted by the above agency/ appropriate agency(s). Then with the help of physical model tests in a wind tunnel, offering appropriate aerodynamic similitude, the bidder shall obtain the most critical forces, stresses etc. with cooling tower at various levels and locations. Such model test shall also include all adjacent topographical features, buildings and other structures which are likely to influence the wind load pattern on the tower significantly. The model test shall be carried out in a well reputed institute/testing laboratory after obtaining prior approval from the Owner. The testing agency selected by the bidder shall have requisite experience and should have successfully carried out tests in the past for at least one cooling tower of similar capacity. The model tests shall be duly witnessed and approved by the Owner/consultant. The model test results shall be made available before final approval of the design. The complete cooling tower shall be designed for all possible wind directions and on the basis of worst load conditions as obtained from Model test and theoretical methods. Under the theoretical method, the circumferential net wind pressure distribution and wind pressure coefficient (p_1) for the tower shell (without meridional ribs) shall be obtained from the "Criteria for structural design of Reinforced concrete Natural Draught Cooling Towers IS: 11504-1985. The above circumferential wind pressure coefficient (p_1) shall be increased by multiplying it by 1.43 to account for turbulence in the incident wind and load intensification due to turbulence induced by the adjacent cooling tower or the other structures of significant dimensions. Therefore, the actual design circumferential net wind pressure coefficient (p) shall be computed as $p=1.43(p_1)$, where (p_1) is the wind pressure coefficient as per IS: 11504-1985. Enhancement factor 1.43 is considered to take the interference effect of adjacent structures of significant dimensions into account. 10% increment shall be considered for imperfection in construction as per IS: 11504. This factor shall be increased further by 10% during foundation design in absence of model test results. If the model is for C/L of shell, wind load shall be appropriately augmented to cater the increase in diameter of the shell (O.D.). This design net pressure coefficient (p) and the distribution along the circumference of tower shall be used at all heights of the tower. The above design net pressure coefficient (p) shall include the effect of internal suction.		

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In order to compute the quasi-static design wind pressure at a given height along the circumference of the tower, the net design pressure coefficient (p) shall be multiplied by the wind pressure acting at that height [P(z)]. For details, reference shall be made to “Criteria for Wind Resistant Design of Structures and Equipments” and as given below. The wind pressure at a given height [P(z)] shall be computed as per the stipulations of IS: 875 (Part 3)-1987. For computing the design wind pressure at a given height, the basic wind speed (Vb) shall be taken as Vb=39 m/sec at 10.0 meters height above mean ground level. For computing design wind speed (Vz) at a height z, the risk co-efficient K1=1.06 shall be considered. For coefficient K2, Terrain category 2 as per table 2 of IS: 875 (Part-3) – 1987 shall be considered. Coefficient K3 shall be determined by taking into account nearby plant site and other features of the station & topography. The wind direction for design purposes shall be the one which would induce the worst load conditions. However, coefficient K3 shall not be less than one under any circumstances. The wind pressure at a given height shall be computed theoretically in accordance to the IS Codal position given as under : $P_z = 0.6 V_z^2 \text{ N/m}^2$ The bidder shall also compute the wind pressure (Pz) along the wind direction by Gust Factor (GF) or Gust effective factor method (GEF). Method for estimating the wind load on the tower and other elements, shall be based on IS: 875 (Part-3)-1987. While calculating the gust factor, the term “b” shall be taken as the diameter of the throat in Fig. 10 of IS: 875 (Part-3)-1987. Design of the tower shall satisfy quasi-static method & GEF method. Dynamic effects on the tower due to wind action shall also be investigated to ascertain the wind induced oscillation such as ovaling and excitation along and across the wind direction. Bidder shall carry out detailed analysis for the tower and consider the worst combination of static & dynamic effects. In case the bidder proposes to adopt aerodynamic rough surface such as provision of meridional ribs in the cooling tower shell, the pressure coefficients as given in the VGB-BTR KUHLTUMRE GERMAN SPECIFICATIONS (latest) (structural design of cooling towers) shall be permitted. The provisions of BTR may be adopted for choosing the value of circumferential wind pressure coefficient (p1) only. The wind pressure coefficient (p1), as obtained from BTR after accounting for internal suction		

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shall be multiplied by a factor 1.43 to arrive at the net design pressure coefficient (p). The bidder shall furnish authorized English Translation of VGB-BTR KUHLTURME GERMAN SPECIFICATIONS (latest) for the review of the Owner. All other stipulations as specified in these specifications shall be met with. Entire analysis and designs adopted shall be fully supported with authenticated literatures/documents along with relevant references where the same has been successfully implemented. 4.7.17.6 Earthquake Forces The seismic analysis shall be carried out in accordance with IS:1893 (all latest parts) by modal analysis for the hyperbolic cooling towers or any other method as approved by the Owner. The earthquake analysis of the shell and its support columns including the foundations shall be carried out by response spectrum method. For the fill supporting structures (RCC frames) response spectrum method is permitted. The modulus of elasticity for concrete shall be obtained from IS: 456-2000 Clause 6.2.3.1 with an Age Factor of 1.0. All the analysis shall be carried out as per the theory of elasticity. Entire analysis and designs adopted shall be fully supported with authenticated literatures/documents along with relevant reference where the same has been successfully implemented. 4.7.17.7 Loads due to temperature effects Stresses due to temperature effects: The cooling tower shell shall be designed for stress due to axi-symmetric temperature distribution corresponding to external ambient temperature variation from 12°C to 50°C. However, the detailed analysis of actual thermal gradient by considering temperatures inside the tower and external ambient temperatures shall be carried out furnishing detailed references and justification for the same. The shell shall also be checked for thermal stresses arising due to partial operation of the tower in case the operational philosophy so demands. The analysis for the stresses resulting from non-axi-symmetric temperature loading shall be carried out. In such non-symmetric temperature loading, the		

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calculation shall be based upon the operating specification. Besides, the shell shall also be designed for one sided solar radiation effect. Nevertheless an effective temperature difference of at least 25°C across the shell thickness constant over the height and follow a sine functions along half the circumference shall be considered. Entire analysis and designs adopted shall be fully supported with authenticated literatures/documents along with relevant references where the same has been successfully implemented. 4.7.17.8 Constructional Loadings The method of construction and the type of formwork to be used shall be decided by the bidder in advance and should be enclosed in the bids submitted. Construction loadings that may occur during execution of work shall be considered in the design of the cooling tower structure. Factors causing temporary loading may include the following depending upon the method of construction. (a) Barrowing of concrete (b) Scaffolding and formwork (c) Loads produced by anchoring devices of climbing scaffolds. (d) Hoist fixings (e) Storage of materials on scaffolding (f) Temporary access (g) Tower crane fixings (h) Works temporarily omitted for access purposes. Any other load such as foundation settlement, etc. All loads likely to act on cooling tower but not specified herein shall also be considered for the design of cooling tower structures.		

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In case different degrees of subsoil stiffness exist, effect of the same shall be taken into account. In such a case, for computing settlements, load distributing capacity of the shell may be considered. Differential settlement between adjacent sections of foundation shall be considered under most unfavourable load combination. 4.7.18 Load Combinations Following minimum load combinations shall be considered for the design of cooling towers structures. (a) DL + WL + SL (b) DL + Se L (c) DL + TL (d) DL + WL + TL + SL (e) DL + Se L + TL + SL (f) 1.0 DL + 1.5 WL (g) 0.9 DL + 1.5 WL (h) 0.9 DL - 1.5 WL Where DL = Dead Load WL = Wind Load SL = Settlement Load Se L = Seismic Load TL = Thermal Load		

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In addition to above, construction loads shall be duly accounted for. Under TL various types of thermal loads, as described above, shall be considered separately. Besides above load combination, other load combinations as per relevant IS codes shall also be followed. 4.7.19 Permissible Stresses For load combination (a) to (e), the stresses in concrete and reinforcement shall be designed as per working stress method of IS: 456 with maximum crack width limited to 0.3mm. For the load case (f) to (h), the shell of cooling towers shall be checked by limit state method as per IS: 456. The stress in the reinforcement steel shall not exceed 87% of the specific characteristic strength of reinforcement steel and the compressive stress in the concrete shall not exceed 45% of the specified 28 days cube strength of the concrete as per IS: 456. In the design of the cooling tower shell, column, pile caps, pedestals, ring beams etc, no increase in the strength with the age of the concrete shall be permitted. Permissible stress for steel structures shall be as per IS: 800 (latest) based on working stresses. 4.7.19.1 The cooling tower is more a wind predominant structure, increase in permissible stresses in structure under working stress design & increase in safe bearing capacity for design of foundation under wind load combination shall not be permitted. 4.7.20 Tower Design Consideration 4.7.20.1 General The complete cooling tower, including the shell, columns, ring beam and foundation, shall be structurally analyzed using a proven finite element modeling technique or an approved alternative method including validation of software used for analysis. For elastic analysis, concrete may be assumed to be uncracked, homogenous and isotropic. The design geometric profile,		

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thickness variation and support conditions of shell shall be considered in the structural analysis. Regardless of analysis method adopted, the equilibrium checks of internal forces and external loads shall be performed. Analysis based on a recognized bending theory of the elastic shells shall be adopted for the design of the tower and supporting structures. Geometric imperfections, if exceed the permissible limit, then the analysis of shell shall take into account of such imperfections and resubmitted for Owner"s approval. Boundary conditions shall be realistic and based on actual configuration. The magnitude of the calculated displacements should be within limits of the applied theory. A detailed dynamic analysis shall be carried out for complete tower for seismic forces by response spectrum method. Cooling tower shall also be designed for cross wind oscillations (wind induced vibration) if the fundamental natural frequency of the tower is less than or equal to 1 Hz. Frequency calculation for free vibration analysis shall also be furnished by bidder during detailed engineering. 4.7.20.2 Size and Shape The base diameter, air intake opening height, tower height and throat diameter shall be determined by thermal design consideration by the bidder and submitted to Owner for approval. As the range of possible hyperbolic shell shapes is infinite, the same shall generally conform to the following major proportions, which have been extensively adopted in cooling tower constructions. $H/D = 1.2 \text{ to } 1.55$ Where H is the total tower height above basin sill level. $H_b/H = 0.75 \text{ to } 0.85$		

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H_b is the vertical distance from the throat to basin sill level and 'D' is the base diameter at basin sill level.

However, other proven profiles may be permitted subject to approval from the Owner. Bidders shall submit along with the offer complete details of the profile, in case the profile is not within the limits stated above, and the names of the sites where such shell profiles have been successfully constructed. Notwithstanding what is stated above, the Owner reserves the right to accept /reject the shell profile.

4.7.20.3 Tower Shell Boundary Conditions

(A) Shell Analysis and Design

The following boundary conditions shall be assumed for the design of cooling tower shell:

(a) At Upper Edge

The top edge of the shell shall be gradually thickened to form a ring beam to guard against possible instability of the top of the shell due to high velocity wind gusts. Top edge shall be considered as a free edge in the analysis.

(b) At Lower Edge

The lower edge of the shell shall be thickened to form a lower ring beam. The thickness transition from shell to lower ring beam shall be smooth and shall be considered as an integral part of the shell. The lower boundary of the shell shall be considered as elastically supported by discrete columns.

The influence of both support structure flexibility and foundation settlement shall be considered in the analysis and design of cooling tower shell. The shell analysis should include following information at 10° plan angle and of not more than 0.05 of the shell height.

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	(i) Meridional and circumferential direct stress resultants and the tangential shear stress resultants. (ii) Meridional and circumferential bending moments. (iii) Displacements normal to the shell mid-surface. (B) Buckling of Tower Shells Critical dynamic pressure (wind pressure) at buckling shall be calculated from BS: 4485 Part-4:1996. Buckling of Cooling Tower shell shall be checked as per Finite Element Analysis using software such as NISA 2, Ansys etc. The factor of safety for snap through buckling shall be more than 5. This requires non linear analysis including simulation of opening in the model. Alternatively bifurcation buckling factor can be calculated using linear Eigen value analysis with modulus of elasticity $E=0.8E_c$, to account for cracked section, with factor of safety more than 7. Besides above, a buckling analysis with wind forces should be made using the theoretical tower geometry and boundary conditions, including the influence of dead weight, by the method of buckling stress state (BSS) approach in accordance with the provisions of VGB/ BS 4485. The buckling safety factor shall be at least 5.0 for load combinations of dead load + wind load. When imperfections in the shell geometry are larger than specified tolerances, the analysis should be rechecked to account for such imperfections and ensure that the desired buckling capacity remains. (C) Opening in Shells Opening through the shells should be avoided as far as possible. They should be of smallest required dimensions and shall be shaped such that stress concentration is minimized at the boundary of the opening.	

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Should thickening of the edges be necessary, it shall be smoothly tempered back to the shell thickness. Openings shall be provided with additional edge reinforcement of a minimum cross sectional area at each edge equal to 75% of the reinforcement intercepted by the openings in the direction parallel to the edges. In addition, diagonal reinforcement shall be provided at each corner as close as possible. The total cross-sectional area in cm² of this reinforcement shall be 0.5d, at each corner where d is the shell thickness in cm. No horizontal thrust due to the inlet piping shall be transmitted to the shell. (D) Minimum Thickness of Shell The minimum thickness of the shell excluding ribs shall not be less than 300 mm. (E) Minimum Reinforcement in Shell Spacing and Placement The reinforcement used shall be cold worked steel high strength deformed bars of grade Fe 415/500 conforming to IS: 1786 – latest. All reinforcement steel shall be corrosion resistant steel/HCRM. The minimum reinforcement to be provided shall be as follows: Top one third portion of shell: 0.4% of concrete cross sectional area along circumferential direction and 0.35% of concrete cross sectional area along meridional direction. Remaining two-third portion: 0.35% of concrete cross sectional area of shell in both meridional and circumferential directions. Minimum bar diameter shall be 10 mm in transverse direction and 12 mm in meridional direction. Spacing of reinforcing bars should not exceed 200 mm in circumferential direction and 250 mm in meridional direction.		

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	The two layers of reinforcing meshes shall be adequately joined by S-hook over the total shell surface. At least two S-hooks in each square metre area of shell surface shall be provided. The hooks shall be of minimum 8 mm diameter bars. The concrete cover shall be 50 mm minimum. The relevant provisions of IS: 2210 – Criteria for the design of reinforced concrete shell structures and folded plates and IS: 2204 – Code of Practice for construction of reinforced concrete shell roof shall also be deemed to be applicable. All other design criteria for the cooling tower shell which are not specified above shall be in accordance with BS: 4485 Part 4 and BTR. (F) Provision of meridional ribs in Cooling Tower Shell Meridional ribs in the cooling tower shell may be provided subject to the following conditions: (a) Minimum thickness of shell excluding ribs shall not be less than 300 mm. (b) Co-efficients for pressure distribution around the cooling tower circumference including suction may be taken as per VGB-BTR KUCHLTURMEN SPECIFICATIONS (latest). All other factors including load intensification factors shall be as specified else where in these specifications. (c) Shell buckling and strength shall be checked as per clause-III B above without considering the effect of ribs. (d) All other stipulations as specified in these specifications shall be met with. (e) Bidder shall furnish an authorized English translation of the VGB-BTR KUHLTURME GERMAN SPECIFICATIONS (Latest) during detailed engineering stage.	

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4.7.20.4 Raker Columns Inclination of the column shall closely match the meridional slope at the shell so that the load transfer to foundation takes place through predominantly axial force in columns. Raker columns shall be designed for the most critical forces transferred to an individual rake column from superstructure considering various load combinations as specified in this document. For selecting effective length of the raker columns, following restraints shall be considered: (a) In case columns restrained at both the ends, the effective length shall be 0.8 and 0.6 times the length of the column radially and tangentially respectively. (b) In case columns are restrained at one end only, the effective length of columns shall be 0.9 and 0.7 times the length of columns radially and tangentially respectively. (c) The columns shall be designed based on working stress method except for the forces from DL + 1.5 WL which shall be designed as per limit state of strength method of IS: 456. 4.7.20.5 Crack Width Control Under working stress method the maximum crack width of tower shell, lintels, raker columns and fill support structure shall be controlled up to 0.3 mm on basis of formulas as per IS:456 and relevant British codes. Fill support structures and Drift Eliminators shall be designed as per the load combinations specified in this document. Appropriate Live Loads and imposed loads shall also be considered in addition. The design shall confirm to limit state method as per IS: 456. For fill support structure, the design shall be done considering the weight of fills, falling water, plugging/scaling load and the live load due to the maintenance activities. 4.7.20.6 Prestressed Concrete Members: Design construction and workmanship of prestressed concrete, members shall be in accordance with IS: 1343 (Latest revision). Steel wire for		

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prestressing shall conform to IS: 1785 (Part 1) (latest edition) or IS: 6003 (latest edition). Crack width control shall be limited to 0.1 mm. Particular attention shall be paid to achieve an effective bond of the wires in pretensioned concrete units. For this purpose, indented wire shall be used. Wires shall be corrosion resistant or should have coating system fit for seawater duty condition. 4.7.20.7 Liquid Retaining Structures:- (a) The cold water basin including sludge pits, cold water channels, shall be designed as per IS: 456 (latest) with crack width control of 0.1 mm for outer face of the wall and inside face of the wall shall be designed as per IS 3370. The structures shall be designed for the following conditions: (i) Water filled inside up to maximum level and no earth outside. (ii) Earth pressure with surcharge load of 2.5 t/m², as applicable, and with/without ground water table at 1.0 m below finished ground level outside and no water inside. (b) The basin and associated structures shall be checked against uplift for basin empty condition. Stability shall be checked during construction stage as well as maintenance stage. The factor of safety shall be as per IS: 3370. (c) Loads during construction, erection and maintenance stage shall also be considered. (d) Temperature fluctuations from operation shall be obtained from the design data. Hot water temperature inside and cold air temperature outside shall be considered. (e) Basin floor slab shall be designed to rest on piles or raft/mat foundation including fill-pack support structures. The stiffness of the subsoil shall be taken into account. The founding level of the raft/mat shall be either on virgin ground level or shall be placed at higher level		

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only after scooping out filled up soil up to virgin ground and then filling back with well compacted sand (80% of relative density) up to the founding level of the raft/mat. The bidder shall ascertain the safe bearing capacity of the stratum at the founding level and may adopt the same subject to Owner's approval. (f) Minimum thickness of basin slab shall be 300 mm with minimum reinforcement 0.35% of gross sectional area in both the directions. Reinforcement shall be placed in two layers, top and bottom surface. The effect of provision of flap valves/pressure release valves shall not be considered in the design of CW basin. In the space underneath the basin floor slab a layer of at least 100 mm thick PCC of mix 1:3:6 shall be provided. (g) All reinforcements used shall be corrosion resistant steel/HCRM. 4.7.20.8 Water Distribution System The structural design of the water distribution system shall consider the worst combination of following loads: (a) Self weight, other imposed loads and live load. (b) Hydraulic pressures during normal operations including pressure surges. (c) Hydraulic pressure due to mal-operation of the tower or supply pumps. The water distribution system shall be provided with adequate pressure surge relief facilities to prevent pressure loading in excess of values used in the design. If such facilities are not provided, a further increase in loading shall be considered in the design. For the structural design, the pressure level to be considered shall not be less than 1.5 times the design pressure. The design of water distribution system and its supports shall be capable of accommodating all thermal stresses and movements due to changes in inlet water temperature and ambient temperature.		

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The possibility of vibrations being imposed on the distribution system shall be investigated in the design. Seismic loading on the water distribution system shall also be taken into account. The design shall be carried out based on uncracked section as per IS: 3370 under normal operating conditions. Strength check for worst loading including malfunctioning shall be carried out with stress limitations as per IS: 3370. The construction shall be completely water tight without the use of fillets, sealing compounds etc. The method of construction shall be such so as to avoid excessive rise in temperature of concrete due to release of heat of hydration. 4.7.20.9 Platforms, Walkways, Stairways, Staircases, Internal Grillage etc. These shall be designed as per working stress method IS: 456-2000 and IS: 800 (Latest). The crack width in all RCC structures shall be limited to 0.3 mm. A minimum live load of 400 kg/sqm shall be considered for the design of all platforms, walkways, staircases etc. in addition to their own weight. 4.7.20.10 Steel Structures These structures shall be designed, fabricated and erected as per IS: 800 (latest revision) and other relevant Indian Standard codes for structural steel work. All steel structures shall be coated with anti-corrosive system. 4.7.20.11 Slide Gates and Screens Slide Gates and Screens, as per IS: 5620 conforming to IS: 2062 Gr. A shall be designed for worst combination of operating and maintenance condition. All steel components shall be coated with anti-corrosive paint system. However, all guides of slide gates and screens shall be of stainless steel of Grade AISI 304L 4.7.20.12 Foundations The design of the cooling tower foundation structures shall be based on IS: 456 as per working stress method for worst load combination as specified in IS code In case of load combination DL + 1.5 WL, the limit state method as per IS: 456 shall be adopted.		

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Foundation shall be checked for safety against overturning, sliding and uplift. While checking stability of the structures, neglect favorably acting loads from water fill, soil cover beyond the edge of the foundation. Ground water table shall be considered at 1.0 m below Finished Grade Level of that particular area for design of foundations and all underground water retaining structures. The foundation shall be of minimum M-25 grade concrete resting over 100 mm thick PCC 1:3:6 layers. Clear cover of concrete shall not be less than 50 mm. Pile foundation if adopted shall be designed in accordance with IS: 2911 (Part-I / Sec-I, II and III). Generally net tension should be avoided in the foundations/piles for the shell support foundation unless specifically permitted by the Owner. While accounting for over burden of the soil for checking the foundation against up-lift, dead weight of the soil directly above the pile cap or ring raft, as the case may be, shall only be considered, neglecting the weight of soil in the cone of up-lift above the foundation. The foundation structures will be subjected to following loading and extreme load combination case shall be considered for design. (a) Most critical forces transferred from superstructure for the various load combinations. (b) Uplift forces (c) Loading due to foundation settlement (d) Concentrated local loading from column nodes (e) Thermally induced local loading where supply culverts pass through the foundation structures without structural isolation. (f) Surcharge of 2.5 t/sq.m.		

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CW basin surcharge load shall also be considered in addition to the other relevant loads for the design.

4.7.20.13 Fill Support Structures and Other Structures

The self weight of the pack support structures shall be based on the weight of the packing including weight of standing, running and dripping water, other operation and plugging/chocking (debris/scaling) loads, etc. in accordance with manufacturer's data. In addition, a live load of 100 kg/m² shall also be considered for the design of supporting structures.

For other structures like walkways, platforms, etc. a live load of 400 kg/sq.m shall be considered. Hand railings shall be designed for horizontal load of 60 kg/m².

Wind deflector walls and any other structural elements shall be designed for a horizontal wind load of 80 kg/sqm or as per manufacturer's recommendations, whichever is higher. Thermal loading shall be as per manufacturer's recommendations. Earthquake loading shall be considered based on criteria given for cooling tower. Response spectrum analysis shall be considered.

Design of RCC members shall be based on IS: 456:2000 with limiting crack width of 0.3 mm.

The cold water basin slab/raft shall form the common foundation for the pack support structures. The foundation shall be designed for the most critical forces transferred from CW basin & fill supporting structures including loads introduced by constructional equipments and crane deployed for fill supporting structure or shell erection.

4.7.20.14 Requirements for Concrete and Reinforcement

Cement: - 43 Grade ordinary port land cement shall be used unless otherwise specified.

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Structural concrete shall be of design mix complying with the relevant provisions of IS codes or any International Code of Practice as approved by the Owner. Durability of the concrete shall conform to severe exposure category as per Table 3 of IS: 456 except noted specifically otherwise. Minimum cement content of all RCC structures shall be 360 kg/cum except in case of concrete blended with GGBS specified above & piling. Reinforcement shall conform to grade Fe 415/500 as per IS: 1786 except noted otherwise. All reinforcements used in RCC structure shall be corrosion resistant. Column reinforcing bars shall be carefully anchored in the shell and foundation. The anchoring length shall not be less than 80 times the diameter of the bars. All foundation structures shall be provided on all sides with a minimum reinforcement of 0.12% of gross cross-sectional area distributed over top and bottom faces. The minimum grade of concrete of structural components of cooling towers shall be as follows in accordance with IS: 456. <table border="0"> <tr> <td>(a)</td><td>Shell and Raker Columns</td><td>: M-40 grade</td></tr> <tr> <td>(b)</td><td>Pre-cast pre-stressed elements</td><td>: M-35 grade</td></tr> <tr> <td>(c)</td><td>All other RCC concrete</td><td>: M-30 grade</td></tr> <tr> <td>(d)</td><td>PCC encasement concrete except piles</td><td>: M-25 grade</td></tr> <tr> <td>(e)</td><td>Piles (with OPC/PPC)</td><td>: M 25 grade</td></tr> <tr> <td>(f)</td><td>Tower foundation</td><td>: M-25 grade</td></tr> <tr> <td>(g)</td><td>Mud mat PCC</td><td>: M-10 grade</td></tr> </table> Coarse and fine aggregates shall be specially selected to ensure that they are not susceptible to alkali/chloride attack or prone to disintegration at high temperatures. In particular, limestone aggregates shall never be used. The			(a)	Shell and Raker Columns	: M-40 grade	(b)	Pre-cast pre-stressed elements	: M-35 grade	(c)	All other RCC concrete	: M-30 grade	(d)	PCC encasement concrete except piles	: M-25 grade	(e)	Piles (with OPC/PPC)	: M 25 grade	(f)	Tower foundation	: M-25 grade	(g)	Mud mat PCC	: M-10 grade
(a)	Shell and Raker Columns	: M-40 grade																					
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maximum size of coarse aggregate shall not be larger than 1/8th narrowest dimension between reinforcement bars not more than 20 mm. Washing and screening of coarse and fine aggregates to remove fines, dirt or other deleterious materials shall be carried out by approved means as directed by the Engineer-in-charge. The water cement ratio by weight shall be 0.45 maximum including free moisture in the aggregates and slump should be suitably decided to provide good quality concrete work. 4.7.20.15 Admixtures Admixtures may be permitted to be used in accordance with relevant IS codes to modify the rate of hardening or setting, to improve workability or as an aid to control concrete quality. The Owner reserves the right to direct the contractor to conduct laboratory tests or use test data, or other satisfactory reference before granting approval. The cost of all tests conducted shall be borne by the contractor. The admixture shall be used in strict accordance with the manufacturer's directions and/or as directed by the Owner. No extra payment will be made to the contractor on account of using admixtures. Particular attention must be given to concrete placement because of the thin wall section and the presence of reinforcing steel. Consolidation of concrete shall be by vibration. Removal of air and water at the form surface shall be by vibration and rodding. Particular attention shall be paid to accurately shape the corners at all openings. Point of discharge of the concrete in to the forms be 1500 mm max. above the concrete surface. Concrete shall be deposited in approximately level layers not greater than 400 mm deep unless permitted otherwise. Concrete in the cooling tower shell in each lift shall be so laid that the no. of vertical or inclined construction joints are minimized to the extent possible. Horizontal construction joints shall be maintained at uniform spacing throughout the height of the cooling tower as per the directions of the Owner. Special attention shall be paid to proper curing of vertical faces of the cooling tower shell so that these do not remain dry. All thin walled structural members shall be protected by means of curing agents. It is recommended to use a curing agent for the cooling tower shell providing additional protection		

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like a single transparent cooling with a material based on vinyl mixed polymer. Inside face of the shell should be protected by a second pigmented coating of the same base material. Any other method of curing, if permitted by the Owner may be used. Sampling and testing of concrete shall be carried out as stated in Technical Specification elsewhere and as per relevant Indian Standard Codes. However, following minimum tests shall be carried out, irrespective of whatever stated otherwise: Test of compressive strength Columns – 1 Set of 3 cubes per column Shell- 2 sets of 3 cubes per climbing section 4.7.20.16 Cover to Reinforcement Unless indicated otherwise the clear concrete cover for reinforcement shall be as per IS Codes. The correct cover shall be maintained by cement mortar spacers/cubes or other approved means, reinforcement for footing/pile caps, grade beam, and slabs on sub-grade shall be supported on pre-cast concrete cover block as approved by Engineer-in-charge. The use of pebbles or stones as cover blocks shall not be permitted. The 28 days crushing strength of cement mortar cubes/pre-cast concrete cover blocks shall be at least equal to the specified strength of concrete in which the cubes/blocks are embedded. The minimum clear distance between reinforcing bars shall be in accordance with IS: 456 (latest edition) or as specified elsewhere in this specification. All lapping of reinforcement bars in the cooling tower shell shall be by lapping as per relevant codal provisions. Prior approval of the Owner shall be taken for deciding the method of lapping the reinforcement bars in the shell.		

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Tolerances for the cooling tower construction shall be in accordance with the following: (a) Shell wall centerline in horizontal plane measured radially at mid point on a 3m wide chord is + 15 mm. (b) Shell wall centerline in meridional plane measured over a height of 1m is + 10 mm. (c) Shell thickness is + 10 mm or -5mm. (d) Horizontal radius of shell at any section other than shell base is ± 50 mm. (e) Horizontal radius at shell base is ± 40 mm. 4.7.20.17 Checking of shell geometry Check for absolute positions may be carried out from ground stations arranged at not more than 10 degree plan angle apart. Readings of horizontal radius shall be taken at every 6m height or weekly during construction period whichever is more frequent. If the permissible dimensional tolerance are exceeded the Owner will instruct the contractor, in writing, to stop construction of the shell. The Contractor shall then examine the situation and submit a report to the Owner who may require the contractor to demonstrate by calculations that the structural integrity of the shell will not be impaired as a result of the imperfections. The calculations shall be submitted to the Owner, for approval, before construction will be permitted to proceed. If in the opinion of the Owner the calculations show that the integrity of the shell could be threatened, the Contractor will be required to submit to the Owner detailed arrangement and supporting calculations to set right the shell geometry for approval, before construction will be permitted to proceed. The cost of carrying out the calculation, any remedial work required and idle time or any delays to the construction programme as a result of dimensional tolerances being exceeded will be borne by the contractor.		

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Adjustment to the tower shell line on the basis of the survey results shall be made gradually; limiting the maximum change of direction from the existing vertical shell profile to be not more than an angular change of 10 mm measured over 1m of height. Any such adjustment shall be made with full knowledge and consent of the Owner.

The contractor shall carry out an as-built-survey of each lift of the shell. The results of these checks will be recorded on a suitably developed drawing of the shell from which it will be possible to locate the survey check point. A copy of these results will be presented to the Owner prior to commencing the next shell pour.

The contractor's shell construction procedures shall include for providing the Owner with the facilities and a reasonable time period as may be required to carry out an independent check of the completed works.

Suitable communication system such as telephone, wireless equipments, etc. shall be provided by the contractor so that the communications are possible at different elevations of the tower from the ground during construction.

All piling work shall be carried out by specialist subcontractor approved by the Owner. Initial pile load test shall be carried out for at least 3 sets of piles for direct compression and lateral load.

Since the effective action of the piles will depend on the adopted method of construction, the contractor shall guarantee that the piles, as constructed by the sub-contractor, shall effectively transmit the maximum loads which can be imposed on the foundation soil and corresponding maximum deflections.

4.7.20.18 General Requirements

- (a) The basin slab shall be divided into two equal parts by a partition wall designed to withstand full hydrostatic pressure, with one side empty. The basin construction joints shall be made watertight by injection of chemical grout through nipples. The basin construction shall be tested for water tightness, in accordance with IS: 3370 (Part I) (Latest edition). The cost of the test and any rectification and re-test if required is deemed to be included in the contractor's quoted price. Any cost of

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filling and emptying of the basin and to rectify defects shall also be borne by the contractor. (b) PVC ribbed water stops with central bulb shall be used where expansion joints are envisaged. The minimum thickness of PVC ribbed water stops with central bulb will be 10 mm and minimum width 250 mm. (c) The basin floor of each compartment shall be provided with a slope of not less than 1 in 500 towards sump for dewatering. From sump, the water will be drained by C.I. drain pipe, embedded below the basin floor, into a drain chamber outside the tower basin or as per the arrangements described elsewhere in the tender document. Suitable sluice gates (rising spindle type) conforming to IS: 3042 or sluice valves shall be provided in the drain chamber or any other arrangement specified elsewhere in the tender document. Suitable operating platform with access ladders for operating the gates or valves and pipes, shall be provided in the drain box.. (d) A 250 mm high sill shall separate the pond floor from the tower outlet. (e) Uniform surface on the top of basin floor shall be provided. In case undulated surface is observed, a top of layer of minimum 25 mm thick 1:3 mix mortar to be provided to achieve uniform surface. (f) Fill will be of film type supported on RCC beam. Film fill should be characterized by reduced air pressure losses, and shall not susceptible to clogging. Design and facing of the film fill shall be such as to expose high air/water surface with minimum air pressure drop. The sluice gates shall be of structural steel with anti-corrosive coating specified elsewhere. Number of sluice gates and removable screen shall be two (2) per tower. Proper rubber seal shall be provided so as to avoid any leakage of water. The rubber seal provided for the sluice gates be tested in accordance with the relevant Indian Standard Code. Sluice gates shall be checked for water tightness and smooth operation in dry and wet conditions.		

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Suitable facilities, as approved by the Owner, shall be provided for handling of sluice gates and screens. A screed or concrete layer not less than 100 mm thick and of grade not weaker than 1:3:6 mix conforming to IS: 456-2000 shall be provided below the cold water basin and other liquid retaining structures. Lean concrete below other foundations and underground structures, unless noted otherwise shall be 1:3:6 nominal mix (with aggregate of nominal size 40 mm maximum) and shall be at least 100 mm thick. All exposed surfaces of concrete, i.e. inside surface of tower basin, entire inner surface of shell, fill supporting beams, columns and bracings, raker columns etc. which are in contact with water/moisture shall be given three coats of water proof bituminous paint of approved make. Unless noted otherwise all concrete surface which are in contact with the earth shall be applied with anticorrosive coat system. Water proofing and plasticizer admixtures conforming to relevant IS codes may be added as per manufacturer's instruction to the concrete subject to approval of the Owner. The tower shall be provided with two numbers external RC staircase, leading to a heavy duty door giving access to the distribution system. Staircase shall be minimum 1000 mm wide (clear), with landings of minimum width of 1000 mm at not more than 2500 mm height intervals unless approved otherwise. The steps shall have a rise of about 125 mm and tread of about 250 mm. Anti-skid nosing at each step shall be provided. Minimum size of all doors shall be 2100 mm high (clear) and 1200 mm wide (clear). The door shall be of steel with anti-corrosive coating of polyurethane as specified elsewhere. However, FRP material or equivalent may also be used subject to approval of the Owner. The door shall be air tight when closed. The hand railing on both sides of the staircase shall be galvanized with three rails of 32 mm NB pipes conforming to medium class as per IS:1239, and posts conforming to medium class as per IS:1239 of 32 mm dia galvanized		

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pipes spaced not more than 1.2 m centers. The top hand rail shall be at 1000 mm above the steps. Complete hand rails shall be applied with anti-corrosive coating system as specified elsewhere. All galvanization work shall have 610 gm/sq.m of deposit. Approved walkways and platforms shall be provided inside the tower at distribution pipe level. These walkways and platforms shall provide safe and clear access to all sprayers and all distribution pipes. A reinforced concrete platform of 1500 mm clear width shall be provided around the tower valves. Other walkways shall be at least 600 mm wide with 50 mm (minimum) safety kerbs along each edge. Access ways shall be clear of all obstructions such as distribution pipe support beams, drift eliminator support beams etc. The walkways shall be provided with transverse slots or other opening which will permit the free passage of air and water. Hot double dip galvanized handrails shall be provided on all sides where there is a risk of falling through the fill. Reinforced concrete platforms 1.2 m clear width all around the tower circumference shall be provided on the tower for fixing of aviation warning light at levels specified elsewhere. Two diametrically opposite galvanized M.S. cage ladder (as per IS: 3696) with Fall protection system on the outside of shell upto full height of cooling tower shall be provided. The fall protection system/vertical fall arrest anchorage system (conforming to EN 353-1:2002) shall be provided as an integrated fall arrest solution made of a vertical Aluminium Alloy Notched Guide Rail over which glides a Guided – Type Fall Arrest Trolley. The trolley shall move up and down accompanying the user who is connected with it with the help of small shock absorbing lanyard. The full body Harness shall be provided. The trolley shall be made of stainless steel with wheels made of brass to prevent corrosion and to enable smooth working. The trolley shall immediately lock over the rail, in case of sudden fall with provision of the Uni-directional locking system which does not allow it to free fall down the rail.		

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The cage ladder shall have 600 mm. wide, 20 mm dia rungs at 300 mm c/c with stays at every 1800 mm, connected to the concrete shell and galvanized Horizontal M.S. cage ring of 50mm x 6mm thick consisting of 50 mm x 6 mm vertical cage flats on the exterior surface of cooling tower up to top of the tower. In addition to the top platform, intermediate landings of 1.0m x 1.0m with handrails shall be provided at every 8 to 10 m height of the MS ladders throughout. Some of these landing levels shall be suitably adjusted to give access to aviation warning beacons for maintenance. Handrails shall be provided on all platforms. The ladder leading to the top platform shall have approach from ground via the RCC staircase. In order to provide approach for maintenance of shell, all Landing platforms shall have 70 mm internal diameter puddle flanged C.I. pipes for passing ropes during maintenance of tower shell. Steel gratings, where required, shall be fabricated out of steel flats with minimum thickness of 6 mm. Thickness of fabricated grating shall be 32 mm with flats so arranged as to have a maximum opening of 25 mm or less. Treads for staircases, where needed, shall be of similar grating construction but provided with toe flats of 6 mm thick, and non-skid nosing in an approved manner extending up to 100 mm above the walkway surface. All steel gratings shall be galvanized and applied with anticorrosive coating as specified elsewhere. The mild steel parts of structures used in cooling towers shall be hot double dip galvanized unless it is coated with a separate anti-corrosive coating system. The minimum coating shall be 610 gm/sq.m and shall comply with relevant IS codes. Galvanizing shall be checked and tested in accordance with IS: 2629. All welding shall be done before galvanizing. Any site joints required to be carried out after galvanizing shall be either flanged or screwed joints. Nails, nuts, bolts and all components coming in direct contact with water shall be of stainless steel of AISI 304 or equivalent. The finished ground level shall be paved for 2.0m width all round the outer edge of the cold water basin. The paving shall consist of 150 thick RCC slab of M-20 grade. The minimum reinforcement shall be 10 mm dia spaced 150 mm center to center both ways top and bottom. The RCC slab shall be overlaid 100 mm thick M-10 PCC mat and 300 mm well compacted sand layer. All		

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around peripheral RCC drain leading to drain chamber shall be suitably provided. (g) Two (2) Slide gates of suitable opening size conforming to IS: 5620 complete with embedded parts of SS 304L, guide frames of SS 304L, gate conforming to IS: 2062 Gr. A, side seal of EPDM Musical Note, bottom seal of EPDM, all other accessories and hardware necessary to install and operate the system as per specifications and drawings or as directed by Engineer-in-charge, complete in all respects. The slide gates shall generally meet the following requirements: <table><tr><td>(i)</td><td>Standard</td><td>:</td><td>IS: 5620</td></tr><tr><td>(ii)</td><td>Depth of water column for design</td><td>:</td><td>3 m</td></tr><tr><td>(iii)</td><td>Guide frame (Embedded in Concrete)</td><td>:</td><td>MSHDG with SS 316 L sealing surface</td></tr><tr><td>(iv)</td><td>Gate (including supporting frame)</td><td>:</td><td>IS 2062 Gr. A</td></tr><tr><td>(v)</td><td>Slide plates of gate</td><td>:</td><td>SS-304 L</td></tr><tr><td>(vi)</td><td>Slide Seal</td><td>:</td><td>EPDM Musical note confirms to IS: 11855</td></tr><tr><td>(vii)</td><td>Bottom Seal</td><td>:</td><td>EPDM confirms to IS: 11855</td></tr><tr><td>(viii)</td><td>Painting</td><td>:</td><td>Specified elsewhere</td></tr><tr><td>(ix)</td><td>Fasteners</td><td>:</td><td>SS 304</td></tr></table> (h) Two (2) Coarse Screens with guide frame to be suitably installed in the cold water channel and made of 6 SWG wire mesh of SS 304L having 16 mm x 16 mm openings with trash tray and embedded parts of SS 304L, screen frame of CS (galvanized to 610 gm/sq.m), guide frame of SS 304L and all other accessories and hardware necessary to install and operate the system as directed by Engineer-in-charge, complete in all respects.			(i)	Standard	:	IS: 5620	(ii)	Depth of water column for design	:	3 m	(iii)	Guide frame (Embedded in Concrete)	:	MSHDG with SS 316 L sealing surface	(iv)	Gate (including supporting frame)	:	IS 2062 Gr. A	(v)	Slide plates of gate	:	SS-304 L	(vi)	Slide Seal	:	EPDM Musical note confirms to IS: 11855	(vii)	Bottom Seal	:	EPDM confirms to IS: 11855	(viii)	Painting	:	Specified elsewhere	(ix)	Fasteners	:	SS 304
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(i) Materials (ii) Mesh Size (iii) Supporting Frame (iv) Guide Frame (Embedded in Concrete) (v) Trash Tray (vi) Fasteners : SS 304 L : 16 mm x 16 mm square openings with 6 SWG wire : MSHDG with SS 304L slide parts : MSHDG with SS 316 L sealing surface : MSHDG : SS 304 (i) Two (2) Fine Screens with guide frame to be suitably installed in the cold water channel and made of 8 SWG wire mesh of SS 304L having 12 mm x 12 mm openings with trash tray and embedded parts of SS 304L, screen frame of CS (galvanized to 610 gm/sq.m), guide frame of SS 304L and all other accessories and hardware necessary to install and operate the system as per specifications and drawings or as directed by Engineer-in-charge, complete in all respects. (i) Materials (ii) Mesh Size (iii) Supporting Frame (iv) Guide Frame (Embedded in Concrete) (v) Trash Tray (vi) Fasteners : SS 304 L : 12 mm x 12 mm square openings with 8 SWG wire : MSHDG with SS 304L slide parts : MSHDG with SS 316 L sealing surface : MSHDG : SS 304		

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(j) Handling facilities of approved make in Cold Water Channel including fabrication, erection complete with all the necessary accessories, embedded parts, hardware, etc. hot double dip galvanized as per IS: 4759 with 610 gm/sq.m of zinc coating as per specifications or as directed by Engineer-in-charge, complete in all respects. (k) Monorails for Slide gates and Screens shall be ISMB 300. Monorail trolleys (manual type) moving over I-beams. Chain pulley block (3.0 Ton capacity with 5 m chain) conforming to IS:3832 with 5m load chain conforming to IS: 3109 complete with necessary accessories such as hooks, slings etc with hardware as per specifications or as directed by Engineer-in-charge, complete in all respects. (l) Handling Facilities on top of cooling tower including fabrication, erection complete with all the necessary accessories, embedded parts, hardware, etc. hot double dip galvanized as per IS: 4759 with 610 gm/sq.m of zinc coating as per specifications or as directed by Engineer-in-charge, complete in all respects for Brackets, hot double dip galvanized as per IS: 4759 with 610 gm/sq.m coating. Swiveling type lifting arm complete with swiveling brackets, pins, etc. along with 250 mm diameter CS pulleys, and all the necessary embedded parts, inserts, hardware, etc. hot double dip galvanized as per IS: 4759 with 610 gm/sq.m coating. (m) 20 mm diameter MS rungs, hot double dip galvanized as per IS: 4759 with 610 gm/sq.m coating and complete with all accessories as per specifications or as directed by Engineer-in-charge. (n) MS structural supports in trusses for HW pipe with all bracings, brackets, cleats, gusset plates, etc. as per detailed drawings or as directed including cutting, fabricating, hoisting, erecting, fixing in position, welded connections and painting with Red Oxide Zinc Chromate primer etc. complete as per specifications or as directed by Engineer-in-charge. (o) MSHDG Access Door with frame in hollow metal construction of 2.1m clear height x 1.2m clear width x 45mm thk with galvanizing to 610 gm/sq.m coating and of 18 Gauge sheet with suitable stiffeners of same material including accessories & fixtures like frame, hinges,		

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latches, hardware etc complete as per specifications or as directed by Engineer-in-charge (p) Minimum two (2) 300 NB flanged CI pipes of Class 'A' type confirming IS: 1536 as directed by Engineer-in-charge shall be provided in the drain sumps for sludge removal. (q) At least two (2) 300 mm dia. Sluice gates conforming to IS: 3042 Class-I as directed by Engineer-in-charge shall be provided for sluice operations. (r) All the MS piping conforming to IS: 3589 and MS plates as per IS: 2062 including bends, T's, elbows, reducers etc. complete with all the necessary HDGS hardware, gaskets etc. including fabrication, cutting, aligning, welding, lowering, laying, hydro-testing etc. shall be provided as per specifications or as directed by Engineer-in-charge for all diameter pipes. (s) Two (2) Double Flanged Butterfly valves of suitable diameter and of approved make conforming to AWWA C-504 / BS: 5155 with mating flanges and complete accessories and hardware as per specifications including aligning, erecting, testing etc. complete in all respects shall be provided separately in the CCW and ACW HW piping respectively. (t) Suitable MSHDG drain nipple with suitable drain plug for flushing of Primary HW ducts and complete with accessories and hardware as per specifications including aligning, erecting, testing etc. all as directed by Engineer-in-charge. (u) Required numbers of 80NB x 200mm long MS heavy duty Stub connections as per IS: 1289 with isolating ball valves as per IS:9890 of threaded type for flow measurement in HW pipes and complete with accessories & hardware as per specifications including aligning, erecting etc. and as directed by Engineer-in-charge. (v) At least four nos. of Dial type pressure gauges of 6" dial size as per IS:3624 including stub connection with isolation ball valve as per IS:9890 and complete accessories, hardware as per specifications		

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	including erecting, testing etc necessary for installing & operating the system shall be provide. (w) All the under-ground piping shall be suitably surface prepared and “coated and wrapped” with epoxy and fiberglass 'RP' tissue as per relevant specifications and as directed by the Engineer-in-charge. (x) All the above-ground piping shall also be surface prepared and painted on outside surface as per relevant specifications and as directed with approved make and type of paints, all as directed by Engineer-in-charge. (y) The PVC film fills made from virgin PVC shall be UV stabilized and of approved make in black colour having 17/19 mm cross flutes with 0.25 mm uniform thickness and double edge folding to meet the requirements of CTI code STD-136. It shall have a heat transfer area not less than 148 m²/m³. UV test shall be conducted as per ISO 4892 and impact test as per ASTM-D-256. The required amount of gluing compound to make modules of fills shall also be provided by the bidder. (z) AC pipes of suitable diameters and of class 15 grade as per IS: 1592 with spigot and including drilling of holes for fixing nozzles, hoisting, grouting in RCC ducts, erecting, jointing with required accessories, testing etc. including end caps complete as per specification and as directed for the full functionality of the system shall be provided. (aa) PVC pipes of suitable diameter, 6kg/ cm² rated conforming to IS: 4985 including drilling of holes for fixing nozzles, erecting, jointing with required accessories, testing etc. including end caps complete as per specification and as directed for the full functionality of the system shall be provided. (bb) Required number of Polypropylene Nozzles of suitable opening sizes to cater to varied water flow rate as per specification or as directed by Engineer-in-charge, complete with all the necessary hardware required for fastening the nozzles to the AC pipes including accessories, hardware etc. shall be provided.	

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(cc) Thermal performance Test involving measurement of water flow as per BS:1042 using pitot tube confirming to ISO:3966, air temperatures (WBT & DBT) using mechanically aspirated Psychrometer, water temperatures (HWT & CWT) using mercury in glass thermometers, air flow using anemometer as per specifications and as directed by the Engineer-in-Charge shall be done by the bidder. All the instruments shall be calibrated (at IIT/IISC) within 6 months prior to test. (dd) Minimum eight nos. of high intensity white flashing type aviation obstruction light at each level as per fig no 6.6 of appendix 6 of annexure 14 of ICAO regulations and Director General of civil aviation requirements and with corrosion resistant aluminum casting finished in stove enameled control gear suitable for 200/240V, 50Hz supply, complete as per specification shall be provided. Access should be provided to all aviation warning lights & flashing lights shall be flashed simultaneously. The life of AOLs shall be more than 10 years and with all the necessary fixing accessories as directed by Engineer-in-charge. The AOL system shall be provided with Photoelectric light detectors to monitor north sky for controlling the aviation warning lights. The lights should be switched on when the ambient light goes below 35 candelas and switched off when the intensity is more than 58 candelas. The lights should not be switched off due to momentary increases in light intensities due to lightning flashes or any other short bursts of light. The detectors should be complete with all the accessories, hardware etc. necessary for installation. The facility for Auto/Manual operation shall be provided. AOL distribution board shall be fed from emergency power distribution board. If high intensity lights are not available indigenously then Bidder shall import the same. (ee) All cables shall be heavy duty PVC insulated, GI wire / flat armored, PVC sheathed, 650/1100V grade FRLS copper cable as per IS: 1554 Part-I with owner's approval. The cable shall be clamped at every 750 mm along its run and will include all the hard ware required for its fixing and terminations etc. The Junction/Terminal boxes should be provided wherever required. The cable schedule shall be as under: 4C x 10 sq.mm Copper Cable for aviation warning lights		

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4C x 6 sq.mm Copper cable for power receptacles, stair case lighting and tail end aviation warning lights etc. 2C x 2.5 Sq.mm copper cable for local connection from local Junction box to aviation warning lights. (ff) The bidder shall also provide 240V x 15A single phase 3-pin outdoor, weather proof, industrial type switch- -socket outlets with inter-lock switches and fitted with metal cap. Required nos. of weather & dust proof (IP-55) 200 mm x 150 mm x 100 mm deep junction box (2/3/4 way) made out of 2mm thk G.S. with ELMEX type terminals, glands etc. complete shall also be provided. (gg) A Lighting Distribution Board and Control Panel for Aviation Warning Lights fabricated from 2 mm thk sheet steel, dust and vermin proof and removable gland plates at top and bottom with ELMEX type connectors and with suitable earthing including 2 nos. 32A TPN incomers, HRC fuses and 2 nos. 32A outgoing connections with HRC fuses and Common Flasher shall be provided. Two inputs will be provided by the Owner – one the main supply and the other as stand by. Automatic change over with suitable delay timers with Auto/ Manual operation shall be provided by the bidder. (hh) To care of ICAO and DGCA requirements, the bidder shall provide Temporary Aviation Warning Lights during construction above the 50m level from general ground level. (ii) The earthing and lightning protection system shall be as per IS: 3043 in general. Air terminators made out of 2m long 40 dia MSHDG round bar with pointed top and clamped at minimum 3 points with heavy duty G.I. clamps shall be provided. It shall be ensured that 1.2 m of the air terminator shall be projecting above the top of the cooling tower. (jj) A 50 x 6 thk GI flat Coronal band connecting all air terminator on one side and to the down conductor on the lower side complete with all the necessary fixtures, hardware etc. required for installation shall be provided. The clamps used shall be GI and heavy duty and shall be fixed approx 1m below the top of the cooling tower and clamped at the spacing not more than 1m C/C. Also, a 50 x 6 thk GI flat down		

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	conductor complete with all the necessary fixtures, hardware etc. required for installation shall be included. The down conductors on the top shall be connected to the coronal band and on the lower side they shall be connected to the test links. The clamping shall be at 1m C/ C with heavy duty GI clamps. The down conductors shall be in one piece as far as possible. The necessary joints shall be of fully welded type and not bolted type except at the test link. These conductors shall be embedded in the concrete of the shell with a minimum cover of 50mm and shall come out of the concrete at the top and bottom of ring beam. (kk) The Earth conductor to be provided by the bidder shall be made out of 40 mm Dia. MS round bar complete with all the necessary fixtures, hardware etc. required for installation and shall be supplied and installed between test link on one side and to the earth mat on the other side. Earthing electrode of dia. 40 mm MS rod x 3m long and making of earth pit as per IS:3043 complete with all the necessary fixtures, hardware etc. required for installation and connection to the earth mat shall also be in the scope of the bidder. (ll) Temporary lightning protection system during construction to meet ICAO and DGCA requirements shall be provided by the bidder, complete with all the necessary fixtures, hardware etc. required for installation. (mm) The bidder shall conduct tests on circuit as per specification or as directed by Engineer-in-charge. (nn) Required nos. of thermowell complete with all the necessary fixtures, hardware etc. required for installation shall be provided by the bidder and he shall also provide required nos. of Temperature and Pressure Gauges, RTDs, Flow Measuring Devices, etc. complete with all the necessary fixtures, hardware etc. required for installation. (oo) The butterfly valves shall be provided with 2NO+2NC potential free limit switches for BF valves complete with all the necessary fixtures, hardware etc. required for installation.	

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(pp) (i) Butterfly valve specification (REFER VOLUME III-F,SECTION 3) All the butterfly valves shall be complete with graduated position indicator, arrow indicating the flow direction. The valves shall be suitable for erection in any position (Horizontal/Vertical, etc.). The operating mechanism shall be mounted directly on or supported from valve body. All the butterfly valves shall be provided with hand wheel. Butterfly valves of size 350 NB and above shall be provided with reduction gear units. Valves shall close in clockwise direction. The hand controls shall be dimensioned to guarantee an easy maneuver under most severe conditions. The hand controls shall be provided with locking systems to avoid the disk assuming a not desired position during operation. The pulling force required on the hand wheel-rim shall not exceed 30 Kg. when operating the valve under full flow and operating pressure. The reduction units shall be watertight, complete with lubrication and position indicator. Only one type of valve shall be provided, either cast or fabricated type. Mixing of two types of valves is not considered acceptable. (ii) Ball valve specification (REFER VOLUME III-F, SECTION 2) (qq) Flanges For valves designed as per AWWA C-504, valve flanges shall conform to ANSI B16.1 Class 125 for CI valves and AWWA C-207 Class D for fabricated steel valves. The counter flanges shall conform to AWWA C-207 Class D. For valves designed as per BS: 5155 the flanges shall be as per BS: 4504. All the flanges shall be of slip-on and flat-face type. Flanges shall be fabricated from steel plates conforming to IS: 2062. 4.7.21 The bidder has to furnish the thermal design calculations in the form of design basis with necessary calculations, curves, references etc. of the cooling tower for approval of the owner/consultant. The bidder has to provide NDCT as per the actual thermal design calculations.		

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4.7.22 Performance Guarantee Performance/Acceptance test shall be carried out for determination of the thermal capability and verification of the guarantee of the cooling tower constructed at the project. (a) Test shall be conducted by accredited representatives of the contractor and owner. The contractor shall be given permission to inspect the tower in advance. Contractor's representatives shall witness all phases of the test and record the data jointly with Owner's representative. (b) The responsibility for conducting the test shall be with the contractor. (c) All test instruments required for the Performance test shall be provided by the contractor. The calibration of the test instruments shall be the responsibility of the contractor. (d) Calibration of the test instruments shall be carried out by an approved independent agency. The calibration of the equipment should not be older than six months before the test and should be valid at the time of testing. (e) The performance of cooling tower shall be compared with the performance required on the basis of the Performance curves for 80%, 90%, 100% and 120% of design water flow. (f) The performance test shall be generally as per CTI Code ATC-105 / BS: 4485 Part-II using characteristic curve method. (g) Every effort shall be made to conduct the test when the conditions are very close to the design condition. The station power load will be maintained near at its maximum. (h) The performance test shall be taken two times viz. at the end of May when the atmospheric temperature is maximum & in the month of July/August when it is wettest. However, no credit will be given for any uncalled improvements in the guarantee performance and to this extent contractor will not be eligible to receive any payment for interpretation of the performance clause in opposite direction.		

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In case the contractor refuses to carry out any modifications in spite of the initial performance test having shown definitely incorrect results, it shall be rightful for owner to take over the entire cooling tower along with all plants and tools made available by him at site of work and modify the cooling tower in accordance with that of Owner's own notions about adjustments/redesign as required and in that case contractor will have no claim on the Owner. It shall also be rightful for the Owner to appoint at contractor's risk and cost any separate consulting and/or contracting agency in respect of such adjustments/modifications. Contractor will be considered not to have acted in positive manner in respect of the failure to give the goods during the initial performance test in the event of contractors not having taken definite action within a period of one month of such initial performance test. (i) ACCEPTANCE CRITERIA shall be in terms of percentage capability of cooling tower as per PG test report. 4.7.23 Layout and Levels The layout fixing the location and levels of all structures shall be made w.r.t. plant's grids and bench marks given by the Owner. 4.7.24 Approval of Design and Drawings The bidder shall submit detailed thermal design basis and calculations in the form of a report to meet BS: 4485 requirements. The Owner/Consultant shall check and approve the thermal design. Once the thermal design is approved, the bidder shall submit detailed analysis & design calculations with 3 hard copies of each of the drawings for the cooling tower structures including design assumptions along with general arrangement drawings for the approval of the Owner/Consultant. The theoretical background utilized for developing the computer programmes shall be made available to the Owner. This shall be given by the bidder before approval of designs. One set of analysis & design calculation/drawings duly approved/marked with comments by the Owner shall be returned to the bidder. After receipt of approval from the Owner, the bidder shall submit copies of final detailed construction/fabrication drawings as per Distribution Schedule for the approval of the Owners. One set of drawings shall be returned duly		

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approved which will become the basis for taking up construction. The bidder shall also furnish to the Owner one good quality permanent negative (film type) of each of the final approved drawings. Additionally, all drawings shall be prepared in AUTOCAD and CD's shall be submitted to the Owner for record. The approval of the Owner shall not relieve the bidder from the responsibility of adequacy of the design and correctness of the drawing. 4.7.25 Vendor List for NDCT For vendor list of NDCT REFER MASTER SPECIFICATION VOLUME –II SECTION 11. 4.8 <u>RAW WATER SYSTEM AND OTHER PUMP HOUSES :</u> <u>RAW WATER & FIREWATER PUMP HOUSE</u> 4.8.1 Pump House shall be provided for housing raw water/fire water pump. Separate bays shall be provided for each pump by providing intermediate dividing RCC piers between the pumps. 4.8.1.1 (a) All pump houses shall be provided with minimum two sets of stop logs for the respective pump bay dimensions along with electrically operated hoisting arrangements. Steel embedments required for stop logs shall be provided for all bays. (b) All bays of pump houses shall be provided with a removable trash rack including electrically operated hoisting arrangements and cleaning arrangements. Moreover, one spare trash rack of respective pump bay dimension shall also be supplied for each pump house. (c) Stop logs, trash racks and hoists shall be supplied in accordance with the specifications given elsewhere. (d) The fire water pumps shall have positive suction. The raw water and fire water pumps shall draw water from the raw water reservoir. The arrangement for intake of raw water to the raw water pump house shall be such that all pumps shall be operative even if either of the compartments of the reservoir is under maintenance.		

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(e) All pump houses shall be adequately equipped with drinking water and toilet facilities. 4.8.1.2 The sub-structure of all pump houses shall be RCC with M-30 grade of concrete conforming to IS: 456. The superstructure of all pump houses shall consist of either structural steel frames or RCC portals with minimum M 25 grade of concrete. 4.8.1.3 All pump houses shall be provided with a separate maintenance bay for maintenance of various equipment and an electrical switchgear room. Length of maintenance bay shall be adequate for one pump maintenance. Pump house where flow regulation is required, suitable steel gate stop logs along with the electrically operated hoisting arrangement shall also be provided. 4.9 <u>PLANT WATER SYSTEM STRUCTURES/COMPONENTS</u> The description of some of the major structures/components covered under the Plant Water System Package is given below: 4.9.1 Raw Water Treatment Plant (a) The stilling chamber aerator, flash mixer, raw water channel shall be of RCC and shall be partly underground and partly over ground. These shall be watertight structures. (b) The clariflocculators shall be of RCC construction including inlet, outlet channels & distribution chamber. (c) The sludge sump & dirty backwash sump shall be an underground RCC pit., Part of the pit shall be covered with RCC slab for supporting the vertical sludge pumps. Sludge from clarifier should be taken to ash slurry sump & Water from dirty backwash sump shall be taken to stilling chamber. For all the pump houses, roof shall be RCC form finish. Filter house building shall have RCC roof. The pump house shall be complete with brickwork, plastering, doors, windows, rolling shutters, flooring, painting and all other items necessary for satisfactory performance of the building. Brick masonry		

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	wall with suitable windows and doors will be provided in accordance with Architectural concept described in Section-IV of this Volume. (d) Pretreatment chemical house shall be a two storeyed concrete framed building having chemical storage area, ozonization system in ground floor & chemical solution tank on 1st floor. The building shall be complete with brickwork, plastering, doors, windows, rolling shutters, flooring, plaster, painting, roofing, etc. and all other items necessary for satisfactory performance of the building. The building shall have toilets, drinking water overhead tank and the scope shall include supply and fixing W.C.'s urinals, showers and all plumbing sanitary and other work required for satisfactory completion of the above building. The tanks and parts of floor slabs shall be lined with Acid/Alkali proof tile lining. (e) Filtered Water reservoir shall be of watertight R.C.C. construction and form finished having two compartments covered with RCC roof form finish. It shall be partly underground and partly over ground. Vent pipes shall be provided at roof. Filtered Water reservoir including RCC roof shall be designed as uncracked structure as per IS: 3370. Food grade protective coating as per BS 1881 part I to IV shall be applied to internal surface & soffit of water reservoir. Total Capacity of Filtered water reservoir excluding freeboard shall be 45000 m³. A free board of 500mm shall be provided. Filtered Water pump house shall be complete with brickwork, plastering, doors, windows, rolling shutters, flooring, painting and all other items necessary for satisfactory performance of the building. MCC room, if required as per system design, shall also be provided. Brick masonry wall with suitable windows and doors shall be provided in accordance with Architectural concept described in Section-IV of this Volume. (f) All water tight structures shall have smooth finish in concrete and shall be given cement wash for decent appearance. All open pits at ground level shall be provided with handrail made with 32 NB galvanized pipe. All open pits shall be provided with 150 high RCC kerb. All drainage and trenches shall be provided with	

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	removable RCC slab at top. These trenches at rail/road crossing, if any, shall be designed for appropriate heavy loading. For all outdoor trenches, the side walls shall project 300 mm above finished ground level. All trenches & precast RCC covers shall be provided with edge angle. (g) All E&M equipments such as pumps, blowers, centrifuge etc in water pre-treatment plant, DM Plant, Effluent Treatment Plant, Sewage Treatment Plant etc shall be provided with permanent housing arrangement with RCC roof, side cladding, flooring, doors/windows, ventilation arrangement, lifting arrangement etc." 4.9.2 CW Treatment cum Ozonization Building & Side Stream Filtration Plant: CW treatment cum Ozonization building shall be a RCC framed single storey building with brick cladding. Foundation for equipment shall be RCC construction. 4.9.3 D.M. Plant (a) Dimension and height of the building shall be decided based on equipment layout and height of the vessels accommodated inside. The DM plant building, adjoining control room and laboratory shall be provided in an RCC framed building with RCC roof form finish with brick cladding. Control room and switch gear room shall have a cable vault below. Control room and laboratory shall be air conditioned. False ceiling with gypboard shall be provided in this area. Underdeck insulation shall be provided in the A/C area as well as in the Air washer room. Staircase in the Control static room Complex shall be extended to the roof also. Flooring on Control room shall be anti-static PVC tiles. Toilet shall be provided in the ground floor. In case a transformer yard is provided, the wall in front shall be designed to satisfy fire rating as per TAC. (b) Floor where acid/alkali spillage are expected shall be isolated with RCC kerb and the flooring inside shall be of acid/alkali resistant tile. The drains inside the building carrying acid/alkali mixed discharge shall be provided with anti corrosive epoxy lining. Outside the building upto neutralising pit, these drains shall be provided with	

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Acid resistant brick lining. Specification for lining is given elsewhere in this document. Acid/alkali unloading and storage area outside the building shall also be provided with kerb with a sump inside. This area shall also be provided with Acid resistant brick lining. (c) Neutralizing pit shall be designed as a water retaining structure with external damp proofing. Floor and walls of the pit shall be given Polypropylene glass reinforced lining. Ceiling as well as floor, supporting pumps for pumping the clear water from neutralising pit shall be given heavy duty epoxy screed lining. (d) D M water storage tank outside the DM plant shall be supported on sand pad with ring wall. (e) Walls inside the DM plant area shall be provided with chlorinated rubber based painting. Main door shall be rolling shutter of adequate size to permit entry of the largest vessel. All doors and windows in the D.M. plant area shall be of aluminum glazed type. Windows shall be of sliding type. 4.9.4 Pipe/Cable Trestles and Foundations No cable/pipe trench is envisaged. All cables & pipes in outdoor area shall run above ground over steel trestles or other supporting structures for easy inspection & maintenance except in some localized area where the same can run in R.C.C. trenches. In case over ground routing is not feasible due to site constraints, the pipe/cable shall be routed through duct-banks. A minimum clearance (clear head room) of 8.5 m shall be kept for all over ground pipe/cable trestles for all road/rail crossings. In other areas, the clear height shall be 4.0m (minimum) from ground/grade level except in pipe corridor between main plant and plant water system which shall be 5.0m (minimum) from ground/grade level. All trestles shall be provided with continuous walkway of minimum 750mm width with handrail and toe-guards all along the length of the trestle along with approach ladder near roads, passageways etc.		

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Before and after the rail/road crossing, a barrier of suitable height shall be constructed so as to prevent the approach of cranes (having height more than 8.5m) etc. up to the pipe/cable rack trestles. Four-legged trestles & foundations are to be provided for supporting the pipe/cables at suitable intervals. Four legged trestles are to be provided mainly at intercepting location of branch pipe rack (maximum distance 100 m) Crossover, operating platform & necessary trussed resisting arrangement at pipe bend shall be provided as required. 4.9.5 Raw water reservoir Raw water reservoir shall be developed in designated area (as shown in plot plan) for collection & storage of raw water. Storage tank shall be of RCC Construction with two compartments in which one shall be operative & other in maintenance. In case of emergency both the compartment will be operational. Sufficient freeboard shall be provided above FRL. Each compartment shall be 24000 m³ capacity. Necessary arrangement should be made in tank for in coming & outgoing & overflow pipes. The Inlet arrangement shall be such that the energy of the incoming water is sufficiently dissipated before entering the reservoir to avoid erosion and necessary concrete erosion treatment work shall be in the scope. The tank shall be provided with adequate handrails at the top bench with the 2 m wide pathway for approach/inspection/maintenance/safety purpose. Storage tank structure shall be designed as per IS-3370 & considering water level at GL. No pressure relief valve arrangement shall be considered to counter uplift pressure. 1 m wide walkway with hand railing shall be provided over the central divide wall. 4.10 <u>WASTE WATER SYSTEM STRUCTURES/COMPONENTS</u> All necessary civil/structural work for wastewater treatment plant described in Volume VI B of this specification shall be under scope of bidder. The description of some of the major structures/components covered under the Waste Water System Package is given below:		

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Coal pile area run-off shall be led to a R.C.C settling tank with two (2) compartments. Top of tank shall be 500mm above surrounding finished grade level to restrict ingress of storm water from adjacent areas. The pond shall have adequate capacity as per design requirement as specified in sec II of VOLUME VI B of this specification. At the downstream of pond, RCC overflow weir and sump shall be provided. Design and detailing of pond shall be as per good engineering practice so as to satisfy functional requirement as specified in Section-II of VOLUME VI B of this specification. Necessary arrangement shall be provided in inlet drain carrying coal pile area run-off so that one settling pond can be operative while the other one under maintenance. In case of exigency, both the settling tanks will be operational. The tank shall be provided with adequate handrails at the top bench with 2 m wide pathway for approach/inspection/maintenance safety purpose. The Power House service water waste shall be collected in a RCC underground oily waste retention pit, which is also under the scope of this package. Necessary pumps and supporting floor/maintenance area shall be provided. This effluent will finally be treated in corrugated plate interceptor. Foundation for CPI shall be designed as per IS: 456. Oil storage and handling area run-off shall be collected to a conventional baffled oil water separator of API design (battery limit shall be as shown in tender drawings). This oil water separator shall be an underground RCC structure having RCC baffle wall and overflow sump for collecting water at outlet end. An oil collection pit shall be provided on sidewall of oil water separator. This structure shall be designed as uncracked section as per IS: 3370. The structure shall project at least 300mm above finished grade level. Handrail shall also be provided around the pit. The overflow sump shall be covered at top over which pumps shall be installed. RCC sump for collecting boiler blow down shall also be under the scope of this package. Civil work for outlet of this effluent shall also be under the Scope of this Package. NDCT blow down, sludge drain from NDCT, C.W.floor wash, effluent from water treatment plant (pre & post) shall also be take into ETP. As far as possible, the effluent from all the sources shall be brought to ETP by gravity. Wherever the flow by gravity is not possible, the pumping arrangement with necessary piping shall be provided.		

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There will be a central monitoring basin sized for holding wastewater for 8 hours (minimum) before entering into ETP. The earthen pond shall have adequate capacity as per design requirement & with 750 mm free board. Top of earthen dyke shall be 500mm above finished grade level. 2 m wide pathway shall be provided all around the pond for inspection/maintenance etc. The pond shall be of such construction as to prevent pollution of ground water by seepage of any wastewater having side slopes and bottom lined with minimum **1.0mm HDPE for minimizing seepage loss**. Over the HDPE lining, PCC blocks of minimum 75mm thickness having interstices filled with cement-sand mortar shall be provided. Filter media shall be suitably designed & provided below HDPE liner.

From Central Monitoring Basin, wastewater shall be pumped to R.C.C watertight stilling chamber partly underground & partly overground. From stilling chamber, water would be directed to High rate solid contact type clarifiers (HRSCC).

HRSCC shall be of RCC construction including inlet, outlet channels & distribution chamber. The treated water from HRSCC shall be stored in a RCC clear water storage tank. Water from storage tank shall be utilized in Ash handling plant, CHP/AHP dust suppression etc. Generated sludge shall be collected in RCC sludge sump & then pumped to ash slurry sump.

Waste water chemical house shall be a two storied concrete frame building having lifting arrangement by monorail hoist, storage area at ground floor & chemical solution tank in 1st floor. The building shall have toilets, overhead water tank. The building shall be complete with brickwork, plaster, painting, doors & windows, rolling shutter, roof etc and all other items necessary for satisfactory performance of the building. The solution tank & parts of floor slabs shall be lined with Acid/Alkali proof tile lining.

All other civil works including drains/MS pipe with fitting/RCC pipes/pipe racks including foundations etc. for successful completion and operation of waste water treatment plant shall also be done

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4.11 <u>CW AND ACW PUMP HOUSE</u> Dimensions, sizes depth of CW/ACW pump house, control building etc. if indicated in bid specification are indicative and bear minimum only. The bidder should note that the cost implication, if any, due to change in the dimension, sizing etc. as per the equipment supplier's requirement is deemed to be included in the offer. Covered R.C.C. channel from Cooling Tower basin to CW Pump House shall be minimum 500 mm above F.G.L. and road-crossing portion shall be designed for Class 'AA' traffic. 4.11.1 CW and ACW Pump House Cooling water (CW) pump house for housing cooling water pumps and auxiliary cooling water pumps shall be provided. Separate bays shall be provided for each pump by providing intermediate dividing piers /walls of RCC between the pumps. (a) (i) CW and ACW Pump Houses shall be provided with two sets of stop logs for the respective pump bay dimensions along with electrically operated hoisting arrangements. Steel embedment required for stop logs shall be provided for all bays. (ii) CW/ACW bays of pump houses shall be provided with a removable trash rack/screen including electrically operated hoisting arrangements and cleaning arrangements. Moreover, one spare trash rack of respective pump bay dimension shall also be supplied for pump house. (iii) Stop logs, trash racks/screens (typ) and hoists shall be supplied in accordance with the specifications covered elsewhere, in this specification. (b) The sub-structure of CW/ACW pump houses including their fore bays shall be RCC with M-30 grade concrete conforming to IS: 456. The superstructure of all pump houses shall consist of structural steel		

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frames or RCC portals with minimum M 25 grade of concrete. The base slab and side walls of CW channel, fore bay and sump for CW/ ACW pump house shall be designed as non-cracked section. (c) CW and ACW Pump Houses shall be provided with a separate maintenance bay for maintenance of various equipment and an electrical switchgear room. Length of maintenance bay shall be adequate for one pump maintenance. However, minimum length of maintenance bay for CW pump house shall be 10 m. (i) The dimensions of the cell for CW and ACW pumps shall be governed by the guidelines of the Hydraulic institute Standards recommendations, The Contractor shall have to carry out sump model studies to ascertain smooth and laminar flow through the bell mouth thereby avoiding entry of eddies or vortices entering the pump column. The contractor shall accordingly provide special features (baffle walls, swirl prevention device, etc, based on sump model studies. The sump model studies shall be witnessed by representative of the owner and his consultant. (d) For all other structures other than the CW and ACW pump house where flow regulation is required, suitable steel flap/slucice gates shall be provided. Stop logs gates shall be provided for CW and ACW pump house. The steel flap/slucice gates/stop log gates shall be provided with self engaging and disengaging lift beams and electrically operated hoisting arrangements, as required. The steel flap /slucice gates/stop log gates shall be provided with proper rubber seal so as to avoid any leakage of water. Rubber seal provided shall be tested in accordance with the relevant Indian Standards. The stop log gates shall be checked for water tightness and smooth operation in dry and wet conditions. The leakages, if any, shall be measured and it shall not be more that 5 liters per minute per meter length of the seal under maximum head. (e) All stop logs gates and trash racks shall be of structural steel, which shall be treated for anti corrosive treatment as specified elsewhere in the tender document. The guide rails meant to facilitate raising and lowering of stop log gate/channel that are welded to guide channel		

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embedded in concrete groove or attached to the sides of stop log shall be of stainless steel grade SS-316 L conditions. All mild steel parts other than the stop logs and trash racks used in the water retaining structures shall be hot double dip galvanised and epoxy coated. The minimum coating of zinc shall be 610 gm/sq.m for galvanised structures and shall comply with IS: 4759 and other relevant codes. Galvanising shall be checked and tested in accordance with IS: 2629. The galvanising shall be followed by the application of an etching primer and dipping in black bitumen in accordance with BS: 3416. 4.11.2 Stop Logs and Screens/Trash Racks (a) Technical specification of zinc spray painting for stop log gates, screen and corresponding guides for CW pump house/raw water pump houses/other pump houses (i) Cleaning before zinc spray painting Surface of the fabricated items shall be thoroughly blast cleaned to near white metal surface as per Swedish Standard (SA 2 ½) from oil/grease. Mill scale and other loose metal deposition due to weld droppings shall to be cleaned by grinding wheels. (ii) Zinc spray painting Zinc spraying shall only be done by zinc rich paint (normally minimum 90 % m/m metallic zinc content of dry film) or by a low melting point zinc alloy within 4 hours of blasting. (iii) Minimum coating of zinc The minimum coating of zinc in zinc spraying shall be 610 gm/sq.m. Zinc shall be conforming to any grade specified in IS: 209 or IS: 13229.		

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(iv) Minimum dry film thickness a. Spray painting with zinc rich primer (DFT-50 microns) to be applied within 4 hours of blast cleaning. b. 1st coat of finishing zinc rich spray painting (DFT-75 microns) of CORECOAT ZRC 3- component system. c. 2nd coat of finishing zinc rich spray painting (DFT-75 microns) of CORECOAT ZRC 3- component system. d. Final coat of High Build Epoxy finish paint (DFT-100 to 150 microns) of CORECOAT FC 150. e. Minimum DFT shall not be less than 300 microns. (v) Application of primer and finish coats The time interval between each coat and application procedure and other details shall be as per manufacturers specification. (vi) Freedom from defects The zinc coating shall be uniform, adherent, reasonably smooth and free from such imperfections as flux, ash patches, black spots, pimples, lumpiness, runs, rust stains, bulky white deposits etc. (vii) Applicability of agreed technical specification This Technical Specification covers for zinc spray painting of Stop Log Gates, screens & corresponding guides only, other technical parameters described in Technical Specification for Civil, structural and Architectural works specified elsewhere, shall remain unaltered. (b) The stop log units shall be operated under balanced head and they shall be designed for maximum water head to which they shall be subjected to. The stop log shall be used only for the maintenance/		

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	inspection of pumps. These are not to be designed for lowering under flowing water. The stop log shall be operated by means of monorail trolley with electric rope hoist and a lifting beam, which shall engage and disengage automatically with stop log in required position. Lifting beams shall be designed and fabricated by the Bidder in coordination with the manufacturer of monorail with electric hoist. The structural design of stop log shall conform to IS: 5620. (c) Trash racks shall be installed in vertical position. Trash racks shall be designed for differential head of 1 m of water column. Each unit of trash rack shall consist of vertical square bar and horizontal square bar of minimum size 10 mm square from durability point of view. The grating shall be pressure locked. Size of the openings for the trash racks shall be 100 mm x 100 mm (clear). All trash racks should be capable of being lowered in the associated stop log grooves to enable drawal of clean water while a particular trash rack is raised for cleaning purposes. Details of block-outs to be provided in structural concrete for stop logs and trash racks shall also be shown on the drawings. (d) All the design computations and drawings for the structural and mechanical parts including hoist supporting structure and connections of various components for stop logs and trash racks shall be submitted by the Bidder for approval of the Owner before the manufacture is taken up. Detailed drawings of mechanical parts such as wheels, wheel parts, hoists and various component parts of the hoists shall also be supplied along with calculations. (e) Bidder shall prepare all necessary shop drawings for the fabrication of stop log/trash rack and shall be responsible for the correct fitting of all parts. Any fabrication done before the shop drawings are approved, shall be at the Bidder's risk. The Owner shall have the right to instruct the Bidder to make any change in the Bidder's fabrication details, which may be necessary in the opinion of the Owner to make the finished construction conforming to the requirements and intent of these specifications without additional charges to the Owner. Fabrication shall conform to the requirements of the relevant Indian Standards.	

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(f) Approval of the Bidder's drawings by the Owner shall not relieve the Bidder of any part of the Bidder's responsibility to meet the requirement of these specifications, or of the responsibility for the correctness of the drawings. The Bidder shall furnish the Owner for record purposes complete sets of the final shop drawings from which the stop logs/trash racks etc. have actually been fabricated. Dimensions, tolerances, types and grades of materials and various component parts shall be shown in sufficient detail to enable the Owner to make a complete review and thoroughly check the drawings. (g) All components of stop logs and trash racks covered under this specification shall be subjected to inspection tests by Owner during manufacture at works. Shop tests shall include all tests to be carried out at Bidder's works of his sub-bidder and at works where raw materials are supplied for manufacture. The tests to be carried out shall be included but not be limited to the tests described herein. (h) Bidder shall conduct all tests according to relevant I.S. or according to relevant British/American Code of Practice in the absence of suitable I.S. Code to ensure that all the components and accessories of stop logs, trash racks, bulk heads, hoists etc. to be supplied as per the contract are confirmed to the requirements of this specification. The accessories e.g. bearings, couplings, etc. shall be subjected to tests as per Manufacture's Standard. The applicable test reports/ certificates shall be submitted to Owner. (i) Tests on motors shall be conducted as per latest revision of IS: 325 and IS: 4029. Tolerance in dimensions shall be within the limits as prescribed in the relevant I.S. Codes and Standards. Surface defects shall be removed as required by the relevant Standards. All local repairs, grinding or machining shall be smoothly blended into the surrounding surface. (j) Complete stop logs, trash racks including exposed surfaces of hoists, gear housing, shafting bearing pedestals, base plates and other machinery shall be fully galvanised. (k) After the equipment has been installed in the field, it shall be operated and tested by the Owner and when so operated and tested, it shall		

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	meet all the requirements of specifications and drawings. The gates shall be raised and lowered several times for their full length of travel. The primary requirements for acceptance shall be that each stop log operates smoothly and guarantees satisfactory water tightness. Any equipment required for inspection and testing shall be provided by the Bidder and no such equipment shall be supplied by the Owner. All defects detected during testing shall be repaired to the satisfaction of the Owner. After completion of all installations, the frames and guides etc. shall be thoroughly cleaned of dirt, dust, rust and concrete spoils or other foreign materials. (l) The stop logs shall be thoroughly cleaned with particular attention being paid to bearing and seating surfaces. The mechanical hoist equipment shall be properly lubricated. Each set of stop logs, Bulkheads and Trash Racks shall be tested under dry conditions and under full water load conditions, by traversing the item concerned from its extreme raised position to full seating position and return at least thrice. (m) Upon successful completion of such tests, final acceptance shall be made by the Owner. But before a completion certificate is issued by Owner, the Bidder shall have to remove from the area of operation, on which the work has been executed, all scaffoldings, surplus materials, rubbish and other materials. If the Bidder fails to comply with this requirement, the Engineer shall get it done by other agencies at Bidder's Cost. (n) The Bidder shall strictly follow at all stages of fabrication, transportation and erection of steel structures, raw materials and other tools and tackles, the stipulations contained in the Indian Standard Safety Code for erection of structural steel work IS : 7205. Local Statutory labour safety regulations are also applicable. (o) The Bidder shall furnish to the Owner a complete and unused set of all special tools and tackles, which are necessary or convenient for erection, commissioning, maintenance and overhauling of any of the equipment provided under the specification. The tools shall be shipped or transported in separate containers clearly marked with the name of equipment for which they are intended.	

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(p) Leakage tests shall be carried out with the stop logs lowered onto the sill. Before that observation for leakage, the stop logs shall be raised and lowered about one meter several times in order to dislodge any debris that might have lodged in the side and bottom seals.

(q) Materials for the various components of Stop logs:

Sr. No.	Component parts	Recommended	Reference Materials
(i)	Stop log/Gate Leaf, Stop logs / Gate frames and embedded parts, Guide Shoe.	Structural Steel	IS : 2062
(ii)	Wheels (the hardness of wheel track surface shall be kept 50 points higher than that of wheel tread), Guide.	Cast steel	IS : 1030
(iii)	Wheel axles, wheel track	Corrosion Resistant steel	IS : 1570
(iv)	Seals	Rubber	IS : 5620 Appendix-D
(v)	Bearings	SKF or equivalent	04 Cr 19 Ni
(vi)	Seal seats, Lifting pin	Stainless Steel	IS : 1570
(vii)	Guide Rails for stop log and trash racks	Stainless Steel SS 316 L	

(r) Materials for Trash Rack shall be IS 2062.

4.12 FUEL OIL HANDLING SYSTEM

Structural arrangement, foundation system, cladding, miscellaneous requirement, finishes, etc., shall be as specified elsewhere in this specification.

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4.12.1 Transferring/Pressuring Pump House The super structure of the pressuring & transfer pump house shall be of RCC framed structure with brick cladding around these pump houses. A separate maintenance bay and MCC/Control room shall also be provided in these pump houses. 4.12.2 Pipe/Cable Trestles and Foundations Four legged trestles and foundations are to be provided for supporting the pipelines/cables at suitable intervals. Cross overs, operating platforms and necessary thrust resisting arrangement at pipe bends shall be provided as required. 750 mm wide platform shall be provided as a walkway along the length of the trestles. 4.12.3 RCC dyke wall of minimum 1.25m clear height above finished ground level shall be constructed around HFO & LDO day tanks as per system requirement specified in mechanical specifications for fuel handling system. All civil, structural & architectural works not specifically mentioned but required for satisfactory completion & commissioning of fuel oil handling system are included in the scope. HFO, LDO tank shall be supported on sand bitumen pad with ring wall. 4.13 <u>AUXILIARY PLANT/NON PLANT BUILDINGS</u> List of Auxiliary plant/Non plant buildings is given in clause No.3.0 of this section. In Auxiliary plant, miscellaneous building will be of RCC construction, excepting CW and ACW pump house superstructure. In Non plant, all buildings will be R.C.C construction excepting workshop, watch tower etc. Roof of all building shall be cast-in-situ R.C.C slab with removable shuttering. Workshop, watch tower will be of structural steel construction.		

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4.14 PIPE/CABLE TRESTLES AND FOUNDATIONS

All cables & pipes in outdoor area shall run above ground over steel trestles or other supporting structures for easy inspection & maintenance except in Transformer Yard area, Switchyard area and some other localized area where the same can run in R.C.C. trenches. In case over ground routing is not feasible due to site constraints, the pipe/cable to be routed through duct-banks subject to the Approval of the owner.

A minimum clearance (clear head room) of 8.0m shall be kept for all over ground pipe/cable trestles for all road/rail crossings. In other areas the clear height shall be 4.0m (minimum) from ground/grade or crest of the road whichever is higher. All trestles shall be provided with continuous walkway of minimum 750 mm clear width with handrail and toe-guards all along the length of the trestle along with approach ladder near roads, passageways etc.

Before and after the rail/road crossing, a barrier of suitable height shall be constructed so as to prevent the approach of cranes (having height more than 8.0m) etc. up to the pipe/cable rack trestles.

Trestles & foundations are to be provided for supporting the pipe/cables at suitable intervals. Four legged trestles are to be provided mainly at intercepting location of branch pipe rack (max. distance 100m). Crossover, operating platform & necessary thrust resisting arrangement at pipe bend shall be provided as required.

4.15 ROADS

Main access roads to the power plant shall be from National Highway NH-6. All plant service roads of this package will be partly RCC road on sub grade and partly Bituminous concrete road laid over water bound Macadam on sub grade providing access to all truck sized building doors and all structures requiring maintenance by vehicles. Extent of different types of road shall be as shown in drawing. RCC pavement will be provided at areas requiring parking facilities. Bituminous topping of all bituminous plant road shall be done after completion of plant construction and maintenance of such road till such time shall be in scope of contractor.

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	(a) All Roads shall be designed in accordance with the provision of the latest edition of the relevant I.R.C. codes of practice. (b) For concrete road, the sub-grade shall be prepared with well-compacted selected soil/earth to achieve 95% of the standard density at optimum moisture content. Sub-base shall be 300mm thick rubble soling for filled/loose soil and 150 mm thick for cutting area (consolidated thickness). Over that 150mm thick WBM laid in two equal layers shall be applied and then dry lean concrete M-15 of 100 mm thick shall be applied. Top concrete slab shall be M-35 as per design thickness with bottom 125 micron polythene sheet. All above shall be as per 'MORTH' specification. (c) For bituminous road, the sub grade shall be prepared with well-compacted selected soil/earth to achieve 95% of the standard density at optimum moisture content. Sub base shall be 300 mm thick (consolidated thickness) with murrum/selected soil/crushed stone (grading-1), 300mm thick rubble soling for filled / loose soil and 150 mm thick for cutting area (consolidated thickness) and 100 mm thick well compacted cushion of murrum/selected soil. The wearing course shall be 75 mm thick bituminous macadam binder course with 10-12 mm seal coat laid on 150 mm thick (compacted thickness) water bound macadam course in two equal layers. (d) All roads as shown in shall have to be constructed as per the technical specification. However, additional roads and access to individual buildings/structures/facilities within scope of this specification which are not specifically shown in layout but required from functional requirement shall be provided by the Bidder. Minimum carriageway and shoulder width shall be as per the drawing enclosed with bid documents. Shoulders width shall be added to the carriageway widths to obtain minimum roadway widths.	

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<table><tr><th>Road Type</th><th>Classification</th><th>Carriageway Width (m)</th><th>Shoulder (m)</th><th>Roadway Width (m)</th></tr><tr><td></td><td>Plant access Roads</td><td></td><td></td><td></td></tr><tr><td>(i)</td><td>Primary Road with Access for 500 T crane</td><td>14.0</td><td>1.0</td><td>16.0</td></tr><tr><td>(ii)</td><td>Primary Road without access for 500 T crane (internal Road)</td><td>7.0</td><td>1.5</td><td>10.0</td></tr><tr><td>(iii)</td><td>access ways</td><td>5.0</td><td>0.5</td><td>6.0</td></tr><tr><td>(iv)</td><td>access ways</td><td>4.0</td><td>-</td><td>4.0</td></tr></table> Finished top (crest) of roads shall be 250mm above the surrounding grade level. Access roads to every system/facility are also included in the scope of work though it is not shown in Bid drawing.					Road Type	Classification	Carriageway Width (m)	Shoulder (m)	Roadway Width (m)		Plant access Roads				(i)	Primary Road with Access for 500 T crane	14.0	1.0	16.0	(ii)	Primary Road without access for 500 T crane (internal Road)	7.0	1.5	10.0	(iii)	access ways	5.0	0.5	6.0	(iv)	access ways	4.0	-	4.0
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4.16	<u>SURFACE TREATMENT</u>																																	
4.16.1	Boiler Area																																	
	The entire area from Power House to Chimney shall be paved with reinforced cement concrete 150mm minimum and sloped to drains. Immediately adjacent to these areas, RCC roads shall be provided as required for access to equipment. Minimum 10 mm dia. HYSD bars shall be provided at a maximum spacing of 200mm in top and bottom layer along both directions.																																	
4.16.2	Transformer Areas																																	
	Oil cooled equipment, such as transformers, shall be located within concrete basins filled with gravel along with ant weed treatment. The individual basins shall be connected by pipeline to a separate chamber/oil pit for																																	

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collection and further reclamation of oil through oil water separators, if necessary. Drains shall be adequate to remove full discharge from deluge system used for fire control. Transformer Yard shall be paved with reinforced cement concrete of minimum 150 mm thickness (requirement of reinforcement shall be same as given for Boiler area pavement). Rail track embedded in concrete pavement and/or roads in transformer yard for movement of transformer and in front of A row for movement of generator stator shall be in the scope of Bidder. 4.17 <u>DRAINAGE SYSTEM</u> Yard Drainage System Scope of drainage shall include following (a) Drains surrounding the buildings and systems and work area within the scope of this specification. (b) Interconnection of drains with the existing/plant water drainage system/main outfall location Drain shall be of RCC construction. Necessary structures shall be provided for crossing of roads/water ways on the way. Storm water from drainage system in Sl. No. (a) and (b) above, shall be led into Rain water harvesting pond . Drains shall be designed as a network covering the plant area as per specification. This plant area drainage shall be led into rain water harvesting pond. Attempts will be made to convert construction drains into main drain as far as practicable. Auxiliary/Branch drains shall cover individual grades to terrains; collect storm water and other non-contaminated discharge from plant buildings and then be connected to Main drain /main out fall at suitable locations. The		

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invert of the in-plant peripheral drains shall be kept such that water can be discharged by gravity to the main/trunk drain under all condition. RCC pipe culverts/box culverts will carry drainage under intercepting roads and railway tracks. Effluent drains shall completely be separated from storm water drain. Suitably designed underground storm water RCC piping on the basis of design loads specified elsewhere in this specification shall be limited to required areas where surface drainage ways are not desirable or practicable from other functional point of view. Class of RCC pipes shall be decided by Bidder as per design requirement. For pipe drains, concrete pipes of minimum grade – Class NP2 will be used. However, for road concrete pipes of Class NP3 will be used and for rail crossing, railway norms shall be followed. R.C.C. Manholes will be provided at maximum 30m intervals along the length, at connection points and every change of alignment, gradient or diameter of pipeline. The drains shall generally be of open type RCC rectangular construction. R.C.C. drains shall be covered with perforated R.C.C. pre-cast slab (M-25) of minimum 75mm thickness with provision of openable galvanized steel grating covers at every 4.0m intervals. Similarly, all drains along the periphery of buildings shall also have perforated R.C.C. pre-cast slab (M-25) of minimum 75mm thickness with provision of openable galvanized steel grating covers at every 4.0m intervals. Design of such drain covers shall be done considering loading as per Cl. No. 3.1.2.1 (d) Vol. VI-A/S-II of Specification. In areas where vehicular loads would be coming, pre-cast RCC covers of suitable thickness without perforations and designed for the vehicular loads shall be provided. In Boiler and ESP area, drains shall be provided with galvanized steel grating. For areas covering vehicular movement, pre-cast covers shall be provided. The width of the pre-cast planks shall be so designed that it can be easily handled during maintenance period. Grating shall be as per Cl. No. 5.0 of Vol. VI/A / S-III. The storm water drainage shall also cater for discharge of treated waste water.		

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The drainage system shall be designed taking into account runoff resulting from 1 hr rainfall intensity with a return period of 100 years. These values are based on the recommendations of the Indian meteorological department. Run-off coefficient for open ground area (unpaved) shall be minimum 0.80 and for paved area and other covered surface including roads the same shall be considered as 1.0. Surface drains will normally have a slope of 1 IN 1000 along longitudinal direction and RCC pipes to have such slopes such as to have effective discharge. RCC or masonry structures will be provided at drops/falls to prevent scouring. Drops/falls shall be provided on both sides of box/pipe culverts. Minimum self-cleansing velocity should be adopted as 0.7m/sec but the velocity of flow should not be more than 2.4 m/sec for concrete drain, however, it is recommended to maintain the maximum velocity within 1.2 m/sec. Open RCC rectangular drains shall be provided for storm water. The thickness of sides & bottom shall be minimum 100 mm or as per design considerations whichever is higher. RCC culverts shall be provided for road and rail crossing. Drains shall be provided on both sides of the roads Inside surface of the drain will have smooth neat cement finish over screed concrete. Invert of the drain shall be decided in such a way that the water can easily be discharged to the recommended nearest main plant drainage system. The minimum slope of the drain shall be 1:1000 longitudinally to take care of the silting problems. 4.18 <u>SANITARY SEWERAGE SYSTEM</u> Sewers shall be designed for a minimum self-cleansing velocity of 0.75 m/sec and the maximum velocity shall not exceed 2.4 m/sec and shall be connected to sewerage treatment plant. Manual on Sewerage and Sewage treatment (published by Central Public Health Environment Engineering Organization, Government of India) shall be followed for design purpose. Plant effluents shall be handled in separate drains/ pipes. The plant effluent		

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drain shall not be mixed with storm water drain or sewer lines. Two types of system shall be adopted for this purpose: 1) Centralized sewage treatment plant along with pipe networking system for transfer of sanitary sewage from different plant & non-plant buildings to sewage plant inside plant boundary 2) Septic tank, up flow filter, chlorination, soak pit arrangement for the buildings (mainly at ash dyke area) required for plant operation outside plant boundary 4.18.1 Sewerage Transfer/Treatment System: Extra heavy Cast Iron pipes shall be used for sanitary work below ground as per IS: 1536. Heavy duty Cast iron pipes shall be used for sanitary work above ground level. Inspection chambers and gully trap chambers shall be in solid fly ash brick construction and manhole spacing shall not exceed 20 m. (a) System The system shall be designed on the principle of "TWO PIPE SYSTEM" having two separate vertical pipes namely Main Soil Pipe (MSP) and Main Waste Pipe (MWP) receiving waste from number of Branch Soil Pipe (BSP) and Branch Waste Pipes (BWP). A BSP either shall have only one W.C. to be connected to MSP or it shall receive discharge from number of urinals to be connected to MSP. A BWP shall receive waste from washbasins, baths, sinks, cooler areas, etc. Floor traps shall be provided to receive waste from waste pipes of various fixtures (except from W.C. which shall be directly connected to MSP) and at locations where wastewater is to be drained out.		

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A MSP shall be directly connected to first manhole of an outside sewer. A MWP shall be discharged into first manhole through a gully trap. All vertical stacks and ventilating pipes shall be carried to a height of at least 1.5 meters above parapet and shall be provided with cowl to top. (b) Sizing Minimum size of BSP receiving discharge from W.C. shall be 100 mm up to MSP/first manhole. Minimum size of BWP shall be 80 mm. Minimum size after gully trap up to first manhole shall be 100 mm. (c) Gradients: The gradient of a horizontal branch shall normally be 1 in 40 but in no case it shall be flatter than 1 in 50 and steeper than 1 in 10. Non-silting and non-scouring velocity shall be maintained. 4.18.2 Sewage Treatment Plant Centralized Sewage treatment plant is to be provided by the contractor. Anticipated number of users may be considered as 650 for design purpose. The contractor shall have to provide complete arrangement for sewage disposal up to sewage treatment plant as far as possible by gravity. Wherever, the flow by gravity is not possible, the effluent shall be transferred by pumping. All this arrangement is included in the scope. Centralized sewage treatment plant shall be with extended aeration method followed by disinfection by chlorine and necessary filtration before reuse. The contractor shall make arrangement for utilizing the treated water for gardening and plantation, along with necessary pumping and piping of required size/ capacity for recycling the treated effluent. The water generated from canteen shall also be taken in to centralized sewage treatment plant. Before canteen sludge enters the sewage treatment network pipe tank, suitable screen and oil trap shall be provided.		

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4.19 <u>AREA GRADING</u> The levelling/dressing of plant area as necessary shall be within scope of this contract. Work shall have to be carried out as per grading layout plan approved by the Owner/Owner's Consultant. 4.20 <u>FENCING</u> Fencing with gates shall be provided around transformer yard, fuel oil area and other areas wherever necessary due to security, safety, and statutory requirements as per following specifications. The fencing, with gate (unless specified otherwise) shall comprise of PVC coated G.I. welded wire mesh fencing of minimum 4 mm diameter (including PVC coating) of mesh size 75 mm X 75 mm of height 2.4 m above the toe wall with a 600 mm high galvanised concertina at the top, such that total fence height of 3.0 m above the toe wall is achieved. The diameter of the steel wire for chain link fence (excluding PVC coating) shall not be less than 2.5 mm. The PVC coated chain link shall be stretched by the clips at 0.5m intervals to three strands of galvanised high tensile spring steel wire (HTSSW) of 2.5 mm diameter interwoven with chain link wire mesh and kept under tension which in turn are attached to the fence post with security nuts and bolts. On every fourth post a clamping strip shall be threaded through the links of chain link and bolted to the fence post with the help of security nuts and bolts. Above the chain link a 600 mm high tensile serrated galvanized wire (HTSW) concertina made with wire diameter of 2.5mm shall be stretched to 6m and attached to two strands of galvanized HTSSW of 2.5 mm diameter by means of clips at 1m intervals. These two HTSSW strands shall be attached to the fence posts with 12 mm security fasteners. All nuts, bolts, fasteners, clamping strips, clamps, clips, etc., shall be galvanized. All fence posts shall be of 75 x 75 x 6 MS angles spaced at 2.5m c/c distance. All corner posts shall have two stay posts and every tenth post shall have transverse stay post. Suitable R.C.C. foundations for the post and stays shall		

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be provided based on the prevailing soil conditions. All posts of fencing shall be painted with chlorinated rubber paint over a suitable primer. Toe walls either of brick masonry with bricks of minimum 50 kg/sq.cm. Crushing strength or of hollow concrete block masonry shall be provided between the fence posts all along the run of the fence with suitable foundation. Toe wall shall be minimum 200 mm above the format on level with 50 mm thick P.C.C. coping (1:2:4) and shall extend minimum 300 mm below the formation level. Toe wall shall be plastered with cement sand mortar (1:6) on both sides and shall be painted with two coats of textured cement paint (Sand tax Matt or equivalent) of approved color and shade. Toe wall shall be provided with weep holes at appropriate spacing. 4.21 <u>GATES</u> All gates shall be of structural steel of minimum 3.75 metres clear width for single lane access road and 7.75 m clear width for double lane access roads. The height of gate shall be same as that of the fence. Each gate shall have provision for wicket gate of size 1.0 m x 2.1 m. The gate frame and post shall be fabricated from medium class MS pipe of nominal diameter not less than 75 mm. The panel plate shall be of minimum thickness 2.5 mm conforming to IS: 513. The gate shall be complete with fabricated hinges, MS aldrops with locking arrangement, tempered steel pivot, guide track of MS tee, bronze aluminium ball bearing arrangement, castor wheel etc. 5.0 <u>DOCUMENT SUBMISSION</u> The bidder shall submit detailed design basis report for the civil structures on which designs shall be prepared and submitted for scrutiny and approval. Design and Construction documents pertaining to all Civil, Structural and Architectural works that will be required to be submitted to Owner/Owner's Consultant/Review Consultant for their approval have been brought out under following clauses. Approval of these documents by the Owner/Consultant shall not relieve the Contractor of his responsibility for any errors and fulfilment of Contract requirements. The actual design of individual structure shall commence only after approval of the related mechanical G. A.		

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drawing. 5.1 <u>DESIGN DOCUMENT</u> Design Document shall comprise Mechanical/Electrical assignment Drawings, design data, design basis report & references, detailed structural analysis (including computer out put, if any) & design calculations and design drawings. Design calculations and drawings shall be submitted and reviewed only after approval of corresponding Mechanical/Electrical/System general arrangement drawings. The contractor shall submit approved GA drawings along with three (3) copies of design documents (except design drawings) and eight (8) copies of design drawings for comments/approval of the Owner /Consultants. Soft/electronic copy of 2D and 3D analysis file and drawing shall be submitted with first submission. Procedure of approval will be as stated in Volume:II. On final approval of the drawing and design, Contractor shall submit three (3) copies of design calculation and twelve (12) copies of the drawing with one soft copy in CD each to the Owner and consultant for distribution. Soft copies of input data/STAAD file shall invariably be forwarded to the owner for scrutiny of the design calculations. The contractor shall submit related extracts of the code/standard to the owner/his consultant for ready reference in case he uses any foreign code / standard 5.2 <u>CONSTRUCTION DOCUMENT</u> Based on approved design drawing, detailed drawings for construction will be prepared by the Contractor. For reinforced concrete structures and foundations detailed bar bending schedules in approved format shall accompany each detailed drawing. For structural steel work the Contractor will prepare detailed fabrication drawing along with bill of materials. Six (6) copies each of selected or all detailed drawings/ fabrication drawings as decided by Engineer for all structures along with bar bending schedule/		

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bill of materials need be furnished to Owner/Consultants for their review and approval. Procedure of approval shall be as stated in Volume: II. Upon approval, eight (8) copies of each drawing along with one soft copy in CD shall be submitted to the Owner and Consultant for their distribution. Procedures for submission and approval of Construction Documents other than stated above have been mentioned in Volume: II and elsewhere in this specification. 5.2.1 As Built Drawings "As-built" drawings shall be prepared by the Contractor after completion of construction/erection incorporating all the changes, if any, done on Engineer's instruction/approval. After completion of construction, Contractor shall submit eight (8) copies of all the drawings, irrespective of any changes during construction, marked "As Built" with one soft copy in CD each to the Owner. 5.3 Guidelines for preparation and submission of drawings: (a) paper size : A0/A1 (b) Fonts : Appropriate to suit the size of the drawing 6.0 <u>LAYOUT</u> Before starting the work, the Contractor shall carry out the setting out of foundation and structures and provide levels, with reference to general existing grid and benchmark. If the Contractor uses the grid, benchmark and reference pillar made by other Contractors, he shall co-ordinate with the Contractor and shall satisfy himself of the accuracy of the reference marks. If he is required to set out the foundation afresh, he shall do so independently with reference to the one existing grid and benchmark, which has been followed by other agency at the instruction of the Engineer. In case any discrepancy is found, it shall be immediately brought to the notice of the Engineer for any rectification/modification necessary. No complaint shall be entertained at a later stage. The Contractor shall accurately set out the position for holding down bolts and inserts.		

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If required, in the option of the Engineer, he shall construct and maintain pillars for grid, references and benchmarks and maintain them till the completion of the construction. He shall also help the Engineer with instruments, materials and labours for checking the detailed layouts and levels. The Contractor shall be solely responsible for the correctness of the layout and levels, and Engineer's approval shall not be deemed to imply any warranty in carrying out the works correctly. The Bidders shall take into account the cost of these in quoting their price. 7.0 <u>WORKMANSHIP</u> Workmanship shall be of the best possible quality and all work shall be carried out by skilled workmen except for those which normally require unskilled persons. Welding shall be done by experienced and certified welders in proper sequence using necessary jigs and fixtures. Fabrication shall be done in shops having proper equipment for accurate edge lanning and milling of column shaft ends, base plate surfaces etc., and shaping and dimensioning of anchor bolt assembly, inserts and other misc. items. In addition to the requirement specified above, if the bye- laws of the local Govt., Municipal or other authorities require the employment of licensed or registered workmen for various trades, the Contractor shall arrange to have the work done by such registered or licensed personnel. In case of manufactured materials, the Contractor shall have, with no additional cost to the Owner, the services of the supervisors of the manufacturers to ensure that the work is being done according to the manufacturer's specifications. 8.0 <u>TEMPORARY WORK</u> All scaffoldings, staging, temporary bracing and other necessary temporary work required for proper execution of the Contract shall be provided by the Contractor at his own cost and inclusive of all materials, labour, supervision and other facilities. The layout and details of such Temporary work shall have the prior approval of the Engineer, but the Contractor shall be responsible for proper strength and safety of the same. All Temporary work shall be so constructed as not to interfere with any permanent work or with the work by other agencies. If it is necessary to remove any of the temporary work at any time to facilitate execution of the work or with the work of other agencies, such removal and		

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re-erection, if required, shall be carried out by the Contractor at the direction of the Engineer without any delay and any extra cost on this account shall be borne by the Contractor. 9.0 <u>INTERFACE WITH STRUCTURES UNDER OTHER'S SCOPE</u> Modification in layout of foundation/structure during detail engineering stage may be necessary to avoid fouling with those under other's scope. Necessary changes on this account will be made without any extra cost to Owner. 10.0 <u>SEQUENCE OF WORK AND PROGRESS REPORT</u> The sequence in which the works are to be carried out shall be as approved by the Engineer in accordance with the construction method accepted by the Engineer and to be followed by the Contractor. A programme of work is to be submitted for the Engineer's review and approval and this has to be periodically updated and modified as per actual progress to enable timely completion. The Contractor shall regularly submit to the Engineer progress reports for periods of working as specified by the Engineer showing up to date progress on all-important items of work. The contractor shall prepare and submit the sequence of works and submit the same to the Engineer-in-charge for approval. Any changes / suggestions by the Engineer-in-charge shall be accommodated in the works scheduled and a fortnightly review shall be taken to ensure desired progress of work. The contractor on such review shall submit beforehand the programme of works he intends to take within the next fortnight for consideration and approval of the Engineer-in-charge. It shall be the responsibility of the contractor to make sure that the raw material/ingredients/equipments are available well in advance before the works are taken up. Delay on accounts of non-availability of raw material/ ingredients/equipments shall be to the contractor's account and no relief / compensation such as extension of time limit etc. shall be granted on such grounds.		

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The contractor shall arrange his procurement of structural steel elements such as plates, rolled members and reinforcement bars etc. in such a way that the works are not held up for want of these material. The owner reserves the right to change the priority of works suitable to the program of commissioning of the plant. LIST OF APPROVED VENDOR:- REFER MASTER SPECIFICATION VOLUME-II, SECTION 11		

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ANNEXURE – I

SOIL INVESTIGATION REPORT

[ATTACHED AT END OF DOCUMENT]

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SECTION - 2

SPECIFIC DESIGN REQUIREMENTS – CIVIL

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1.0 <u>INTRODUCTION</u> This section outlines following: 1.1 Soil Characteristics. 1.2 Design considerations for Reinforced Concrete Structures. 1.3 Design considerations for Foundations. 1.4 Roads. 1.5 Quality assurance and quality control 2.0 <u>SOIL CHARACTERISTICS</u> Preliminary geotechnical investigation work is carried out at site by the Owner. However soil characteristics and parameters to be adopted in final design, the contractor is required to do detail geotechnical investigation work as part of the contract to verify/generate data so required. The cost of such work shall be deemed to have been included in the contractor's quoted price. It should be noted that nothing extra whatsoever on account of variation between soil data annexed in this specification and that found by detailed geotechnical investigation to be carried out by bidder shall be payable. 3.0 <u>DESIGN LOADS</u> All structures and portions thereof shall conform to the latest revision of relevant Indian Standard specifications and also to the various other technical requirements. Any structure, which carries Indian Railway Loading or is situated in the vicinity of Railway Lines, the design has to conform to the Indian Railway Standard Specifications and approval must be obtained from Railway Authority including the clearance etc. All structures shall be designed to sustain within the stress limitation as specified in the Code, all dead loads plus assigned live, equipment, wind, seismic or other design		

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loads.

3.1 LOADS

3.1.1 Dead Loads

Dead load shall include the weight of all structural components and architectural appurtenances incorporated in the structures plus hung loads and any other permanent, externally applied load. This should also include equipment dead load. The content of tanks, silo, bins and hoppers shall be measured at full capacity for this purpose. Hung loads and the contents of tanks, silo, bins, and hoppers shall be listed separately so that they can be excluded from dead load when dead loads are acting as stabilizing loads for uplift. For Chimney all permanent loads due to the weight of chimney shell internal platform & lining supported on them. flue duct, staircase other accessories etc.

The following unit weight of material shall be considered for computation of loads. Loads given in IS:875 (part-I) shall be made use of for material not listed below:

Materials	Unit weight
(a) Reinforced Cement Concrete :	25.0 kN/cum
(b) Plain cement concrete :	24.0 kN/cum
(c) Structural steel :	78.5 kN /cum
(d) Brick work :	19.0 kN /cum
(e) Cement plaster :	21.0 kN /cum
(f) Floor Finish :	24.0 kN /cum
(g) Coal :	12.0 kN /cum
(h) Fly Ash :	16.0 kN /cum
(i) Bottom Ash :	16.0 kN /cum

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3.1.2

Live Loads

Live loads in different areas shall include dust loads, minor equipment loads, cable trays, small pipe racks/hangers, operation/maintenance loads etc. The loads considered shall not be less than those specified in IS: 875 (Part II).

The loads listed hereunder are minimum loads for the areas involved. Special use areas shall be investigated and loading revised upward as necessary.

Hung loads shall be based on minimum loading equivalents of 1.0 kN/ Sq.m for piping and 0.5 kN/Sq.m for electrical, ventilation and air conditioning. Loadings resulting from concentrations of facilities in specific areas shall be substituted where listed base loading is excluded.

3.1.2.1

All Buildings

(a)

Roofs:

(i)

Inaccessible roof (Flat):

1.5 kN/Sq.m + hung loads, if any + 0.5 kN/Sq.m (dust load).

(ii)

Accessible roof where equipments are placed

5 kN/Sq.m + hung loads, if any + 0.5 kN/Sq.m (dust load)

(iii)

Accessible roof without equipments

1.5 kN/Sq.m + hung loads if any + 0.5 kN/Sq.m (dust load).

(iv)

Inclined roof

As per IS : 875 (Part 2)

(b)

Stairs & Platforms

5.0 KN/Sq.m

(c)

Corridors

5.0 KN/Sq.m

(d)

Removable gratings, chequered plates walkways etc.

5.0 KN/Sq.m

(e)

Office, Laboratory Conference rooms and

5.0 kN/Sq.m

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other non-plant areas etc 3.1.2.2 Power House Building (a) Ground Floor (i) Unloading Bay 50 kN/Sq.m (ii) Other areas 25 kN/Sq.m (b) Mezzanine Floor 15 kN/Sq.m plus hung loads (c) Operating Floor (i) Equipment Lay down Area 35 kN/Sq m plus hung loads or actual load furnished by equipment supplier whichever is higher (ii) Rotor Removal Area 50 kN/Sq m plus hung loads or actual load furnished by equipment supplier whichever is higher Rotor removal area beams shall also be checked for half the rotor load at the center of the beam (iii) Other Areas in Turbine Hall 25 kN/Sq.m plus hung loads (iv) All other Areas in Operating Floor except Turbine Hall 15 kN/Sq.m plus hung loads (d) Due to anchoring of conductors on any "A" row column $2 \times 20 = 40$ kN (Twin ACSR Moose Conductor) and 10 kn (Shielding Wires) OR Actual load furnished by equipment supplier, whichever is higher		

3.1.2.3 Mill Building

(b)	Feeder Floor	25 kN/Sq.m + hung loads + 0.5 kN/sq.m (dust load)
(c)	Tripper Floor	15 kN/Sq.m + hung loads + 0.5 kN/Sq.m (dust load)

- (a) Imposed load on service platform around Chimney shell, shall be taken as 500 kg/m². Design live load during construction/erection shall be considered as 1000 kg/ m².
- (b) Imposed loads from duct joining the Chimney shall be considered.

(a)	Ground Floor	10 kN/Sq.m
(b)	Cable Spreader Floor	7.5 kN/Sq.m
(c)	Pump House operating Floor	15 kN/Sq.m
(d)	Office Floor	5 kN/Sq.m
(e)	Switchgear room	15 kN/Sq.m
(f)	All other Floors	10 kN/Sq.m

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3.1.2.6 Non Plant Buildings (a) Floors with equipment 10 kN/Sq.m (b) All other floors 5 kN/Sq.m 3.1.2.7 Underground Structures/Trenches/pits Minimum surcharge shall be 20 kN / Sq.m. For structures in vicinity of roads and heavy vehicular movement, surcharge shall be considered as applicable as per loading specified elsewhere in this specification. Trenches/pits inside building shall be designed for a surcharge equal to Live Load intensity of Ground Floor or 15 kN/Sq.m whichever is greater. In Boiler area and other outdoor areas within Power Block, the minimum surcharge shall be 20 kN/Sqm. 3.1.2.8 Covers for Trenches/Channels Self-weight of top slab and a uniformly distributed load of 4.0 kN/Sqm on each panel or one 0.75 kN central point load, whichever is critical, shall be considered. At road crossings, the covers shall be designed for vehicular movements as per IRC standards. 3.1.2.9 Roads Design of roads shall be in accordance with Indian Road Congress standard, IRC 37. 3.1.2.10 Road Culverts and its allied structures including R.C.C. Pipe Crossings & Road Crossing of Trenches shall be designed for Class `AA` loading (wheeled and tracked both) and to be checked for Class `A` loading as per IRC standards. 3.1.2.11 Railway Supporting Structures, Rail Culverts (a) Railway supporting structures and rail culverts shall be designed as per Railway Bridge Rules.		

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Reduction in Live load as per provision of IS: 875 shall not be permitted. (b) The areas covered with equipment shall be designed on the basis of weight of equipment (flooded/operating) in addition to an uniform live load of 5.0 kN/Sqm or specifically defined live load whichever is greater. Foundations and fixing arrangements for items of equipment, which generates vibration, shall be designed to prevent transfer of such vibrations to the adjoining structures. For loads caused by moving equipment over the floor for installation, consideration shall be given to the shoring of beams and floor, from floors below. 3.1.3 Equipment Loads (a) Loadings (both static and dynamic) of major equipments, including boiler, turbine-generator, boiler feed pumps, feed water heaters, de-aerator, PA, FD & ID fans, Coal Mill ,Chimney, Ash handling Plant, Coal handling Plant, Cooling Tower obtained from the manufacturer's certified drawings of the specified equipment to be furnished. Where design of structures supporting minor equipment other than those included above has to proceed, the loadings shall be estimated from similar jobs or catalogue data. (b) All equipment, tank and piping design loadings shall include Hydraulic Testing loads. (c) Air and gas duct loadings shall include weight of insulation, duct attachments, dust accumulation loads, seismic, wind and other loads as applicable. (d) Crane girders and supporting columns shall be designed for vertical and horizontal forces (including impact forces) as developed from the crane weights and wheel loads. Unless otherwise specified, the vertical and horizontal loadings shall conform to the applicable sections of the IS specifications.		

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	(e) Weight of equipments, ducts, tanks, pipes, conduits etc. supported by structure shall include maximum possible loading conditions i.e. flooded material contents and associated impacts, test loadings, anchorage and constraint effects. (f) All structural components shall be designed to accommodate anticipated concentrated loads which will or may be applied during the life of the plant. Where both concentrated and uniform loads cannot act simultaneously, the structure or component shall be analyzed for both conditions of loading and shall be designed for most critical condition. (g) Jet forces resulting from guillotine type pipe ruptures shall be considered in the design, if it is of high magnitude. Jet force to be considered shall be equal to the product of the pipe cross section and the internal design pressure applied on an area equal to the pipe cross section. (h) Lay down areas in the Turbine Hall shall be investigated for concentrated loads resulting from equipment components to be stored during erection and maintenance operation. Where live load allowance is inadequate to permit storing of such equipment components, the design live load shall be increased to permit such use or the area shall be restricted by identifying lay down areas for specific components, each area to be identified by permanent marking.	
3.1.4	Wind Loading Wind loading shall be in accordance with Indian Standard Code IS: 875 (Part 3) for a basic wind speed of 39m/sec. Terrain Category-2 shall be considered for all structures. Risk coefficient (k1) shall be considered as 1.07 for all structures.	
3.1.5	Seismic Loading The lateral forces shall be established in accordance with the recommendations of IS-1893. The site falls in Zone-III as identified in the map	

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of IS 1893:2002. Importance factor (I) shall be taken as 1.75 (Table 2 of IS 1893 (PART IV): 2005). Under earthquake condition, the whole frame except roof shall be assumed loaded with 50% design live load. No further reduction in column live loads shall be considered. In view of the asymmetrical nature of main powerhouse, response spectrum method will be used for analysis. 3.1.6 Temperature Loads The structures shall be designed to withstand stresses due to fifty (50) percent of the total temperature variation. The total temperature variation for temperature loading should be taken as two-thirds (2/3) of the average annual variation in temperature. The average maximum annual variation for this purpose shall be taken as the difference between the mean daily minimum temperature during the coldest month of the year and mean daily maximum temperature during the hottest month of the year. Expansion and contraction due to changes of temperature of materials of a structure shall be considered and adequate provision shall be made for the effects produced as per provision in the relevant IS codes. 3.1.7 Steam Piping Load Minimum intensity of steam piping load shall be 6.0 kN/Sqm for the areas at different levels through which steam piping is routed. However, the bidder shall check the loading as per static/dynamic analysis for steam piping or load data supplied by piping vendor and the worst loading shall be considered in design. Horizontal anchor loads, if any, shall also have to be considered in design. 3.1.8 Earth Pressure Load Earth pressure for all underground structures shall be calculated using coefficients of earth pressure at rest, coefficient of active or passive earth pressure (whichever is applicable). However, for design of substructure of pump house, cold-water basin of cooling water and under ground liquid storage tanks, earth pressure at rest shall be considered. In addition to earth pressure and ground water pressure, surcharge load shall also be considered for the design of all underground structures including		

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channels, sumps, cable & pipe trenches, etc., to take into account the vehicular traffic in the vicinity of the structure. Intensity of Surcharge Load shall be as described elsewhere in this specification. 3.1.9 Crane, Monorail & Elevator Loads Crane girders and supporting columns shall be designed for vertical and horizontal forces (including impact forces) as per crane vender's data. All lifting beams and monorails shall have their design loads increased for impact factor as mentioned hereinafter. (a) Impact Factor: Loads for cranes, hoists and elevators shall be taken as per IS: 875. The minimum impact factor to be used in design shall be as follows: (i) Crane loads : a. For vertical force, an impact factor of 25% of the maximum crane wheel load b. A lateral crane surge of 10% of the weight of the trolley plus lifted load applied at the top of each rail c. A horizontal surge of 5% of the maximum static wheel loads of the crane applied at the top of the rail in longitudinal direction. (ii) Monorail loads a. Impact factor of 10% of lifted load of hoist for monorail and support design b. Impact factor of 25% of the lifted load for electrical pulley and support design		

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(iii) Elevator: A 100% of the lifted load including elevator live load plus the cab weight for the elevator support beams. 3.1.10 Construction Loads The integrity of the structures shall be maintained without use of temporary framing struts or ties and bracing so far as possible. However, construction or crane access considerations may dictate the use of temporary structural systems. Special studies shall be made and documented by bidder to ensure stability and integrity of the structures during any periods involving use of temporary bracing systems. 3.1.11 Other Loads Stresses imparted to structures due to differential settlements, variation of water table, erection and maintenance load, creep and shrinkage shall also be considered in design of all structures. All Power House columns adjacent to first row of Boiler columns shall be designed for an additional load of 500 kN to account for piping/cable rack loads. All structures situated in the vicinity of railway lines shall be designed conforming to the Indian Railway Standard Specification. 3.1.12 Thrust Load Thrust blocks will be designed against the thrust load from pipelines considering the test pressure in the pipelines 3.2 <u>STABILITY OF STRUCTURES</u> Design shall be checked against buoyancy due to the ground water during construction and maintenance stages for structures like under ground tanks, pits trenches, basements, etc. Minimum factor of safety shall be considered as per latest revision of IS: 3370 considering empty condition inside and ignoring the super imposed loads. For purpose of calculating downward load		

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	due to any overburden, only the mass located vertically above the projected area shall be taken into consideration. All building sub-structures including pump houses shall be checked for sliding and overturning stability during both construction and operating conditions for various combination of loads. Factor of safety for these cases shall be taken as mentioned in IS:456 and other relevant IS codes, subject to the following minimum values. 3.2.1 Factor of safety against overturning due to wind, seismic or other lateral load shall be 1.5 minimum. 3.2.2 Factor of safety against sliding shall be 1.5 minimum. 3.2.3 Factor of safety against uplift due to hydrostatic forces shall be 1.2 and due to any other loads shall be 1.5. Stability of the structure shall also be investigated for loading conditions during construction, repair or other temporary measures. Lower factor of safety may be used for such loading conditions as per relevant IS codes. In case where dead load provides the restoring force, only 0.90 times characteristic dead load shall be considered. Imposed loads shall not be considered as restoring force. Ground water table shall be considered at 1.0 M below ground level in that area for design of foundations and all underground structures. 3.3 <u>LOAD COMBINATIONS</u> While designing consideration shall be given to the following load combinations: (a) DL + LL (b) DL + LL + PL + Equip ± TL (c) DL + LL + PL + Equip + Cb + CtLA ± CS ± TL	

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(d) $DL + LL + PL + Equip + Cb + CtLB \pm CS \pm TL$ (e) $0.9*DL \pm EL \text{ (for DL only)} \pm TL$ (f) $0.9*DL \pm WL1 \pm TL$ (g) $0.9*DL \pm WL2 \pm TL$ (h) $DL + LL + PL + Equip + Cb + Ct \pm EL \pm TL$ (i) (* Appropriate portion of LL which is considered for working out EL shall only be taken) (j) $DL + LL + PL + Equip + Cb + CtL1 \pm (CS1+WL1) \pm TL$ (k) $DL + LL + PL + Equip + Cb + CtL1 \pm (CS1+WL2) \pm TL$ Where the above loads are: PL = Pipe Load DL = Dead loads of structures, floors, walls etc. Equip = Equipment loads LL = General live loads on floors. Cb =Crane Bridge Ct =Crane trolley positioned at middle of bridge CtLA = Crane trolley + Load near one row CtLB = Crane trolley + Load near other row CtL1 = Crane trolley + Half load lifted at centre of bridge CS = Crane surge for full load		

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CS1 = Crane surge for half load lifted WL1 = Wind load from left to right WL 2 = Wind load from right to left EL = Earthquake load TL = Temperature load Appropriate impact factor shall be considered as per IS: 875 (Part 2) - 1987 while calculating crane loads. In calculating wind loads, appropriate internal thrust/suction shall be considered along with external pressures as per IS: 875 (Part 3) - 1987. All possible load conditions considering external and internal pressures shall be considered in analysis and design for each combination number (f), (g), (j) & (k) above to assess worst effect on whole structure as well as its components. Appropriate allowable increase in permissible stresses as per IS codes, may be taken only under normal loads along with wind and seismic conditions. However, members which are designed primarily to resist wind, no increase in permissible stresses will be permitted. Applicable load factors to be used for design of RCC structures by Limit State Method as per IS: 456. <u>Load Combinations for Underground Structures:</u> Following loading conditions shall be considered in addition to the loading from super structure for the design of sub-structure of pump house, channels, sumps, tanks, reservoirs, trenches and other under ground structures. Only liquid pressure from inside and no earth pressure and ground water pressure, and surcharge pressure from outside (applicable only to the structures which are liable to be filled with water or any other liquid). Earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside.		

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Base slab of the pump house shall be designed for the condition of different combination of pump sumps being empty during maintenance stages with maximum ground water table. Intermediate dividing piers of pump sumps and partition walls in channel shall be designed considering water on one side only and the other side being empty for maintenance. Design shall also be checked against buoyancy due to ground water during construction and operation stage. Minimum factor of safety as per IS: 3370 against buoyancy shall be ensured considering empty condition ignoring superimposed loads. 3.4 <u>DESIGN CONCEPTS</u> Wind and seismic forces shall not be considered to act simultaneously. For the design of main plant structures during seismic condition, the Deaerator Feed Water Tank shall be considered full up to operating level. However, for other load combinations, Deaerator Feed Water Tank in flooded condition shall be considered. ‘Lifted Load’ of crane shall not be considered during seismic condition. For design of all underground structures/foundations, ground water table shall be considered at 1.0 M below the Finished Ground Level. If R.C.C. floors and roofs except those cast over metal decking are assumed to act as diaphragm transmitting lateral loads to braced bays then main beams/ girders shall be provided with shear connectors. However, whenever large/ more number of cut outs is provided in the floor slab, horizontal floor bracings shall be provided below slab to transfer horizontal force to columns without considering diaphragm action from slab. Shear connectors shall also be provided over beams having R.C.C. slab on one side and opening/ chequered plate/grating on other side. For R.C.C. roofs cast over metal decking, horizontal bracings must be provided below slab to transfer horizontal force to columns. In Turbine Bay, horizontal wind girders between A-row and B-row columns must be provided below Mezzanine and Operating floor at gable ends to		

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transmit wind load from gable columns. PTFE bearing shall be provided where horizontal loads not to be transferred. For calculation of seismic load, equipment load shall be considered as Dead Load. Ultrasonic pulse velocity tests shall be carried out for the top decks of all machine foundations including. T.G deck slab, TG foundation and TG super structure/substructures to ascertain the homogeneity of concrete. In addition, additional cubes (at the rate of one cube per 150 Cu.m of concrete subject to a minimum of six cubes) shall be taken to carry out Ultrasonic Pulse velocity (UPV) testing on the cubes, to serve as reference UPV values. Testing shall be done as per 18:13311 (Part-1). In case of any defect, the EPC Contractor shall rectify the defects suitable using cement/epoxy grout, etc. Whenever any structure under this contract will carry or receive additional load from the work of any other contract, the structures under this contract shall be provided with sufficient margin to carry the above load (like Mill Bay structure, Trestles etc.) details of which shall be finalized during detail engineering. Gratings/chequered plates shall not be considered as restraining members for compression flange of beams/girders. Diaphragm action shall also be not considered in design. Adequate horizontal bracings to be provided. 4.0 <u>DESIGN OF REINFORCED CONCRETE STRUCTURES</u> 4.1 Reinforced Concrete Structures shall be designed in accordance with the requirements of IS-456 & IS-875 subject to the minimum Grades as specified in this specification for all possible combination of loads, e.g. dead load, live load, crane loads, wind or seismic loads, soil loads and surcharge loads. The following minimum grades of concrete as per IS-456 shall generally be considered		

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	Sr. No.	Class	Grade of concrete	Min. cement content Kg/Cum	Max. free water cement ratio
	(a)	Plain cement concrete used for screeds and backfill	M15	240	0.6
	(b)	Lean concrete	M10		
	(c)	Paving in main plant area/ Grade Slab	M20	300	0.55
	(d)	Reinforced concrete for super structure and foundation	M25	300	0.45
	(e)	Reinforced concrete for water retaining structure	M30	330	0.45
	(f)	Pre-cast concrete	M25	300	0.5
	(g)	Reinforced concrete for foundation of TG, Mill & Fan foundations, crusher foundation.	M35	340	0.45
	(h)	TG, crusher top deck	M35	340	0.45
	(i)	Piles	M25	400	0.5
4.2	Reinforcing bars shall be TMT bars of grade Fe415 or Fe500 conforming to IS-1786 and Mild Steel bars conforming to IS: 432 (Grade I) Main producer such as "SAIL", "TATA STEEL" & "RINL" or Vendor approved by MAHAGENCO.				
4.3	Fly ash can be added in ordinary Portland cement (Grade 43). Batching plant shall be deployed for producing the concrete. Fly ash shall conform to IS:				

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	3812. Percentage of fly ash to be mixed in concrete shall be based on trial mix and subject to maximum of 25% replacement of cement. Such a concrete (OPC + Fly ash) can be used for all areas other than for the critical structures identified below. Higher grade of Portland ordinary cement namely Grade 43 and Grade 53 conforming to IS: 8112 and IS: 12269 respectively can also be used for specific application. However, the ordinary Portland cement (Grade 43) shall necessarily be used for following structures. (a) TG foundation top deck and sub-structure (b) Spring supported decks of all machine foundations. (c) Other structures subjected to dynamic loading. (d) Crusher top deck and sub-structure 4.4 The design of R.C. Structures shall be carried out by limit state or working stress method as per the provisions of IS-456. 4.5 Concrete tanks/water retaining structures will be designed in accordance with the recommendation of IS-3370. 4.6 <u>GROUTING MATERIAL</u> Grouting shall be done with Conbextra GPX-2 of 'Fosroc' or 'SIKA' for Equipment foundations and Conbextra GP-1 for all structural column bases. For pipe-supports, grouting shall be done with 1:1:2 cement-sand - 6mm down stone chips. 4.7 For reinforcement detailing IS: 5525 and SP: 34 shall be followed. 4.8 The walls shall be provided with reinforcement on both faces for sections 150 mm or more, even if not required from design consideration. 4.9 <u>LIQUID RETAINING/STORAGE AND UNDERGROUND STRUCTURES REQUIRING DRY CONDITIONS</u> All raw/sewage/treated water storage/retaining structures and all underground structures where dry working conditions is required shall be	

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designed in accordance with IS 3370 limiting the concrete and steel stresses within the permissible limits. The crack width of these structures shall be limited to 0.1 mm. Roof beams and slabs of Pump houses shall be designed as per IS 456. The following structures shall be considered as liquid retaining/storage and underground structures requiring dry working conditions. (a) All RCC raw/sewage water/filter water storage reservoir/sumps. (b) RCC sub structure of Raw water pump house/CW pump house, CW channel and forebay, NDCT basin and outlet channel, clarifloculators, CW pit, CEP pit, underground sub structure of wagon tippler, underground coal conveyor tunnel, underground structures of ETP/STP/WTP. All water retaining/storage structures and all underground structure requiring dry working condition shall be designed assuming liquid up to the height of wall irrespective of provision of any over flow arrangement. Use of PRV to counter uplift shall not be allowed. In all liquid retaining structures leak-tightness shall be ensured and guaranteed. To achieve the same, methodology in design and construction in the way of providing PVC water bars at construction/expansion joints and/or injection grouting, usage of admixture in concrete or any such method should be adopted. All underground water retaining/conveying system structures shall have plasticiser cum waterproofing cement additives conforming to IS: 9103 of 'SIKA', 'FOSROC' make. In addition, limits on permeability as given in contact with soil shall be provided with minimum two coats of bituminous painting of grade 85/25 conforming to IS:702 @ 1.7 kg/sqm (minimum) for water/damp proofing. Storm water drains shall not be provided with bituminous paint and weep holes also shall not be provided in storm water drains. 4.10 <u>EXPANSION/CONTRACTION JOINTS:</u> All expansion joints shall be made of engineering grade polystyrene foam backer rod (circular cross section) at 12 mm depth with minimum density of 22 kg/cum and compressive strength of 0.40 kg/sqm having dia. 25% more		

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than the expansion joint width and filling flexible polyurethane sealant having minimum 25% movement accommodation capacity, to a depth equal to half the joint width. 5.0 FOUNDATION DESIGN The design of foundation shall be carried out by Limit State or working stress method as per the provisions of IS-456: 2000 and on the basis of the soil investigation Report done by the Bidder. Structural concrete for foundation work shall be M-25, unless a higher grade is specified elsewhere in this specification. 5.1 FOUNDATIONS (FOR MAIN PLANT STRUCTURES) Foundations for the main plant structures are those for Power House building columns, Boiler House columns, Mill and Bunker bay columns, ESP columns, etc. Top of RCC foundation for the steel columns shall generally be kept at a lower level so that the column base plates together with gussets and stiffeners remain below the finished floor level. Foundation levels of some columns shall have to be suitably lowered to accommodate underground services, pits, trenches, etc. Common foundation should be provided for columns on both side of the expansion joint and shall be designed for loading on both columns. Foundations for Buildings and structures shall be designed to resist forces and moments, caused by vertical loads and by wind or seismic loads, based on static and dynamic analysis done for those structures. The foundation sections shall be sized and reinforced adequately for moments and shear stresses. 5.2 HEAVY EQUIPMENT FOUNDATIONS Loadings (both static and dynamic) of major equipments such as turbine-generator, boiler feed pumps, PA, FD & ID fans, Coal Mill, crusher foundation etc. shall be obtained from the manufacturer's certified drawings of the specified equipment. Where design of structures supporting minor equipment other than those included above must proceed but the exact		

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load data is not available, the loadings shall be estimated from similar jobs or catalogue data. The foundations for Turbo generator, Boiler Feed Pumps, PA fans, FD fans and ID fans and Mill shall rest on suitable vibration isolation system consisting of springs and damper (M/s. GERB). However, Coal Pulverisers shall be supported on conventional block foundations. Technical Specification for Vibration Isolation System is attached in Annexure-I of this Section. For static and dynamic analysis of machine foundation following data shall be furnished by the equipment manufacturer. 5.2.1 Loading diagram showing static and dynamic loads and points of application of loads. 5.2.2 Operating speed of m/c, Critical speed of m/c. 5.2.3 Weight of rotating parts, maximum eccentricity of rotating mass from the geometric axis of rotation. 5.2.4 Location of C.G. of machines in all three axes. 5.2.5 Mass Moment of Inertia. 5.2.6 Allowable amplitude/velocity of vibration at machine bearing points. 5.2.7 Temperatures in various areas during operation. Design of foundations for major equipments shall be done in accordance with relevant parts of IS-2974. Unbalanced loads for normal operating condition as given by machine manufacturer and/or VDI 2060 whichever is more shall be used for calculating dynamic response. The dynamic analysis shall consist of free vibration analysis and forced vibration analysis. While designing following aspects shall also be taken care of: (a) The turbine generator, pulverizer and large fan foundations shall be isolated from adjacent structures for vibration control.		

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(b) The turbine generator pedestals shall be designed to meet the manufacturer's deflection criteria and other recommendations. (c) Natural frequencies of structures and components shall be away from the running speed of equipment by at least 20% generally but for important ones it shall be away by at least 30%. However, frequency separation criteria and amplitude criteria as laid down in IS: 2974 and /or DIN 4024 and/or VDI 2056 and/or as required by the machine manufacturer, whichever is more stringent shall also be satisfied. A fatigue factor of 2.0 shall be considered for dynamic forces/due to normal unbalance. For design of foundation of large fans etc. provision shall be kept in the foundation for addition of mass/area for retuning of the foundations, if required at a later date. All block foundations resting on soil shall be designed using the elastic half space theory or Barkan's theory. The mass of the RCC block shall not be less than three times mass of the machine and the CG of the combined mass of foundation and equipment should pass through the CG of the base area with tolerance not more than 5%. For the foundations supporting minor equipment weighing less than one ton or if the mass of the rotating parts is less than one hundredth of the mass of the foundation, no dynamic analysis is necessary. However, if such minor equipment is to be supported on building structures, floors, etc., suitable vibration isolation shall be provided by means of springs, neoprene pads, etc. and such vibration isolation system (VIS) shall be designed suitably. Analysis and design of the Steam Turbine-Generator (STG) foundation shall be carried out in accordance with relevant codes IS: 2974 Part-3 and IS: 456 and/or manufacturer's requirements. The loads to be considered for static analysis and design shall consist of dead weight of the machine and foundation, machine power torque, condenser loads under normal operating condition, equivalent static load due to machine unbalance, thermal elongation forces, forces due to one sided operation of the condenser, forces due to condensate pump failure, vacuum loads, forces due to piping, frictional forces at machine sole plate level for turbine, generator and condenser, temperature distribution under operating condition, failure loads of turbine (blade		

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unbalance/loss of blade/bowed rotor), failure loads of generator (short circuit loads), seismic loads due to generator, turbine and condenser and erection loads. In case of machines supported on VIS with springs and viscous dampers, it shall be ensured that not more than 5% of the dynamic loads are transmitted to the substructure. Necessary provisions of DIN 4024 shall be adhered to while designing the substructure. Substructure shall be designed for static loads. The vibration isolation system shall consist of helical spring units and viscous dampers supporting the RCC inertia block which support the machine. The spring units shall conform to DIN 2089 and DIN 2096. For all equipment foundations supported on VIS system, the stiffness of the supporting substructure shall be at least ten (10) times that of spring elements as per DIN 4024. Tension in piles shall not be allowed for any combination of loads. 5.3 <u>OPEN FOUNDATIONS</u> In case open foundations are adopted, the following shall be adhered to: 5.3.1 Minimum width of foundation shall be 1.0 m. 5.3.2 Minimum depth of foundation shall be 1.0 m below NGL. 5.3.3 It shall be ensured that all foundations of a particular structure/ buildings/ facility shall rest on one bearing stratum, i.e. either overburden or rock. 5.3.4 Wherever the intended bearing structure is weathered rock but the actual stratum encountered during foundation excavation consists of both overburden soil and weathered rock at founding level, under such cases either the foundation shall be lowered completely into the weathered rock or the overburden soil upto the weathered rock level shall be removed and built up through PCC up to designed foundation level. 5.3.5 The net allowable bearing pressure values to be adopted for design upon Owner's approval shall correspond to total permissible settlement as		

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mentioned under para “permissible settlement of foundations” or the permissible settlement from functional requirement, which ever is more stringent. 5.3.6 Permissible settlement of foundations: The total permissible settlement and differential settlement shall be governed by IS: 1904 and IS: 13063 and from functional requirements, whichever is more stringent. However, total settlement shall be restricted to the following : (a) All facilities in Main Plant area, ducts, Equipment - 25 mm foundation (b) All foundations in switchyard, control room - 40 mm Building including, isolated/strip continuous/ Raft foundation (c) Other footings of width upto 6m - 40 mm (d) Other footings of width greater than 6.0 m (raft) - 75 mm (e) Footings on rock - 12 mm In case the total permissible settlement is to be restricted to less than as above specified from functional requirements, then the net allowable bearing pressure shall be reduced/reviewed accordingly in consultation with Owner. 5.4 <u>PILE FOUNDATIONS</u> In case piles are adopted, following shall be adhered to: 5.4.1 The pile foundation shall be of RCC, Cast-in-situ bored, precast/cast-in- situ driven pile as per IS: 2911. Bored piles shall be installed by using rotary hydraulic rig. Three-stage flushing of pile bore shall be ensured, by airlift technique or any other internationally accepted method duly approved by the Owner. 5.4.2 The minimum diameter of pile shall be 450mm for cast-in-situ and 300mm for precast piles. The uplift and lateral load capacity shall be established by field test.		

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5.4.3 Only straight shaft piles shall be used. Minimum cast length of pile above cut-off level shall be 1.0 m. 5.4.4 The bidder shall furnish design of piles (in terms of rated capacity, length, diameter, termination criteria to locate the founding level for construction of pile in terms of measurable parameter like (SPT & SCPT value, set criteria etc.), reinforcement for job as well as test piles, etc.) for Owner's approval. 5.4.5 The piling work shall be carried out in accordance with IS: 2911 (Relevant part) and accepted construction methodology. The construction methodology shall be submitted by the Bidder for Owner's approval. 5.4.6 Number of initial load tests to be performed for each diameter and rated capacity of pile shall be as under: Vertical Lateral Uplift } Minimum of 3 Nos. in each mode. The initial pile load test shall be conducted with test load upto three times the estimated pile capacity. In case of compression test the method of loading shall be cyclic as per IS: 2911 (relevant part). 5.4.7 Number of routine pile load tests to be performed for each diameter/ allowable capacity of pile shall be as under: (a) Vertical-1.0 % of the total number of piles provided. (b) Lateral -1.0 % of the total number of piles provided. The routine tests on piles shall be conducted upto test load of one and half times the allowable pile capacity. The Owner shall approve piles for routine load tests. Routine load tests may be done by conventional method as per IS: 2911 (Part-4). In case, routine pile load test shows that the pile has not achieved the desired capacity or pile(s) have been rejected due to any other reason, then the Bidder shall install additional pile(s) as required and the pile cap design shall accordingly be reviewed and modified, if required,		

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without additional cost to the Owner. 5.4.8 Testing of piles and interpretation of pile load test results shall be carried out as per IS: 2911 (Part-4). Bidder shall ensure that all the measuring equipment and instruments are properly calibrated at a reputed laboratory/ institute prior to their use. Additional measurement for pile movement shall also be done. 5.4.9 Low Strain Pile Integrity test shall be conducted on all test piles and job piles. This test shall be used to identify the piles for routine load test and not intended to replace the use of static load testing. 5.5 <u>OTHER REQUIREMENTS</u> 5.5.1 In case of high ground water table, for excavations comprehensive dewatering arrangement shall be required. Scheme for dewatering and design with all computations and back-up data of dewatering and sheet piling shall be submitted for Owner's information. 5.5.2 The founding level for trenches/channels shall be decided as per functional requirement. The bottom of excavation shall be properly compacted prior to casting of bottom slab of trenches/channels. 5.5.3 Excavation for open foundations shall be covered with PCC immediately after reaching the founding level. In case of any local loosening of soil at founding level during excavation, the same shall be removed and compensated by PCC of Grade M15. The foundation pits shall be maintained dry during the complete construction period by means of suitable dewatering systems. 5.5.4 Backfilling, around foundations and bottom of pipes, thrust blocks, etc. shall be carried out with approved material in layers not exceeding 30 cm thickness and each layer shall be compacted to 90% standard proctor density for cohesive soil and to 75% of relative density for non-cohesive soils. 5.5.5 Excess/surplus excavated material shall be disposed off by the Bidder as per the instructions of the Owner upto a lead of about 5 km.		

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- 5.5.6 CBR tests for flexible pavement design shall be carried out by Bidder after earth filling has been completed, if applicable.
- 5.5.7 The storage tanks shall rest on flexible tank pad resting on an open/shallow foundation or pile foundation. The tank pad shall be made of two layers. The first layer shall be thoroughly compacted fill of gravel, coarse sand or other suitable material topped with minimum 75mm thick compacted crushed stone, screenings, fine gravel, clean sand or similar material mixed in hot asphalt (80/100 bitumen or equivalent 8 to 10% by volume), rolled and compacted. The second layer shall be with minimum 25 thick premix carpet with 12 mm and down broken stone chips and 80/100 grade hot bitumen. The tank pad shall be laid by an expert agency having wide experience in execution of similar works. The tank pad shall be made up from founding level to the required level by controlled compaction in layers of 200 mm to achieve a relative density of 85% using suitable compaction equipment approved by the Owner. In addition to the above, in case of an open/shallow foundation, a ring wall shall be provided adjacent to the tank wall for retaining the fill below tank. The foundation system shall be designed as per the provisions of IS: 803. The tank shall have a flexible bottom plate, which shall establish complete bearing with the foundation fill.

6.0 GENERAL REQUIREMENTS

The following minimum thickness shall be followed:

(a)	Pile caps	:	900 mm
(b)	Suspended floor/slab/walkways/canopy slabs, etc	:	150 mm
(c)	Ground floor slab(non-suspended)	:	150 mm
(d)	Water Retaining slabs / walls	:	200 mm
(e)	Cable/pipe trenches/underground pits/	:	125 mm

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Lauder walls and base slab <table><tr><td>(f)</td><td>All footings (including raft foundations)</td><td>:</td><td>300 mm</td></tr><tr><td>(g)</td><td>Parapets</td><td>:</td><td>125 mm</td></tr><tr><td>(h)</td><td>Sunshades at edge</td><td>:</td><td>75 mm</td></tr><tr><td>(i)</td><td>Precast louvers / fins</td><td>:</td><td>50mm</td></tr><tr><td>(j)</td><td>Pre-cast trench cover slabs/floor slabs/louvers</td><td>:</td><td>75 mm</td></tr><tr><td>(k)</td><td>Paving</td><td>:</td><td>150 mm</td></tr><tr><td>(l)</td><td>Basement walls and base slab</td><td>:</td><td>200 mm</td></tr><tr><td>(m)</td><td>Silo / bin walls</td><td>:</td><td>150 mm</td></tr><tr><td>(n)</td><td>Underground reservoir below ground water table</td><td>:</td><td>200 mm</td></tr><tr><td>(o)</td><td>Above ground water table</td><td>:</td><td>150 mm</td></tr></table> From fire resistance point of view minimum thickness of reinforced concrete members shall be as per fig 1 of table 16a of IS 456 or specified above, whichever is higher			(f)	All footings (including raft foundations)	:	300 mm	(g)	Parapets	:	125 mm	(h)	Sunshades at edge	:	75 mm	(i)	Precast louvers / fins	:	50mm	(j)	Pre-cast trench cover slabs/floor slabs/louvers	:	75 mm	(k)	Paving	:	150 mm	(l)	Basement walls and base slab	:	200 mm	(m)	Silo / bin walls	:	150 mm	(n)	Underground reservoir below ground water table	:	200 mm	(o)	Above ground water table	:	150 mm
(f)	All footings (including raft foundations)	:	300 mm																																							
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(n)	Underground reservoir below ground water table	:	200 mm																																							
(o)	Above ground water table	:	150 mm																																							
6.2	<u>MINIMUM HEIGHTS FOR PEDESTALS/ENCASEMENTS OF STEEL COLUMNS</u>																																									
Pedestals to Steel Columns for building structures: In case the top of pedestal is kept at a lower level so that the column base plate together with gussets and stiffeners remain below finished floor level (FFL) the column bases as well as the column sections shall be encased in concrete above FFL as per following: <table><tr><td>Open area</td><td>:</td><td>300 mm above paved level</td></tr><tr><td>Covered area</td><td>:</td><td>300 mm above FFL</td></tr></table> Stair and ladder pedestal shall be kept 200 mm above the finished floor level.			Open area	:	300 mm above paved level	Covered area	:	300 mm above FFL																																		
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Pedestals to Steel Columns for Equipment structure (a) Equipment in open area : as required (300 mm min) (b) Equipment in covered area : as required (150 mm min) (c) Structures and equipment : as per vendor's data subject to supplied by vendor minimum as specified above 6.3 <u>GROUND FLOOR SLAB-ON-GRADE</u> Ground floor slab-on-grade shall be minimum M-25 grade RCC construction laid over minimum 100mm thick lean concrete. Minimum 250 mm thick graded stone (63mm down size) soling with interstices filled with sand and compacted mechanically, shall be provided as sub-base below lean concrete. The sub- base shall be laid over rammed and well-compacted earth fill or hydraulically compacted sand fill as specified elsewhere in this specification. 6.4 <u>STAIRS, PLATFORMS, HANDRAILS</u> All internal stairs, platforms and walkways shall either be of RCC or minimum 6mm thick chequered plate construction. All outdoor stairs, platforms and walkways shall either be of RCC or minimum 40mm thick grating. All handrails and posts shall be of 32NB medium duty Galvanised M.S. pipes as per IS: 1239 (Part I). 7.0 <u>ROADS</u> Geometric design of road shall be done in accordance with Indian Road Congress Standard IRC-37. The ruling gradient for roads in longitudinal direction shall be 1 in 30. Normally roads shall have much flatter gradient. Transverse camber of 1 in 40 shall be provided. A detailed CBR test, shall be carried out as per the procedure outlined in IS-2720 (Part-XVI). CBR test shall be carried out in remoulded soil samples under soaked condition. All roads shall have minimum shoulder width on either side of carriageway		

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as stated elsewhere in bid specification. Shoulders shall have sufficient load bearing capacity to support loaded trucks. A flatter slope of 1 in 80 shall be provided on shoulders. Pipe, slab culverts, or RCC box culverts, as suitable, shall be provided at road crossings for drainage, LP pipes, Ash pipes, cable trenches etc. Level crossings shall be provided where a Railway siding line crosses the road. All culverts shall be designed for IRC class "AA" loading and checked for class A loading. Design of concrete road shall be made as per IRC 58-2002, considering single axle load of 10.2 ton with a load safety factor of 1.1. As surface soils show low to moderate swelling potential, so provision of clause no.- 6.2.3 of IRC – 15 - 2002 to be adhered to or as per recommendations of detailed soil investigation to be conducted by bidder regarding road construction. Construction of road shall be in accordance with IRC 15-2002 and other relevant IS/IRC/ MORT&H Codes of practice. Design of Asphalt concrete road (Bituminous road) shall be made as per IRC 37- 2001. As surface soils show low to moderate swelling potential, so Annexure-4 of IRC: 37 -2001 to be followed for design of pavement on expansive soils. Construction of Asphalt road shall be in accordance with SPECIFICATIONS FOR ROAD AND BRIDGE WORKS by Ministry of Surface Transport –Roads Wing (MORT&H) and other relevant IS/IRC Codes of practice. 8.0 DRAINAGE Open RCC rectangular drains shall be provided for storm water. The thickness of sides & bottom shall be minimum 100 mm or as per design considerations whichever is higher. RCC culverts shall be provided for road and rail crossing. Drains shall be provided on both sides of the roads. Inside surface of the drain will have smooth neat cement finish over with screed concrete. Invert of the drain shall be decided in such a way that the water can easily be discharged to the recommended nearest outfall outside the plant boundary. The minimum slope of the drain shall be 1:1000 longitudinally to take care of the silting problems. It is recommended to maintain the maximum velocity within 1.2 m/sec		

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9.0 TRANSFORMER TRACK & JACKING PAD

Lay out of transformer track and jacking pads shall be as shown in appropriate drawing. Transformer track shall be designed as beam on elastic foundation. For this, appropriate soil investigation/test shall be carried out to establish design parameters. Grade of concrete, reinforcement etc shall be as specified earlier.

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ANNEXURE – I

VIBRATION ISOLATION SPRING FOUNDATIONS

1.0 GENERAL REQUIREMENT

Steel helical springs and viscous dampers shall be provided for equipments requiring foundations with vibration isolation system by the supplier with requisite experience and proven track record of similar installation in power plants of Unit capacity not less than 500 MW.

Complete Vibration Isolation System with Steel Helical Springs and Viscous Dampers shall be provided for the foundations of Turbo-generator, Boiler Feed Pump, ID, Fan, FD Fan and PA Fan and other areas as per requirement.

2.0 MATERIAL (DESIGN & SUPPLY)

2.1 STEEL HELICAL SPRINGS AND VISCOUS DAMPERS SHALL CONSIST OF

- (a) Steel helical spring units and viscous dampers along with viscous liquid including associated auxiliaries for installation of the spring units and dampers like steel shims, adhesive pads etc.
- (b) Frames for pre-stressing of spring elements.
- (c) Suitable hydraulic jack system including electric pumps, high-pressure tubes etc. required for the erection, alignment etc. of the spring units. One set of extra hydraulic jacks and hand-operated pumps shall also be provided.
- (d) Any other items which may be required for the pre-stressing, erection, release of pre-stress, alignment and commissioning of the steel helical springs.

2.2 The objective of designing the supporting arrangement for any rotating equipment shall be so that the vibration level is maintained as minimum as possible under all operating conditions. Accordingly, respective rotating equipment shall be supported on RCC deck slab which in turn shall rest on

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vibration isolation unit consisting of steel helical springs and viscous dampers, which in turn shall be supported on RCC supporting structure. The above design shall form part of this specification 2.3 The spring units shall have definite stiffness in both vertical and horizontal directions with the horizontal stiffness not less than 30% of vertical stiffness. The stiffness shall be such that the vertical natural frequency of any spring unit at its rated load carrying capacity is not more than 3 to 5 Hz. 2.4 The damper units or spring-cum-damper units shall be of viscous type offering velocity proportional damping. The damper units shall be suitable for temperatures ranging from 0 to 50 deg. C. The damping resistance of individual damper units shall be such that the designed damping is provided using reasonable number of units. Damper shall have damping resistance ranging from 40 kN sec/m to 750 kN sec/m. 2.5 The sizes of the spring units, damper units and spring-cum-damper units shall be such that groups of such units can be accommodated on column heads in case of elevated foundations and on pedestals/walls in case of foundations at ground level. 2.6 The steel helical springs and viscous dampers shall be designed for ensuring “fit and forget” guarantee. 3.0 <u>MANUFACTURING & TESTING</u> 3.1 Complete manufacturing and testing of the steel helical springs and viscous dampers shall be done at the manufacturing shop of the approved sub-vendor/supplier. For this purpose, the contractor/sub vendor shall submit the detail program for approval of engineer and take up the manufacturing/testing after approval of such program. The program shall include : (a) Manufacturing schedule and quality check exercised during manufacturing. (b) Detail of test to be carried out at the manufacturing shop with their schedule. (c) Special requirements, if any, regarding concreting of top deck.		

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(d) Complete step-by-step procedure covering the installation and commissioning of the spring system. (e) Manuals for erection, commissioning, testing and maintenance of the steel helical springs and viscous dampers. (f) A checklist for confirming the readiness of the civil fronts for erection of steel helical springs and viscous dampers (g) Checklist for equipment required at each stage of erection (h) Bill of materials (data sheet) of various elements such as spring units, viscous dampers, with their rating, stiffness etc. included in the supply. (i) Bill of materials (data sheet) for frames for pre stressing, hydraulic jack including electric pump, high pressure tubes, hand operated pump etc. with their rating and numbers. (j) Any other details, which may be necessary to facilitate design and construction of the foundations/structures. 3.2 The springs shall conform to codes DIN 2089 and DIN 2096. The quality assurance and inspection procedures shall be finalized on the basis of the above codes and the quality plans be drawn accordingly. 4.0 <u>ERECTION, COMMISSIONING AND SUPERVISION</u> 4.1 Complete erection and commissioning of the steel helical springs and viscous dampers including pre-stressing of elements, placing of elements in position, checking clearances on the shuttering of the RCC top deck, releasing of pre stress in spring elements, making final adjustments and alignments etc. all shall be done under a specialist supervisor of supplier/sub vendor trained for this purpose. 4.2 The scope of work shall be deemed to include all activities, which may not have been explicitly mentioned but are reasonably implied for the successful commissioning of steel helical springs and viscous dampers.		

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4.3	The contractor shall guarantee the performance of the steel helical springs and viscous dampers for 24 months from the date of commissioning of each machine which shall be termed as "Guarantee Period".	
5.0	<u>REALIGNMENT OF SPRING SYSTEM</u>	
	If any realignment of the steel helical springs and viscous dampers is required to be done for aligning the shaft or for any other reasons during the first one year of operation from the date of Commercial Operation of the machine, the same shall be done by the contractor as and when asked for at no extra cost of the Owner.	
6.0	<u>ACCEPTANCE CRITERIA</u>	
	Stiffness values shall be checked. The permissible deviations shall be as per DIN 2096. Following acceptance criteria shall be followed:	
6.1	General workmanship is being good and as recommended by the manufacturer are approved by the Engineer.	
6.2	Tolerances are within the specified limit	
6.3	Material test certificate (MTC) complies with the applicable codes/standards.	
6.4	Bought out material is from the approved manufacturer/vendor	
6.5	Bought out material is matching with the approved sample	
7.0	<u>CODES AND STANDARDS</u>	
	Latest revision of following codes shall be used for the design of the spring supported foundations:	
	(a) IS: 456 : Code of practice for plain and reinforced concrete	
	(b) IS: 2974 : Code of practice for design and construction of machine foundations.	

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(c) IS : 1893 : Criteria for earthquake resistant design of structures (d) DIN: 4024 : Machine foundations; Flexible supporting structures for machine with rotating masses (e) DIN: 2089 : Helical compression springs out of round wire and rod : calculation & design (f) DIN: 2096 : Helical compression springs out of round wire and rod: quality requirements for hot formed compression springs. (g) VDI :2056 : Criteria for assessing mechanical vibrations of machine. (h) VDI: 2060 : Criteria for assessing the state of balance of rotating rigid bodies (i) IS: 13920 : Ductile detailing of RCC structure. SPECIAL ATTENTION : The bidder is at liberty to design the vibrating machine foundations without using the VIS system described above. The dynamic design of foundations shall conform to the relevant BIS/International specifications which are more stringent . In either case, it shall be ensured that vibrations do not pass to the other adjoining foundations/structures.		

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ANNEXURE – II

SAMPLING, TESTING AND QUALITY ASSURANCE FOR CIVIL WORKS

1.0 INTRODUCTION

- 1.1 This part of the specification covers the sampling, testing and quality assurance requirement (including construction tolerances and acceptance criteria) for all works and structures covered in this specification i.e. excavation and filling, cast in situ concrete and allied works, fabrication and erection of structural steel works, masonry/sheeting and allied works, finishing items, water supply and sanitation, modular aerated concrete panel, pre-engineered building, special items of works, and piling.
- 1.2 This part of the technical specification shall be read in conjunction with other Parts of the technical specifications, general technical requirements & erection conditions of the contract. Wherever IS code or standards have been referred they shall be the latest revisions.
- 1.3 All tests required for all materials (procured by Bidder) and workmanship shall be done/got done by the Bidder at his own cost. The rate for respective items of work or price shall include the cost for all works, activities, equipment, instrument, personnel, material etc. whatsoever associated to comply with sampling, testing and quality assurance requirement including construction tolerances and acceptance criteria and as specified in subsequent clauses of this part.
- 1.4 The Bidder shall organize weekly QA/QC meeting with its subcontractor's QA/QC representative. All the ongoing activities shall be discussed and recommendations shall be reviewed for effectiveness.
- 1.5 Regular audits for the works of all its Vendors and testing Laboratories shall be arranged. Engineer shall be informed in advance about the Audit programs. All the Audit Reports and the follow-up Reports shall be submitted to the OWNER. OWNER may also perform Audits on the functioning of the BIDDER and its Vendors/Laboratories.

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- 1.6 The Bidder shall provide the facilities whatsoever required and also bear all cost for all sampling, testing and quality assurance in the field and in the laboratory. The Bidder shall carry out all sampling and testing in accordance with the relevant Indian standards and/or international standards and this technical specification. Where no specific testing procedure is mentioned, the tests shall be carried out as per the best prevalent engineering practices and to the directions of the Engineer. All sampling shall be done in the presence of the Engineer or his authorised representative. The Bidder shall establish the Field Quality Assurance (FQA) laboratory and field tests shall be done in the presence of the Engineer and/or his authorised representative. The tests which cannot be carried out in the field laboratory shall be done at a laboratory of repute as agreed by the Engineer, If the Engineer desires to witness such tests at laboratory, Bidder shall arrange to conduct the test in his presence.
- 1.7 The recommendations and suitability of material for concreting and other building materials like brick, cement, aggregates etc., shall be ascertained by Bidder prior to start of work.
- Preliminary evaluation of aggregate and its evaluation for potential alkali-aggregate reactivity as per following scope of work shall be done:-
- (a) Evaluation of Aggregates
- (i) To carry out different tests on coarse aggregate sample i.e. specific gravity, water absorption, sieve analysis, deleterious material; soundness, crushing value, impact value, abrasion value, elongation index and flakiness index, as per IS: 2386.
- (ii) To carry out different tests on fine aggregate sample i.e. specific gravity, water absorption, sieve analysis soundness, deleterious material, silt content, clay content and organic impurities as per IS: 2386.
- (iii) To prepare evaluation report based on test results of I) and ii) above and to advise regarding suitability of fine and coarse aggregates.

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(b) Evaluation of Aggregates for Potential Alkali-Aggregate Reactivity: Evaluation for Potential Alkali-Aggregate reactivity as per following scope of work: (i) To carry out petrographic analysis and accelerated Mortar bar Test on aggregate samples (1N NaOH at 80 deg. Centigrade for 14 days as per ASTM 1260, or the method established/ developed by CSMRS for 22days test. (ii) To prepare a report based on test results of I) above and to advise regarding suitability of aggregates and further testing required if any. (c) To carry out repeated temperature cycle test on aggregates for aggregates to be used in RCC of dynamic foundations from a reputed rock mechanics laboratory like National Institute of Rock Mechanics, Kolar etc. and to advise regarding suitability of fine and coarse aggregates. Moreover Bidder prior to start of work shall ascertain the recommendations and suitability for fill material. A full-scale test shall be conducted including Grain Size Analysis, Specific Gravity, Moisture Content and Standard Proctor Density of fill material. The Bidder shall submit the test results to the Owner in triplicate, within three (03) days after completion of any test. All records shall be submitted, unless specified otherwise, as per the format developed by the Bidder and approved by the Engineer. The Bidder shall identify the main purchase orders & that of sub-contracts as per owner's specification and shall forward the list of manufacturers/ vendors for each bought out items envisaged in the contract. The bought out item (BOI) list shall include all the materials brought out in technical specifications and finalised drawings. The BOI's shall conform to the relevant IS/technical referred specifications for the highest quality grade of material unless otherwise specified. All bought out items shall be procured from the manufacturer's approved by OWNER and tested as per relevant IS Codes/ Owner's Specification. To facilitate advance planning (well before the start of activity as per L-2 network) of material testing/approval of bought out items, representative samples shall be procured by the Bidder (from approved		

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1.8	vendors) and submitted to the Engineer for his approval before bulk procurement at least two months prior to start of works. In case of manufacturers test certificate submitted for acceptance, it shall be clearly traceable and correlated with the consignment received at site. Approval of material/sample by the Engineer shall not relieve the Bidder of his responsibility, for their conformance to the specification, as well as the requisite quality and performance of material. Structural Steel and reinforcement steel shall be procured from main steel producers like SAIL, TISCO, RINL, Jindal Steels etc. No rerolled structural steel is permitted. Field Quality Plans shall detail out all the equipment, the quality practices and procedures etc. to be followed by the Bidder's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site. The Bidder shall furnish complete QA & QC programme for the work envisaged which may include the following:- (a) The organization structure for the management and implementation of the proposed Quality Assurance Programme (b) Documentation Control System (c) The procedure for procurement of materials and source inspection. (d) System for site controls including process controls. (e) Control of non-conforming items and systems for corrective action (f) Inspection and test procedures for site activities (g) System for indication and appraisal of inspection status (h) System for maintenance of records (i) System for handling, storage and delivery.	

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(j) Quality Plan detailing out quality practices and procedures, relevant standards and acceptance levels for all types of work under the scope of this contract. The EPC Bidder shall appoint a dedicated, experienced and competent quality management representative on site, preferably directly reporting to the Project Manager, supported as necessary by experienced personnel, to ensure the effective implementation of the Approved quality assurance programme. The onsite quality management representative shall have the organisational freedom and authority to implement the requirements of these quality assurance arrangements, free from commercial and programme restraints. The QA setup of the Bidder shall consist of qualified and experienced Engineers, with their supporting staff for approval of the owner. Field Quality Assurance (FQA) organisational set up in addition to requisite mechanical & electrical engineers shall consist sufficient graduate civil engineers & supervisors to take care of quality assurance activities of both site & laboratory. The deployment of man power for FQA set up shall be scheduled on the basis of L-2 network so that necessary manpower shall be available to take care of relevant areas of works in progress during currency of works or as and when directed by the Engineer to cope with the work demand. Based on the schedule of work and the approved FQP, the Bidder shall prepare a schedule of FQA tests and shall submit to the owner and shall organize the tests as scheduled. 1.9 The Field Quality Assurance (FQA) laboratory shall have all necessary equipment and instruments and shall be managed by a qualified / experienced person. An indicative list of test equipment is attached at Exhibit-I. All these testing equipment shall be provided by the Bidder at his own cost. The Bidder shall maintain the equipment in good working condition along with valid calibration certificates, for the duration of the contract. Any other equipment though required for testing but not listed in the equipment list shall be provided/arranged by the Bidder at his own cost. FQA laboratory building shall be constructed by the Bidder at his own cost. The laboratory building shall be constructed and installed with the		

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1.10	appropriate facilities. Temperature and humidity controls shall be available wherever necessary during testing of samples. All the construction activities shall be taken up according to the approved work procedure/method statement. All the work procedure/method statement shall be prepared by the bidder and submitted to the owner at least 30 days prior to the intended start of the actual work. Work procedure/method statement shall be submitted in the format approved by the Engineer. Bidder shall ensure that work procedure/method statement shall include, among the others, the following: (a) Purpose (b) Scope (c) Reference document/Standards (d) Methodology of work (e) Field quality plan (f) Job safety analysis The Bidder shall obtain the approval of the Owner of the work procedure/method statement including Field Quality Plan (FQP) before the award of the work. These shall cover for all the items/activities covered in the schedule of items and required for the completion of the work. 1.11 All materials components and equipment covered under this specification which shall be manufactured at shop/factory of the vendor/sub vendor shall be covered under a comprehensive quality assurance program. The detailed quality plan for manufacturing shall be drawn up by the Bidder and will be submitted for owner for approval in the prescribed format for manufacturing quality plan. Manufacturing Quality Plan (MQP) will detail out for all the components and equipment, various test/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Bidder's/Sub-Bidder's/ sub-supplier's quality	

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	Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/ performance testing. The quality plan shall be submitted on electronic media e.g. floppy or E-mail in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM. 1.12 The Bidder shall store and handle the materials as per the requirements of the relevant standards/procedures at his own cost. 1.13 All T&P/equipment brought at site for the use shall be in a good working condition and shall preferably be not more than two years old. The Bidder shall submit to the engineer the weekly status of performance of tools & plants deployed at site for mechanised working. These shall include availability of batching plant with printer for recording batch wise details, transit mixers, concrete pumps, vibrators, winches, cranes, welding machines, hoists etc. as per format enclosed at Exhibit-II. In case of outage of any T&P/ equipment for more than 40% of requirement, the Bidder shall ensure the deployment of additional T&P/equipment to augment the mechanised work at no extra cost to owner. 1.14 All major bought out items shall be included in the quality plan. The Quality plan shall include following works/Bought out items wherever relevant to the Technical specifications, BOQ & drawings. (a) Earthworks including selection of fill material, compaction, proctor density tests etc. (b) Preparation of subgrades & sub-base for paving/ road works (c) Roads & Pavements. (d) Bituminous paints for water proofing & Bituminous concrete's (e) Cement, reinforcement steel & structural steel procurements (f) Coarse/ Fine aggregates, ash, water for concrete (g) Cast-in-situ concrete & allied works	

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(h) Masonry & allied works (i) Precast concrete & handling. (j) Ready Mix concrete. (k) Sheet piling & allied works (l) Water supply & sanitation (m) Piling works if required (n) Structural steel works including approved welding procedures (o) Floor finishes, tiling etc. (p) Doors including fire proof doors, windows, ventilators, partitions, louvers, rolling shutters etc (q) Pre-fabricated/Pre Engineered buildings (r) False ceiling & insulation systems (s) Roof metal decking/Wall claddings (t) Painting system- Procurement & application (u) Acid-Alkali resistant linings (v) Electro forged gratings/Pressure locked gratings (w) Concrete Admixtures, chemical injection grouting, waterproofing chemicals etc. (x) Anti-termite treatments (y) Preparation of Concrete joints & joint fill materials (z) Roof water proofing		

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(aa) Pond/Hydraulic tests of water retaining structures (bb) Drainage/Cross drainage works/Hume pipes (cc) Glazing & aluminium works as specified (dd) CW liners 1.15 List of Exhibit is as follows: (a) Exhibit I-Typical Field Quality Lab Equipment (b) Exhibit II- List of Bought out Items (c) Exhibit III- Weekly Reporting of utilisation of equipment (d) Exhibit IV-Indicative Quality Plan. 2.0 <u>GENERAL QA REQUIREMENTS</u> 2.1 <u>QA REQUIREMENTS FOR PROPERTIES, STORAGE AND HANDLING OF COMMON BUILDING MATERIALS</u> (a) All the materials like Bricks, Stones, Concrete Blocks, Lime, Cement, Water, Aggregates, Sand Reinforcement Steel, Structural Steel shall conform to the relevant IS Codes/Owner's Technical Specification requirements. (b) All materials shall be stacked and stored by the Bidder as per IS-4082 and as per the requirements specified in Owner's Technical Specification. (c) All material shall be stacked separately. (d) Lime and cement shall be stored in Weather Proof, Dry & Leak Proof Conditions stores.		

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(e) Different consignment of different types of cement shall be stored separately with clear identification mark. Not more than 10 layers of Cement bags shall be permitted. (f) Cement stored for more than 60 days in Bidder’s godown shall be retested for compliance. (g) Cement shall be consumed on first in first out basis. At every stage of storage and usage, the week of production of Cement shall be displayed in a manner satisfactory to the owner. (h) Steel shall be stacked and stored consignment wise, size wise and grade wise with identification mark. Identification mark shall be traceable to the lot no of manufacturing. (i) For properties, storage and handling of all materials used shall comply with the requirements of Owner’s Technical Specification.		
2.2	<u>QA REQUIREMENTS FOR ACID/ ALKALI RESISTANT LINING</u>	
(a) Acid Resistant Bricks/Tiles shall be tested for Water Absorption, Compressive Strength, Resistance to Acid, Flexural Strength, Dimensions and all other tests as per IS-4860 and IS-4457. (b) Acid and Alkali Resistant Bitumastic ready mixed paint shall be tested for all tests as per IS-158. (c) Bitumastic shall be tested as per IS-9510. (d) Potassium Silicate, Resin type and Sulphur type Mortars shall be tested as per IS-4832, Part I, II and III/ Technical Specifications. (e) Surface preparation shall be checked as per IS-2395. (f) Application of Primer, laying of Acid Proof Bitumastic layer, Acid/ Alkali Resistant Tiles/Bricks, Chemical Resistant Epoxy Lining and Epoxy Paint shall be as per Owner’s Technical Specification. (g) Thickness of Acid and Alkali Lining shall be checked.		

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(h) Epoxy painting shall be carried for required coating thickness and dry film thickness. 2.3 <u>QA REQUIREMENTS FOR PRE CAST CONCRETE WORKS</u> (a) All the materials used in Pre cast Concrete work shall be tested and conform to the requirements of IS codes and Owner's Tech. Specification. (b) Concrete mix for Pre cast members shall be M25 grade conforms to IS-456-2000. (c) All relevant QA requirements pertaining to cast in-situ concrete shall be applicable. (d) Load test on Pre cast members shall be carried out for the type of members as decided by Owner's Engineer as per IS-456-2000. (e) Pre Cast Concrete member shall be checked for dimensions (length, cross sectional dimensions, straightness, squareness, and flatness) and tolerances shall be as per Owner's Technical Specification. 2.4 <u>QA REQUIREMENTS FOR RCC PILES (PART I) - BORED CAST-IN-SITU PILES</u> (a) Standard Penetration Test (SPT) as per IS-2131 and Owner's Technical Specification for determining the founding level of piles. (b) Uniaxial Compressive Strength (UCS) test shall also be performed on Rock Cores. In case it is not possible to test the cores so obtained for Uniaxial Compressive Strength, core shall be tested for point load strength Index and correlated to obtain Uniaxial Compressive Strength. (c) Founding level of the piles shall be decided based on the criteria given in Owner's Technical Specification. (d) Check for control of position and alignment of piles as per IS-2911 Part I/Sec-2		

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	(e) Boring & Drilling : Drilling mud shall be tested for the following (i) Liquid limit of drilling mud (Bentonite Slurry) as per IS-2720 Part V. Acceptance criteria shall be as specified in Owner's Technical Specification. (ii) Sand content of Bentonite powder. (iii) Density of freshly prepared Bentonite suspension shall be checked in each pile bore before concreting. (iv) Marsh viscosity (v) Differential free swell index (vi) pH value of Bentonite suspension Properties of drilling mud shall be checked prior to commencement of the piling work and thereafter, min. once per week or as found necessary by Owner's engineer. One sample consisting of 3 specimens shall be tested for above. (f) Check cleaning of pile bore (g) Concreting: All the checks/tests on concrete and concrete materials shall be carried out as per FQP and IS-2911 Part I/Sec.2 (i) Before starting concreting the contaminated drilled mud at the (slurry collected in sampler tube) bottom of pile bore shall be tested for density and sand content. Density should not be more than 1.25T/Cum. (ii) For Working Piles: Minimum one sample consisting of 6 test cubes shall be made for first ten piles. Out of these 3 shall be tested for 7 days cube strength and 3 for 28 days cube strength. Minimum one sample of 6 test cubes for every 25 nos. of piles shall be tested, out of these 3 shall be tested for 7 days cube strength and 3 for 28 days cube strength	

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	(h) Reinforcement bars used for piles shall be of tested for quality and conform to the requirements of relevant IS codes. (i) Check distances between two adjacent main reinforcement bars and should be as specified in Owner's Technical Specification. (ii) Check proper cover and central placement of reinforcement cage in the pile bore by suitable concrete spacers/rollers. Check minimum clear cover to reinforcement should be as specified in technical specification. (i) Check cut off level of piles as per drawing. (j) Check recording of all data during installation of piles in prescribed pile data sheet. (k) Check that vibrators are used for preparation of test cubes/ specimens. (l) Slumps of concrete shall be tested at every one-hour interval. (m) Checking position and Alignment: Each pile shall be checked for its position w.r.t. specified location. Each pile shall be checked for its alignment. Permissible limits for deviation shall be as specified elsewhere in the Owner's Technical Specification. (n) Check for Pile Bore: On completion of boring and cleaning, the bottom of each pile bore shall be checked from the samples collected from near the bottom of pile bore or any other method approved by Owner's Engineer, to ensure that it is free from pile bore spoil/debris and any other loose material before concreting. (o) Low strain pile integrity test on all job piles and test piles shall be conducted as specified in the Owner's Technical Specification. This test shall be used to identify the piles for routine tests.	
2.5	<u>QA REQUIREMENTS FOR RCC PILES (PART V) LOAD TEST ON PILES</u>	
	(a) Pile load testing shall conform to IS-2911 (Part IV) and Owner's Technical Specification.	

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(b) Check all the equipments and instruments used are properly calibrated. (c) Initial load test and routine load test shall be carried out. (d) Initial load test to assess the safe load carrying capacity of pile before start of work. (i) Cyclic vertical (compression) load test to assess safe vertical load capacity. (ii) Lateral load test to assess safe horizontal load capacity. (iii) Pull out (Tension) load test to assess safe pull out load capacity. (e) Routine Load Test on Working Piles (i) Direct Vertical (Compression) load test for vertical load capacity. (ii) Lateral load test for horizontal load capacity (f) All other tests on piles shall be carried out as specified in Owner's Technical Specification. (g) Pile load-testing procedure to be got approved from Owner. 2.6 <u>QA REQUIREMENTS FOR PLASTERING & ALLIED WORKS</u> (a) Materials like sand, lime for preparation of putty, coarse aggregate, gypsum etc. shall confirm to the relevant IS codes specified in Owner's Technical Specification. (b) Check proper mixing of mortar. (c) Plaster surface shall be checked for following defects and the remedial measures for the same shall be adopted as per IS-1661.		

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(i) Blistering (ii) Bond filer or loss of adhesion. (iii) Cracking and crazing (iv) Efflorescence (v) Grinning (vi) Irregularity of Surface Texture (vii) Popping or blowing (viii) Recurrent surface dampers (ix) Softness or chalkiness (d) Trueness of Plastering System: Finished plaster surface shall not show any deviation more than 4mm when checked with straight edge of 2 m length. (e) Check thickness of plaster. 2.7 <u>QA REQUIREMENTS FOR CONCRETING INCLUDING CONCRETING OF MAJOR EQUIPMENTS FOUNDATIONS</u> All records of concreting, reinforcement, testing of materials, as-built dimensions, the details of the rectification, etc, shall be maintained as given below. Four copies of such record in a bound form shall be submitted to owner for their record and future reference. Cement consumption at batching plant shall also be obtained through computer output. Provision of an on line printer is mandatory. Calibration of batching plant shall be carried out at the starting and once in three months, and shall conform to IS: 4925. (a) Testing data of aggregates (b) Mix design details.		

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(c) Testing records of admixture including dosage, workability and setting time. (d) Approved scheme for concreting. (e) Quantity of ice used if any for temperature control of concrete for top decks of machine foundations. (f) Hourly records of concreting including pour card. (g) Protocol indicating the dimensional tolerance and details of inserts. (h) Records giving the details of rectification giving the location of grouting, the quantity of grout used at each location, type of grout used. (i) Bar bending schedule. (j) Location and details of mechanical anchoring used for reinforcement. (k) Protocol giving the details of checking of reinforcements before concreting and conformance to the reinforcement details as shown in the construction drawings. (l) Photographs showing the areas where rectification works have been carried out. Photographs should be taken before and after rectification. (m) Report on petrographic examination & potential reactivity of aggregate and the repeated temperature cycle tests. (n) All tests/checks shall be carried out as per FQP. (o) Check temperature control of fresh concrete temperature of fresh concrete should not exceed 25 degree C at the time of placement. (p) Plasticiser/super plasticiser cum Retarder type mixture to be added in the concrete shall be tested as per IS-9103. Once any concrete mix design is approved by the engineer, the IR spectro analysis test result		

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of the admixture shall be submitted along with test results as per IS 9103 for reference. (q) REINFORCEMENT: Check conformity of material to relevant IS codes. (i) Check lapping/spacing of Reinforcement staggered, as under no circumstances more than 50% of bars at cross section shall be lapped. (ii) Sample test for mechanical bars grips shall be carried out upto the yield strength of reinforcement of bars. The no. of tests to be carried out shall be 3% of the number of bar grips used subject to a minimum of three. (r) Batching shall be calibrated regularly at least once in a 3 months. (s) Ultrasonic Pulse Velocity Test as per IS-1331 Part I for Top Deck and column of T.G. Foundation to ascertain the homogeneity and integrity of concrete. In addition additional cubes (@ of 150/m³ of concrete subject to minimum of 6 cubes) shall be taken to carrying out UPV test on cubes. UPV test shall be carried out by a specialized agency. (t) All precautions and control as specified in Owner's Technical Specification shall be taken care of during concreting. IS 456-2000 shall be applicable for acceptance of execution of concrete works & test results. 2.7.1 Staging and Form Work Automatic climb form scaffolding systems shall be used. Slip form with proven record for similar towers may be used subject to conformance to relevant IS and specific approval of the owner. The design and detailed construction of the form work and the scaffolding system shall be based on the relevant IS code. In absence of the same DIN 4420/ACT 347 shall be followed. Concrete shall have sufficient strength to with stand the anchoring loads of scaffolding system. The concrete strength shall be continuously checked and documented during the climbing process of the scaffolding.		

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(a) Design and execution of the form work, staging, shuttering and scaffolding shall conform to National Safety Council and all relevant IS Code provisions, i.e. IS: 2750, IS: 4014, IS: 4923, IS: 800 etc. In case the IS Codes do not cover the specific type of shuttering system, then any international Code of Practice, as approved by the engineer, may be followed. (b) Deployment of vertical laser ray equipment for measuring the dimensions and controlling the shape of the tower at all elevations and plan angles shall be carried out. 2.8 QA REQUIREMENTS FOR STRUCTURAL STEEL WORK (a) Physical and chemical properties of material as per relevant codes. Review of correlated Mill Test Certificates or check testing in absence of MTC. (b) Ultrasonic test on plates above 40mm as per ASTM A435. (c) Welding Procedure Specifications, Procedure Qualification Record & Welders Qualification Test shall be as per ASME Section IX/AWS D1.1 (d) Fillet Welds: (i) Check for size and visual examination. (ii) Macroetch examination on production test coupons for main fillet welds with minimum one joint per built up beams, columns and crane girder etc. (iii) 25% weld length of tension member of crane girder shall be subjected to Dye Penetration Test. (iv) On all other fillet welds, DPT on 5% of weld length with minimum 300mm at each location shall be carried out. (e) Butt Welds: (i) 100% visual examination		

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	(ii) DPT on all butt welds after back gouging (iii) Mechanical testing of production test coupons with minimum one joint per built up beam, column and crane girder. (iv) 100% radiography test on butt welds of tension flange (bottom flange) of crane girder. All other butt welds shall be subjected to Radiography test on 10% weld length of each welder. Wherever RT is not feasible, UT shall be carried out. (v) Full penetration welds (other than butt welds) shall be subjected to Ultrasonic Testing in following quantum: (vi) 100% UT on web to flange joint of crane girder. (vii) 10% UT on other full penetration joints. (f) Every 1st and further every 10th set of identical structure shall be checked for control assembly in shop before erection. (g) All structure components/members shall be checked for dimensional tolerances during fabrication and erection as per IS-7215 and IS-12843 respectively. (h) Check for Surface Preparation and Paint thickness. (i) In case of failure of any welds in SPOT RT/UT, the % age for retesting shall be doubled at that particular location. Acceptance criteria of NDT on welds shall be as per AWS D1.1. (j) Low hydrogen electrode (AWS E-7018) for welding of High/Medium tensile steel, for M.S (IS 2062 Gr. A/Gr. B, IS 8500) sections thickness above 20mm shall be used. Preheating and Post weld heat treatment requirements shall be complied as specified in the technical specs. /approved WPS. (k) For CW liners Inspection of welds for shop and field erection shall be as follows:-	

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	(i) 100% DPT after back gauging/grinding of butt welds by DPT kit shall be carried out as per IS-3658. No line/round and no crack should be observed. (ii) 100% DPT shall be carried out on fillet welds by DPT kit as per IS: 3658. (iii) 10% radiography shall be carried out on shop butt welds, the acceptance criteria shall be as per ASME Sec.V and ASME Sec. VIII Div.1. (iv) 100% Radiography/ Ultrasonic test on field Butt welds shall be carried out, the acceptance criteria shall be as per ASME Sec.V and ASME Sec. VIII Div.1. (v) Hydro testing shall be done as per the method detailed out in Technical specifications.	
2.9	<u>QA REQUIREMENTS FOR SHEETING WORKS.</u> (a) Colour coated sheet (i) Chemical & physical properties of raw material sheet as per relevant codes. (ii) Base Metal Thickness (iii) Thickness of coatings (iv) Type of coating/paint (v) Hardness of painted surface (2H pencil Hardness) (ASTM-D-3363) (vi) Flexibility Test Bend test as per ASTM-D-328 at 180 degree bends (twice the thickness of sheet). There should not be any crack.	

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Dimensional check after profiling of sheets (vii) Weathering Resistance Test Salt spray test as per ASTM B-117 for minimum 1000 hrs. one sample per batch at random. (b) Bonded Mineral Wool Insulation (i) Thickness (ii) Density (iii) Thermal Conductivity (iv) All other tests as per IS-8183. (c) Sheetting Installation (i) Workmanship including alignment (ii) Level, Slope (iii) Side and End Laps (iv) Proper Installation of Flashing (v) Fixing including opening, (vi) Location, Installation of Lining & Installation. (d) All bought out items shall be procured from the manufacturer's approved by Owner's Engineer and tested as per relevant IS Codes/ Owner's Specification.		

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2.10 <u>ARCHITECTURAL & MISC. WORKS</u>		
(a) Material used for floor finishes and allied work shall conform and tested as per the requirements of relevant IS Codes specified in Owner's Technical Specification.		
(b) Finish shall be checked for :		
(i) Level, Slope, Plumb		
(ii) Pattern & Symmetry		
(iii) Alignment of joints, dividing strips etc.		
(iv) Colour, Texture		
(v) Surface Finish		
(vi) Thickness of Paint		
(vii) Details of edges, junction etc.		
(viii) Performance		
(ix) Precautions specified for durability.		
(c) For fabricated item like metal doors, windows, ventilators, louvers, rolling shutters and grills etc. Following checks shall be carried out.		
(i) Overall Dimensions		
(ii) Mullions Transoms		
(iii) Doors & Windows shall operate without jamming		
(iv) Doors, windows & frames etc. shall be on a true plane, free from warp or buckle.		

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	(v) All welds shall be dressed flush on exposed and contact surfaces. (vi) Correctness of locations and smoothness of operation of all shop installed hardware and fixtures. (vii) Provision of hardware & fixtures to be installed at site. (viii) Glazing beads shall be cut with mitered corners. (ix) Glazing clips, fixing devices etc. shall be supplied in adequate nos. (x) Shop coats shall be properly applied. (xi) Exposed aluminium surface shall be free from scratches, stains and discoloration.	
2.11	<u>ROLLING SHUTTERS/GRILLS</u> After installing the shutters, the Bidder shall test the performance of the shutter in the presence of the engineer. The shutter shall be smoothly operable under all ambient conditions. All controls and locking devices shall give fault free performance.	
2.12	<u>FIRE PROOF DOORS</u> (a) Fire Proof doors shall be tested for the requirements mentioned in IS-3614 Part-II and Owner's Technical Specification. The doors shall be approved by TAC & shall have minimum 2 hours fuse rating. (b) DFT of paint of Fire Proof Doors shall be checked.	
2.13	<u>GLASS AND GLAZING</u> (a) Materials used in glass and glazing shall conform to the requirements of Owner's Technical Specification and IS Codes specified in Owner's Technical Specification.	

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(b) All installation shall be free from cracked, broken or damaged glass, edges of large panes of thicker glass and heat insulating glass be inspected carefully for chipped, cracked or underground edges. (c) Glazing shall be carefully done to avoid direct contact with metal frames. (d) All glasses shall be embedded in mastic for steel works and fixed by neoprene gasket for aluminium works to give a leak proof installation. (e) On completion, the panes shall be free from dirt, stains, excess putty etc. to the complete satisfaction of the engineer.		
2.14	<u>ROOF WATER PROOFING & ALLIED WORKS</u>	
(a) Material used shall be tested and conforms to the requirements of IS Codes/International Codes specified in Owner’s Technical Specification. (b) All elastomeric membrane is fully dried to perform testing with water ponds created on minimum 5% of area of nominal size 6m x 6m for height of 25 mm to 30 mm at critical locations for a period of 48 Hrs. No dampness shall be visible on the underneath side of roof (i.e. ceiling, parapet and well junction etc.). The above testing shall be carried out prior to application of wearing course.		
2.15	<u>PAINTING & ALLIED WORKS.</u>	
(a) Various materials used shall conform and tested for the requirements of Indian/International Codes specified in the Technical Specification. (b) Surface to receive paint shall be made smooth. (c) Painting shall be checked for thickness of different coats as specified in schedule of items and Owner’s Technical Specification/Drawing.		

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2.16	<u>QA REQUIREMENTS FOR ROAD WORK</u> Quality Assurance and testing requirements for roadwork shall be as per IRC Publication-Specification for Road & Bridges (Section 900, Quality Control for roadwork) (a) Check for control of alignment and surface regularity as per Clause 902. (b) Quality control tests during construction as per Clause 903. (i) Tests on earth work for embankment and subgrades construction as per Clause 903.2 (ii) Tests on sub bases and bases (excluding bitumen bound base) as per Clause 903.3 (Table 900-3) (iii) Tests on Concrete Road Constructions as per Clause 903.5 (Table 900-6) (c) Road work shall be carried out as per relevant IS provisions if IS provisions are provided in the specifications	
2.17	<u>VIBRATION ISOLATION SYSTEM</u> (a) Chemical and physical properties of raw material (b) NDT on welds (c) MQP and Review of Manufacturer Test Certificates (If supply of VIS is in the scope of Civil Bidder) (d) Dimensional Check (e) Check for level. (f) Spring Rate Test	

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2.18 <u>CHIMNEY LINERS</u> (a) Check for chemical and physical properties of material as per relevant codes. (b) Welding Procedure & Welders Qualification test as per ASME IX. (c) Dye Penetration test on welds shall be carried out as per ASTM E 165. (d) 10% spot radiography test on all butt weld shall be carried out where radiography test is not possible. Ultrasonic test shall be carried out. 2.18.1 Fabric Expansion Compensator: Each layer of fabric Compensator shall be checked for thickness, unit weight, tensile strength & elongation, composite layer of the expansion joint shall be tested for temperature with stand ability test. Thermal Insulation shall be checked for thickness, density, thermal conductivity test and all other tests as per IS 8183. Tests and checks on all other items shall be carried out as per relevant codes and Owner's Technical Specification. 2.18.2 Chimney Electrical Works All the equipments, being supplied shall be of type tested quality and proven one. All the equipment and devices shall be subjected to routine tests and acceptance tests as per relevant standard. The type test report shall be submitted to Owner for review and acceptance. 2.18.3 Chimney Structural Steel Works And Misc. Metal Items QA requirement for this shall be as per Clause No. 3.03 pertaining for Fabrication and Erection of Structural Steel Work.		

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2.19 <u>RESERVOIR LINING</u> (a) Requirement of HDPE Material – The high density Polyethylene Liner shall be manufactured of polyethylene resin. The resin composition and production shall meet its intended purpose as detailed in the technical specifications. The natural polyethylene resin without the carbon black shall meet density requirement of 0.935 to 0.940 g/cc and melt index less than 0.4g/10min. The test methods shall confirm to ASTM D 1505 or ASTM D792 or equivalent for density test and ASTM D1238, condition E or equivalent for Melt Index test. (b) Carbon Black shall be included in the resin to make it UV resistant and its content shall not be less than 2 % as per ASTM D 1603 (c) The lining shall confirm to ASTM D1004, ASTM D4833 ASTM D1693, ASTM D 4437, ASTM D 3895 and as per criteria mentioned in the Tech specification. Thickness shall be as per ASTM D 5199, Tensile properties shall be as per ASTM D 6693, Tear resistance shall be as per ASTM D 1004. (d) Vacuum box Testing (VBT) and Air Pressure Testing (APT) shall be carried out as per the procedure in Technical Specifications (e) Installation and laying shall be as per the procedure laid down in the tech specifications The Bidder shall submit a field quality plan for the reservoir lining in the Owner's format incorporating all the requirement and acceptance criteria as per the technical specification. 2.20 <u>STOP LOGS AND TRASH RACKS</u> (i) Structural design shall be as per IS 5620 and IS: 4622 and as per details given in tech specifications. (ii) Filling valves shall be provided in the stop logs to balance the water pressure before lifting the stop log		

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(iii) The trash rack to be provided shall Type-1 trash rack (removable section rack), conforming to IS: 11388 (latest). (iv) Center to center spacing , clear opening and center to center spacing of trash bars to be provided in the rack shall be as per technical specifications (v) Leakage test shall be carried out in the stop logs as per the methodology specified in the technical specifications. The leakage shall then be measured and it should not be more than 5 liters/minute/ meter of length of seal under maximum head or as specified. (vi) All material used for trash rack and stop logs shall be of high grade and free from defects and conforming to all the relevant standards mentioned for the various component material in the technical specification. Radiographic examination or magnetic particle testing or other comparable tests shall be carried out for determining the soundness of steel castings and shall be conducted by the Bidder if asked by the employer. (vii) The Bidder shall submit a Field quality Plan in Owner's format incorporating all the quality aspects mentioned in the technical specifications. (viii) The lifting beam is to be tested for twice the weight of the heaviest component to be lifted by the beam. IS: 13591 shall be referred for measurement of the deflection and acceptance criteria.		
2.21	<u>GEOMEMBRANE/GEOTEXTILE FILTER</u> (a) Geotextile filter shall be woven type and shall satisfy the following criteria: (b) Material for Geotextile filter shall be 100% polypropylene. (c) Equivalent opening size shall be as required	

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(d) Specific gravity shall be 091, Weight in gms/sqm shall be min. 200. Thickness shall be at least 0.55 mm and width to be supplied shall not be less than 1.75 meter. (e) Other physical properties like Breaking strength, percentage elongation at break, grab strength, percentage Elongation(Grab Test), tear strength (single rip) Water permeability shall be as per the details given in technical specification and as per ASTM-D-5035, ASTM-D-5034, ASTM-D-2261 and IS:169 (Latest edition). (f) Geotextile filter shall be with U-V (Ultraviolet) treatment suitable for a temperature range from 0 °C to 50 °C so that the strength and life of the same is not affected due to exposure to ultraviolet rays. In addition to the above, geotextile filter shall have good resistance to chemicals and to biological degradation.		
3.0	<u>CONSTRUCTION TOLERANCE AND ACCEPTANCE CRITERIA</u>	
3.1	<u>EXCAVATION AND FILLING</u>	
3.1.1	Tolerance	
	Finished surface level shall be within 20mm of the level shown in the drawing.	
3.1.2	Acceptance Criteria	
	Following acceptance criteria shall be followed.	
	(a) When only one set of sample is tested, then all individual samples collected and tested should pass without any deviation	
	(b) For retest of any sample two additional samples shall be collected and tested, and both should pass without any deviation.	
	(c) Where a large number of samples are tested for a particular test than 9 samples out of every 10 consecutive samples tested shall meet the specification requirement.	

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Tolerance on finished levels for important filling areas at approved interval shall be + 20mm. However, for an unimportant area, tolerance up to +75mm shall be acceptable at the discretion of the Engineer. However, these tolerances shall be applicable for localised areas only.																										
3.2 <u>CAST-IN-SITU CONCRETE AND ALLIED WORKS</u>																										
3.2.1 Tolerances																										
3.2.1.1 Cast-In-Situ Concrete																										
Unless otherwise specified, the tolerance in construction shall be as follows:																										
<table border="1"> <thead> <tr> <th></th><th>Description of Item / Structural element</th><th>Permissible Deviation in Mm</th></tr> </thead> <tbody> <tr> <td></td><td>The dimensions of concrete as cast when compared with those on the drawings shall be within the tolerance given below:</td><td></td></tr> <tr> <td>(a)</td><td>Faces of concrete in foundations and structural members against which backfill is placed.</td><td>+ 25 - 10</td></tr> <tr> <td>(b)</td><td>Eccentricity of footing 2% of footing width in the direction of placement but limited to 50mm.</td><td></td></tr> <tr> <td>(c)</td><td>Top surfaces of slabs and of concrete grouted to receive base plates</td><td>+ 5 - 5</td></tr> <tr> <td>(d)</td><td>Alignment of beams, lintels, columns, walls, slabs and similar structural elements.</td><td>+ 5 - 5</td></tr> <tr> <td>(e)</td><td>Cross sectional dimensions of walls, slabs and similar structural elements</td><td>+ 5 - 5</td></tr> <tr> <td>(f)</td><td>Deviation from specified dimensions of cross-section of columns and beams.</td><td>+ 12 - 6</td></tr> </tbody> </table>				Description of Item / Structural element	Permissible Deviation in Mm		The dimensions of concrete as cast when compared with those on the drawings shall be within the tolerance given below:		(a)	Faces of concrete in foundations and structural members against which backfill is placed.	+ 25 - 10	(b)	Eccentricity of footing 2% of footing width in the direction of placement but limited to 50mm.		(c)	Top surfaces of slabs and of concrete grouted to receive base plates	+ 5 - 5	(d)	Alignment of beams, lintels, columns, walls, slabs and similar structural elements.	+ 5 - 5	(e)	Cross sectional dimensions of walls, slabs and similar structural elements	+ 5 - 5	(f)	Deviation from specified dimensions of cross-section of columns and beams.	+ 12 - 6
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	Description of Item / Structural element	Permissible Deviation in Mm
(g)	Alignment of holding down *bolts without sleeves	+ 1.5 - 1.5
(h)	Alignment of holding down *bolts with sleeves.	+ 5 - 5
(i)	Level of holding down *bolt assemblies.	+ 10 - 10
(j)	Embedded Parts (in any *direction).	+ 5 - 5
(k)	Level of embedment for equipment support	+1.5 0
(l)	Level of embedment for other embedded Parts	+ 5 - 5
(m)	Centers of pockets or holes * with greatest lateral dimension not exceeding 150 mm.	+ 10 - 10
(n)	Variation in steps:	
	(i) Riser	+ 1.5 - 1.5
	(ii) Tread	+ 3.0 - 3.0

3.2.1.2 Reinforcement

Tolerance on placing of reinforcement and for cover shall be as per clause 12.3 of IS: 456.

Reinforcement shall be placed within the following tolerances:

- (a) For effective depth 200 mm or less : $\pm 10\text{mm}$
- (b) For effective depth more than 200 mm : $\pm 15\text{mm}$

Tolerance for cover

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Actual concrete cover should not deviate from the required nominal cover by + 10 mm 3.2.1.3 Pre cast concrete Tolerance on dimensions of pre-cast units shall be as follows: (a) Length: +/- 0.1 percent subject to minimum of +/- 5 mm and maximum of + 10 mm. (b) Cross-sectional dimensions: +/- 3 mm or +/- 0.1 percent whichever is greater. (c) Straightness or Bow: 1/750 of the length subject to minimum of +/- 5 mm and maximum of +/- 10 mm. (d) Squareness: When considering the squareness of the corner the length of the two adjacent sides being checked shall be taken as the base line. The shorter side shall not vary in length from the perpendicular by more than 5 mm. (e) Flatness: The maximum deviation from a 1.5m straight edge placed in any position on a nominal plant surface shall not exceed 5 mm. 3.2.1.4 Formwork and staging (a) Staging shall be checked for its soundness as a whole and for adequacy of the joints and its foundations. Formwork joints shall be inspected for soundness of connections. All joints shall be either vertical or horizontal and shall be such as to avoid loss of liquid through the formwork. (b) Dimensional tolerance for formwork shall be as per Clause 9.6 of IS : 14687 and 11.1 of IS : 456, which is reproduced as given below: (i) Deviation from specified : +12mm dimensions of cross section of columns and beams		

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(ii) Deviation from dimensions of : - 6 mm footings a. Dimensions in plan : + 5 -12 mm b. Eccentricity : 0.02 times the width of the footing in the direction of deviation but not more than 50 mm c. Thickness : $\pm$ 0.05 times the specified thickness The above tolerances apply to concrete dimensions only, and not to positioning of vertical reinforcing steel or dowels. (c) Checklist for formwork shall be as per Clause 9.9 of IS: 14687. Format as per Annexure-C of IS: 14687 shall necessarily be made for all important structures including all machine foundations. (i) Acceptance Criteria a. The acceptance criteria of concrete shall be in accordance with clause no.16 of IS: 456. However in exceptional circumstances, and that too in non-critical areas, the Engineer may accept concrete work which is marginally unacceptable as per the criteria laid down in IS: 456. For such accepted work, payment shall be made at a reduced rate pro rate to the concrete cube strength obtained, against that stipulated. b. Unacceptable concrete work shall be dismantled by the Bidder and replaced by fresh work, meeting the specification requirements. In the course of dismantling, if any damage is done to the embedded items or adjacent structures, the same shall be made good, by the Bidder, to the satisfaction of the Engineer, at no extra cost to the Owner.		

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c. Test shall be conducted for the water tightness of the liquid retaining structures as per IS: 3370 and IS: 6494. 3.2.1.5 Tolerances for Cooling Tower Construction (a) Shell wall center line in horizontal plane measured radially at mid point on a 3m wide chord. (b) Shell wall center line in meridional plane measured over a height of 1m. (c) Shell thickness (d) Horizontal radius of shell at any section other than shell base (e) Horizontal radius at shell base. +/- 15 mm +/- 10 mm + 10 mm or - 5 mm +/- 50 mm +/- 40 mm Check for shell geometry shall be carried out as per the method detailed out in the technical specification. 3.3 <u>FABRICATION AND ERECTION OF STRUCTURAL STEEL WORK</u> 3.3.1 Tolerances (a) Fabrication tolerances (i) Maximum permissible gap in built up members (ii) Maximum permissible deviation in depth and/or width of girder at the joints		

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(iii) Maximum permissible out-of-square of flanges in built-up girders (iv) Tolerances on length of beams and girders and their components (v) Permissible deviation in column heights All tolerances for above shall be as per drg / IS: 7215 (b) Erection tolerances (i) Permissible tolerances in erected steel columns (ii) Permissible tolerances in erected steel trusses (iii) Permissible tolerances in crane girder and rails All tolerances for above shall be as per approved drg / IS: 12843 The tolerances for structural steel used for structural purpose shall be as referred in IS: 2062, IS: 1730 (c) Requirement of pre-heating <table border="1"> <thead> <tr> <th>Thickness of thickest part at the area of welding/heat affected zone</th><th>Welding using other than low hydrogen welding electrodes IS : 2062</th><th>Welding using low hydrogen welding electrodes or submerged arc welding IS:2062</th></tr> </thead> <tbody> <tr> <td>Up to 20 mm (including)</td><td>None</td><td>None</td></tr> <tr> <td>Over 20 mm to 40 mm (including)</td><td>66⁰ C</td><td>20⁰ C</td></tr> <tr> <td>Over 40 mm to 63 mm (including)</td><td>Not allowed</td><td>66⁰ C</td></tr> </tbody> </table>			Thickness of thickest part at the area of welding/heat affected zone	Welding using other than low hydrogen welding electrodes IS : 2062	Welding using low hydrogen welding electrodes or submerged arc welding IS:2062	Up to 20 mm (including)	None	None	Over 20 mm to 40 mm (including)	66 ⁰ C	20 ⁰ C	Over 40 mm to 63 mm (including)	Not allowed	66 ⁰ C
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Thickness of thickest part at the area of welding/heat affected zone	Welding using other than low hydrogen welding electrodes IS : 2062	Welding using low hydrogen welding electrodes or submerged arc welding IS:2062
Over 63 mm	Not allowed	110° C

3.3.2 Acceptance Criteria

- (a) The acceptance criteria of Non Destructive Testing (NDTs) on welds shall be as per AWS D1.1 (Dynamically Loaded Structures - tension welds). In case of failure of any of the tests, the Bidder at his own cost shall also carry out rectification of such defective welds. Retesting of the rectified joint, shall also be carried out by the Bidder at his own cost.
- (b) Every 1st and further every 10th set of identical structure shall be checked for control assembly in shop before erection.

3.3.3 Embedded part

Tolerances shall be as specified under concrete works.

3.4 MASONRY & ALLIED WORKS

3.4.1 Tolerances

- (a) All masonry shall be built true and plumb within the tolerances prescribed as below. Care shall be taken to keep the perpends properly aligned. Unless specified otherwise the tolerances in construction of masonry shall be as below:
 - (i) Deviation in verticality in total height of any wall of a building more than one storey in height shall not exceed $\pm 12.5\text{mm}$.
 - (ii) Deviation from vertical within a storey shall not exceed $\pm 6\text{mm}$ per 3m height.

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	(iii) Deviation from the position shown on the plan of any brickwork more than one storey in height shall not exceed 12.5mm. (iv) Relative displacement between load bearing walls in adjacent storeys intended to be in vertical alignment shall not exceed 6mm. (v) Deviation of bed joint from horizontal in any length upto 12m shall not exceed 6mm, and in any length over 1m it shall not exceed 12.5mm total. (vi) Deviation from the specified thickness of bed-joints, cross-joints or perpends shall not exceed ± 3mm. (b) The plastered surface shall be checked for (i) Blistering, bond failure or loss of adhesion, cracking, crazing, efflorescence, grinning, irregularity of surface texture, popping or blowing, recurrent surface dampness, softness or chalkiness defects and the remedial measures for the same shall be adopted as per IS: 1661. (ii) The finished plastered surface shall not show any deviation more than 4 mm when checked with a straight edge of 2 metre length placed against the surface. (iii) The thickness of the plaster shall be measured exclusive of the thickness of key i.e., grooves or open joints in brickwork. The average thickness of plaster shall not be less than the specified thickness. The minimum thickness over any portion of the surface shall not be less than the specified thickness by more than 3 mm for plaster thickness above 12mm and 1 mm for ceiling plaster. Extra thickness required in dubbing behind rounding of the corners at junctions of wall or in plastering of masonry cornices etc. shall be ignored.	

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3.4.2 Acceptance Criteria Following acceptance criteria shall be followed: (a) General workmanship is being good and as recommended by the manufacturer and approved by the Engineer. (b) Tolerances are within the specified limit. (c) Material test certificate is in compliance with the applicable codes/ standards. (d) Bought out material is from the approved manufacturer / vendor. (e) Bought out material is matching with the approved sample.		
3.5	<u>FINISHING & ALLIED WORKS</u>	
3.5.1 Tolerances (a) The floor finish shall be checked specially for the following: (i) Level, slope, plumb as the case may be (ii) Pattern and symmetry (iii) Alignment of joints, dividing strips etc. (iv) Colour, texture (v) Surface finish (vi) Thickness of joints (vii) Details of edges, junction etc. (viii) Performance (ix) Precautions specified for durability		

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Local depressions on account of faulty workmanship shall not be acceptable. Tiles/natural stones with cracked or broken/chipped edges shall not be acceptable. (b) The door, window, ventilator, partition during and after fitting and fixing etc shall be checked for the following: - (i) Installation shall be at correct locations, elevations and in general on a true vertical plane. (ii) Fixing details shall be strictly as shown on drawings. (iii) Assembly of composite units shall be strictly as per drawing, with mastic caulking at transoms and mullions, gaskets, weather strips etc. complete. (iv) All frames on external wall shall be mastic caulked to prevent leakage through joint between frames and masonry. (v) All openable sections shall operate smoothly without jamming. Lock, fasteners, etc, shall engage positively. Keys shall be non-interchangeable. (vi) Cutting to concrete or masonry shall be made good and all abrasions to shop paint shall be touched up with paint or same quality as shop paint. (vii) Aluminium doors, windows, ventilators, partitions etc., shall be free from scratches, stains or discolouration. (viii) Door and window shutters shall operate without jamming. The clearance at head and jamb for door shutters shall not exceed 1.5 mm. For double leaf doors, the gap at the meeting stiles shall not be more than 2.5 mm. 3.6 (a) <u>FOR FALSE CEILING SYSTEM FOLLOWING SHALL BE CHECKED FOR</u> (i) As installed shall be true to shape, level.		

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(ii) Correctness for the opening for the fixtures, colour and shade. (iii) All joints shall be in the same line and cross-joints shall be securely fixed to walls. (iv) There shall not be any sagging and/ or unevenness in the surface Acceptance criteria Ceiling panels shall be best quality material in thickness and properties called for in the schedule of items. Material Test Certificate to be submitted before bulk supply. Finished ceiling shall be at the correct plane and prevent an aesthetically pleasing and uniform appearance, free from sags and warps. Joints and exposed grids shall be in true lines and symmetrically placed in manner as shown in drawings. Cut outs for light fixtures, diffusers and other relevant services shall be of exact dimensions and in exact locations. (b) <u>WATER PROOFING</u> Water proofing shall be tested for water tightness by creating a pond of water minimum 25 mm height on area of 6 m x 6 m, for the period of 48 hrs on fully dried elastomeric membrane surfaces. Minimum 5% area of the roof shall be subjected to water tightness test. Such test necessarily be conducted on vulnerable areas like drain channel/drain head. No dampness shall be visible on the underneath side of roof (i.e. ceiling), parapet and well junctions etc. which have been subjected for testing. The above testing shall be carried out prior to application of wearing course. 3.7 <u>WATER SUPPLY, DRAINAGE & SANITATION</u> 3.7.1 Tolerances		

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(a) All soil pipes, waste pipes, ventilating pipes and all other pipes, when above ground, shall be gas tight. all sewers and drain laid below ground shall be watertight. (b) Obstruction/straightness test The obstructions shall be checked by inserting a smooth ball, of diameter 13 mm less than the pipe bore at the high end of the sewer or drain. If absence of any obstructions, such as yarn or mortar projecting through the joints, ball shall roll down the invert of the pipe and emerge at the lower end. The straightness shall be checked by means of a mirror at one end of the line and lamp at the other. If the pipeline is straight, the full circle of the light may be observed. The mirror will also indicate obstruction in the barrel, if the pipeline is not straight. (c) Service pipes testing with water The service pipes shall be slowly and carefully charged with water, allowing all air to escape avoiding all shock or water hammer. The service pipe shall then be inspected under working condition of pressure and flow, when all draw off taps are closed. The service pipes shall be checked for satisfactorily support and protection from damage corrosion and frost. (d) Fixtures etc. All fixtures and fittings shall be connected by watertight joints. No dripping of water shall be acceptable. (i) Acceptance criteria Following acceptance criteria shall be followed: - General workmanship is being good and is recommend by the manufacturer and approved by the engineer - Tolerances are within the specified limit.		

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	c. Material test certificate is in compliance with the applicable is codes. d. Bought out material is from the approved manufacturer /vendor. e. Bought out material is matching with the approved sample.	

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<u>EXHIBIT - I : TYPICAL FIELD QUALITY LAB EQUIPMENT</u>		
Sr. No.	Equipment	Nos.
1.0	Vicat Apparatus with deskpot	2
2.0	Le chatelier flask	2
3.0	Le chatelier Mould	2
4.0	Cube Moulds for cement testing	12
5.0	Vibration Machine	1
6.0	Laboratory cement autoclave	2
7.0	Length comparator	2
8.0	Shrinkage Bar mould	2
9.0	Sieve shaker	1
10.0	Sieves for sand, coarse & fine aggregate	1 set for each
11.0	Sieves for coarse aggregate for Road	1 set
12.0	Proctor testing equipment	2 sets + 18 cores
13.0	Slump testing equipment	6 sets
14.0	Oven	2
15.0	Physical balance	1
16.0	Rapid moisture meter	2
17.0	Digital Thermometer (range 0-300 o C)	4
18.0	Burette	2
19.0	Measuring cylinders	9

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Sr. No.	Equipment	Nos.	
20.0	Measuring flasks	3	
21.0	Cube compressive Strength Testing Machine of capacity 2000 kN (Automatic pilot, Hydraulically operated with digital display)	2 sets of 2000 kN capacity each	
22.0	Cube moulds of assorted sizes	150	
23.0	Electronic/ digital Weigh balance	2 (30 kg capacity), 2 (200 mg capacity)	
24.0	pH balance	As per requirement	
25.0	Radiographic facilities	Party should deploy BARC approved agency for carrying out RT	
26.0	Mechanical weighing machine	1 (100 kg capacity)	
27.0	Ultrasonic testing machine	As per requirement	
28.0	D.P. Test kit	10	
29.0	Vernier 300 mm, 600 mm	2	
30.0	Micrometer (0.25 mm) out side (25.00)	2	
31.0	Radiography film viewer	1	
32.0	Inside Micrometer 25-750 dia	2	
33.0	Digital elcometer for paint thickness	2	
34.0	Baking oven for electrode	3	

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Sr. No.	Equipment	Nos.
35.0	Portable ovens	2
36.0	Hot plate	2
37.0	Vibrating table for Cube casting size 1.0 m X 1.0 m as per IS : 2514	1
38.0	Pressure type Air content meter	2
39.0	pH meter digital with Calibration liquid	2
40.0	Thermostatically controlled Oven of size 600 mm X 600 mm X 600 mm of range 0-300°C	2
41.0	Compaction factor apparatus	1
42.0	Pocket Penetrometer	4
Note: The list of equipment shown above is indicative additional equipment if any, required for successful completion of work shall be provided/arranged by the Bidder.		

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<u>EXHIBIT - II : LIST OF BOUGHT OUT ITEMS*</u>		
1.0	Zinc silicate primer	
2.0	Polly Amide cured painting system	
3.0	Epoxy based titanium dioxide/micaceous iron oxide pigmented paint	
4.0	High solid content liquid applied urethane based elastomeric membrane as per ASTM C836 and C898	
5.0	Epoxy based coloured pigmented finish , polyamide cured paint	
6.0	Epoxy adhesive and structure sealant	
7.0	Electro Forged gratings of M.S. conforming to IS: 2062	
8.0	Glass Block for Glass block masonry work	
9.0	Unitized Glazing system of approved glass and structural system	
10.0	Heavy duty C.C tiles with abrasion resistant Corborundum / quartz chips	
11.0	Glass Mosaic tiles	
12.0	Vitrified ceramic tiles	
13.0	PTFE type sliding bearings	
14.0	Modular aerated concrete panels with U channels as per IS:277m galvanized steel expansion fasteners and fiberglass tape	
15.0	Colour coated metal decking	
16.0	Troughed permanently colour coated sheets	
17.0	Pre-Engineered Buildings.	

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18.0	Fire Proof single leaf/double leaf metal doors with mineral wool insulation, conforming to IS:3614 with panic device and panic lock, horizontal full width lever, openable on pressing door stoppers	
19.0	Automatic operation systems for doors size 2000x2100 mm with all electrical and mechanical accessories	
20.0	False Ceiling System	
21.0	False Ceiling suspension System	
22.0	Anchor Fasteners	
23.0	Plasticizers	
24.0	Aluminium composite panel cladding comprising of 4 mm thick thermoplastic core of mid low density polyethylene sandwiched between two skins of minimum 0.5 mm thickness.	
25.0	Granular textured coating finish	
	*Note: The above list is indicative additional items if any, required for successful completion of work may be added in the list	

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EXHIBIT-III

FORMAT FOR WEEKLY REPORTING OF UTILISATION OF EQUIPMENTS

Sr. No.	EQUIPMENT NAME AND DETAILS :				WEEK ENDING ON :			
1.0	<u>PLANNED WEEKLY</u>							
	Quantity Of Work		Cumulative Quantity Of Work		Hours of equipment required for planned quantity of work		Cumulative Hours of equipment required	
2.0	<u>ACTUAL WEEKLY</u>							
	Quantity Of work completed by T&P	Cumulative Quantity Of work Completed by T&P	Quantity of work completed by manual means	Cumulative Quantity of work completed by manual means	Actual hours of equipment operated	Cumulative Actual hours of equipment operated	Actual Hours of Breakdown/ Repair	Cumulative Actual Hours of breakdown /Repair

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Sr. No.	EQUIPMENT NAME AND DETAILS :	WEEK ENDING ON :
2.1	Whether the printer of batching plant is operational and batch wise weekly yield of batching plant is enclosed - Yes / No/ Not applicable	
2.2	Whether the compressor / cleaning mechanism of concrete pump is operational - Yes/ No / Not Applicable	
2.3	Whether the electricity supply connections to all T&P's has been checked - Yes/ No / Not Applicable	
2.4	Description of Needle vibrators available at site :-	
	Diameter	Nos.
2.5	The calibration of batching plant is valid - Yes/ No / Not Applicable	
	(Signature of Quality Personnel of Contractor)	
	Legends to be used:	
Class A: Critical; Class B: Major; Class c: Minor (SR, TR, Mfr, TC, LB.) 'A' shall be witnessed by owner FQA .		

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'B' shall be witnessed by owner Erection / Construction department.

'C' shall be witnessed by owner Erection supplier.

A and B check shall be Owner CHP stage)

Where

SR=Site Register.

TR=Test Report.

MfrTC = manufacturers Test Certificate

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EXHIBIT-IV

FIELD QUALITY PLAN

Sr. No.	Characteristics/Item	Type of Check	Instrument	Class	Quantum/ Frequency of check	Ref. documents and acceptance standard	Format of record	Remarks
1.0	<u>EXCAVATION AND FILLING</u>							
1.1	Nature of soil/rock	Visual	As required	B	Random	As per Contractors scheme for excavation	SR	Field Laboratory Test Equipment List is enclosed
1.2	Initial ground level	Measurement	Digital Theodolite/ Total Station	B	100%		SR	
1.3	Dimensions of excavated pit.	Measurement	As required	B	100%		SR	
1.4	Final pit/bed level.	Measurement	As required	B	100%		SR	
1.5	Side slope during excavation	Measurement	As required	B	Random		SR	

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Sr. No.	Characteristics/Item	Type of Check	Instrument	Class	Quantum/ Frequency of check	Ref. documents and acceptance standard	Format of record	Remarks
1.6	<u>EXCAVATION IN HARD ROCK.</u>							
1.6.1	Receipt & Storage of Explosive	Physical	-	A	100%	Indian Explosive Act, 1940	SR	Agency employed shall be got approved from Owner's Site Engr. Incharge.
1.6.2	Blasting Operation	Physical	Compressor Drilling Machine	A	100%	IS : 4081	SR	
1.7	Excavation in Hard Rock (Blasting Prohibited)	Physical	- do -	A	100%	As per approved drawing / scheme	SR/TR	
1.8	<u>FILL</u> (suitability of borrow material)							
1.8.1	Grain size analysis	Physical	As required	B	One in every 2000 cum for each type and source of fill	IS:2720 (Pt. IV)	SR/TR	

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Sr. No.	Characteristics/Item	Type of Check	Instrument	Class	Quantum/ Frequency of check	Ref. documents and acceptance standard	Format of record	Remarks
					materials subject to a min. of 2 samples			
1.8.2	Liquid & plastic limit	Physical	As required	B	One in every 2000 cum for each type and source of fill materials subject to a min. of 2 samples	IS:2720 (Pt. IV)	SR/TR	
1.8.3	Shrinkage limit	Physical	As required	B	One in every 5000 cum for each type and source of fill materials	IS:2720 (Pt. IV)	SR/TR	
1.8.4	Free Swell index	Physical	As required	B	One in every 5000 cum for each type and source of fill materials	IS:2720 (Pt. XI)	SR/TR	

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Sr. No.	Characteristics/Item	Type of Check	Instrument	Class	Quantum/ Frequency of check	Ref. documents and acceptance standard	Format of record	Remarks
1.8.5	Chemical Analysis				One in every 5000 cum for each type and each source of fill materials			
(a)	Organic matter	Physical	As required	B		IS 2720 Pt. XXII	SR/TR	It should not be more aggressive than existing virgin soil
(b)	Calcium carbonate	Physical	As required	B		Part XXIII- (IS 2720)	SR/TR	
(c)	pH value	Physical	As required	B		Part XXVI- (IS 2720)	SR/TR	
(d)	Total soluble sulphate	Physical	As required	B		Part XXVII – (IS 2720)	SR/TR	
1.8.6	Standard Proctor Test to determine optimum moisture content and dry density of fill	Physical	As per IS: 2720	A	One in every 2000 cum for each type and source of fill materials	IS 2720 (Pt. VII)	SR/TR	

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Sr. No.	Characteristics/Item	Type of Check	Instrument	Class	Quantum/ Frequency of check	Ref. documents and acceptance standard	Format of record	Remarks
1.8.7	Moisture content of fill before compaction	Physical	As per IS: 2720	A	One in every 2000 cum for each type and source of fill materials	IS 2720 (Pt. II)	SR/TR	
1.8.8	Degree of compaction fill							
(a)	Dry density by core cutter method	Physical	As per IS: 2720	A	(i) For foundation back fill one for every 10 foundations for each compacted layer	IS 2720 (Pt. XXIX)	SR/TR	Test For compacted soil
	OR							
	Dry density in place by sand replacement method	Physical	As per IS-2720	A	(ii) For area filling, one every 1000 SQM area	IS 2720 (Pt. XXVIII)	SR/TR	Sand replacement method shall be preferred

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Sr. No.	Characteristics/Item	Type of Check	Instrument	Class	Quantum/ Frequency of check	Ref. documents and acceptance standard	Format of record	Remarks
					for each compacted layer			
(b)	Relative density (Density index)	Physical	As per IS-2720	A	-do- (i) & (ii) above	IS 2720 (Pt. XIV)	SR/TR	Test for sand.
(c)	Dry Density by proctor needle penetration	Physical	As per IS-2720	B	Random checks to be carried out for each compacted layer	Standard practice	SR/TR	
1.8.9	Sand	Physical	As per IS-2720, IS-383	B	Random	IS-2720, IS-383	SR/TR	
1.8.10	Stone	Physical	As per IS-2720, IS-383	B	Random	IS-2720, IS-383	SR/TR	
2.0	<u>CAST-IN-SITU CONCRETE</u>							
2.1	<u>MATERIALS</u>							
2.1.1	Cement							

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Sr. No.	Characteristics/Item	Type of Check	Instrument	Class	Quantum/ Frequency of check	Ref. documents and acceptance standard	Format of record	Remarks
(a)	Setting Time*	Physical	As per IS	A	One sample from each lot	As per IS 4031	SR/TR	* In case the cement is supplied by contractor
(b)	Compressive Strength*	Physical	As per IS	A	One sample from each lot	As per IS 4031	SR/TR	* In case the cement is supplied by contractor
(c)	Ensure that cement is stored in weather tight covered storage on raised platform	Visual	As per IS-4082	B	100% covered storage	Covered storage, weather tight on raised platform	SR /LB	Cement held more than 60 days in contractor's godown has to be tested for compressive strength and setting time
2.1.2	Coarse Aggregate							
(a)	Moisture content	Physical	AS per IS Code	B	Once for each stack of 100	IS: 2386 Part-III	SR/LB	Accordingly water content

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Sr. No.	Characteristics/Item	Type of Check	Instrument	Class	Quantum/ Frequency of check	Ref. documents and acceptance standard	Format of record	Remarks
					Cum. Or part there of Except during monsoon when this has to be done every day before start of concreting	IS:456 IS: 383		of the concrete will be adjusted
(b)	Specific gravity, density, voids, absorption.	Physical	As per IS Code	B	Once for each source and for every change of source	IS: 2386 Part-III IS:456, IS: 383	SR/LB	These tests will be carried out while establishing design mix and the results to be intimated to Owner.
(c)	Sieve Analysis (particle, size & shape)	Physical	As per IS Code	B	One per 100 cum. (or) change of source whichever is earlier once per	IS: 2386 Part-I IS: 383	SR/LB	-do-

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Sr. No.	Characteristics/Item	Type of Check	Instrument	Class	Quantum/ Frequency of check	Ref. documents and acceptance standard	Format of record	Remarks
					source			
(d)	Deleterious materials	Physical	As per IS Code	B	Once for each source and for every change of source	IS: 2386, Part-II, IS: 383	SR/LB	Experts opinion regarding suitability of the materials shall be obtained from Specialized Agency
(e)	Soundness	Physical	As per IS Code	B	- do -	IS: 2386, Part-V IS:383	SR/LB	- do -
(f)	Acid & Alkali reactivity	Physical	As per IS Code	B	- do -	IS: 2386, (Part-VII) IS:383	SR/LB	- do -
(g)	Flakiness & Petrographic examination	Physical	As per IS Code	B	- do -	IS: 2386 (Part-VIII), IS: 383	SR/LB	- do -
(h)	Crushing value, abrasion value	Physical	As per	B	- do -	IS: 2386 Part-IV	SR/LB	
	and impact value		IS Code			IS:383		

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Sr. No.	Characteristics/Item	Type of Check	Instrument	Class	Quantum/ Frequency of check	Ref. documents and acceptance standard	Format of record	Remarks
(i)	Repeated Temp. Cycle Test of Aggregate.	Test	As per IS Code	B	Once for each source and for every change of source	No residual expansion	Test Report	Applicable for Aggregate used in TG, BFP, Fan & Mills Foundations
2.1.3	Fine Aggregate							
(a)	Bulkage (if applicable), moisture content	Physical	As per IS Code	B	To be done every day before start of work and when required	IS: 2386 Part-III IS: 383	SR/LB	Volume of sand and weight of water shall be adjusted as per bulkage & moisture content
(b)	Mortar making Properties	Physical	As per IS Code	B	- do -	IS: 2386, IS: 383	SR/LB	Acceptability criteria as per IS:383
(c)	Silt, clay content and organic impurities	Physical	As per IS Code	B	Once for each source and for every change of source.	IS: 2386 Part-II IS: 383	SR/LB	Acceptance limit as per relevant IS code
(d)	all other tests similar to coarse							

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	aggregates excluding petrographic examination							
2.1.4	Water							
(a)	Test for neutralization of water using indicator.	Testing	Chemical Reagent	B	Once for every change of season and on every change of source	IS:3025, IS : 456	SR/LB	
(b)	Tests for ascertaining limit of solids	Physical	As per IS Code	B	-do-	IS:3025, IS : 456	SR/LB	
(c)	Tests for pH Value	Testing	As per IS Code/ digital	B	-do-	IS:3025, IS : 456	SR/LB	
2.2								
2.2.1	Concrete							
(a)	Workability - slump test	Physical	As per IS Code	B	One sample every 2 hrs. from every mixing plant.	IS: 456	SR/LB	

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Sr. No.	Characteristics/Item	Type of Check	Instrument	Class	Quantum/ Frequency of check	Ref. documents and acceptance standard	Format of record	Remarks
(b)	Trial mix (Cubes compressive strength) Mix Design	Physical	As required	A	Min. 4 Trial Mixes with admixtures without admixtures	IS-516& IS: 456, IS:10262	SR/LB	For trial mix min of 6 cubes for each mix 3 specimens shall be tested at 7 days remaining 3 shall be for 28 days comp. Strength
(c)	Crushing strength (works Tests cubes)	Physical	As required	A	One set of 6 cubes per 100 cum or part thereof for each grade of concrete, per shift whichever is earlier	IS: 516, IS:456	SR/LB	Min. of 6 cubes for each mix 3 specimens shall be tested at 7 days remaining 3 shall be for 28 days comp. Strength

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(d)	Water cement ratio	Physical	As required	B	At random at the time of batching	As per IS: 1199 and approved design mix.	SR/LB	
(e)	Cement content	Physical	As required	B	At random at the time of batching	IS: 1199 and approved design mix.	SR/LB	
(f)	Admixtures for Concrete	Testing	As per IS Code	B	100%	IS:456 and approved design mix	Test Report	Admixtures of approved brand and tested quality shall be used.
(g)	Water Tightness Test for Water Retaining Structures	Test	As per IS Code	B	100%	IS:3370	Inspection Report	
(h)	Dimensions of finished structure	Physical	- do -	B	100%	As per Tech. specification.	- do -	
2.2.2	Concrete conveying, placing & compaction							
(a)	Calibration of Batching Plant	Physical	As required	A	To be calibrated at the time of	Review of Test certificate	TC	Cement consumption at

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Sr. No.	Characteristics/Item	Type of Check	Instrument	Class	Quantum/ Frequency of check	Ref. documents and acceptance standard	Format of record	Remarks
					starting and subsequently once in three months and shall confirm to IS- 4925.			batching plant shall also be obtained through comp. output
(b)	Transportation of concrete	Physical	Visual	B	100%	as per construction / erection methodology	SR	
(c)	Placement of concrete	Physical	Visual	B	100%	as per construction / erection methodology	SR	
(d)	Temperature Control of Concrete for top deck of TGs	Test	Thermometer	B	100%	Temperature 25 °C.	SR	
(e)	Check for placement	Physical	-	B	100%	As per approved drg.	SR	

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(f)	Compacting	Physical	As required	B	At Random	check for segregation as per IS 456	SR	
(g)	Curing	Physical	As required	B	At Random	Check for period of curing as per IS 456	SR	
(h)	Cleanliness, provision of chute and arrangement for transportation and placement of concrete	Visual	As required	C	100%	Before clearance for concreting	Inspection report	
2.2.3	Test /check on RCC structure in hardened conditions							
(a)	Ultrasonic Test on top deck of TG foundation	Test	UT Machine	A	100%	IS: 13311 Part-I, and Tech. Specification.	Test Report	The grid shall be 300 mm or as required by the Engineer
(b)	Core Test	Physical	As required	A	As required by Owner's Engr.	As per IS 456	SR/LB	

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(c)	Dimensional check on finished structures & Dimensional Tolerances	Measurement	As required	B	Approved Drawing	As per IS: 456/tech. Specification.	SR/LB	
(d)	Water Tightness Test of liquid retaining structure/tanks	Test	-	A	100%	IS: 3370 / Tech. Specification.	SR/LB	
2.3	<u>REINFORCEMENT STEEL</u>							
(a)	Physical, chemical properties	Review of TCS		A	Each consignment	IS: 1786 , IS:432 IS: 1566	Mfr. TCS	In the absence of manufacturer's test certificate check testing shall be carried out "consignment shall be considered as 50 MT"
(b)	Tolerance	Measurement	As required	B	At Random	IS: 1852 , IS:432, IS: 1786	SR/LB	
(c)	Freedom from cracks surface	Visual	As required	B	100%	IS: 1852, IS-432,	SR/LB	To be checked

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	flaws, Lamination					IS: 1786		at site. Steel collected from source should be free from excessive rust. To be stored as per Technical Specs
2.3.1	Placement of Reinforcement Steel							
(a)	Check for bar bending schedule with necessary laps. Spacers & chairs	Visual & measurement	As required	B	100%	Approved Drawings	SR	
(b)	Check for cover, spacing of bars	Visual & measurement	As required	B	100%	Approved Drawings	SR	
(c)	Check for bending of bars	Visual & measurement	As required	B	100%	Approved Drawings	SR	
(d)	Check for spacers and chairs after the reinforcement cage put inside the formwork	Visual & measurement	As required	B	100%	Approved Drawings	SR	

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(e)	Lapping of bars	Measurement	As required	B	100%	IS: 456/Drawing & approved bar bending schedule	SR	
(f)	Check all joints, Crossing	Visual	As required	B	Random	Approved drawing/bar bending schedule	SR	
2.4	<u>STAGING AND FORMS</u>							
2.4.1	Materials and accessories	Visual	As required	B	Once	As per relevant IS	SR	Formwork materials shall be strictly as per specifications and approval of the Engineer. Materials for

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								the formwork shall be washed thoroughly clean and without broken or damaged edges either due to repetitive use or otherwise. Oiling of formwork before
(a)	Soundness of staging, shuttering and scaffoldings	Visual	As required	B	Once	As per manufacturer's spec.	SR	Concrete shall be resorted to
(b)	Connections between individual scaffolding units and safe slenderness ratio. Two independent safety measures against collapse	Visual	As required	B	Fortnightly	As per National Safety council & relevant IS codes i.e. IS:14687	SR	

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Sr. No.	Characteristics/Item	Type of Check	Instrument	Class	Quantum/ Frequency of check	Ref. documents and acceptance standard	Format of record	Remarks
(c)	Concrete strength during climbing process.	Physical Testing	As per IS provision	B	For each lift of shuttering	As per provisions and tolerances	SR	
(d)	Hoisting for personnel and materials	Visual	As required	B	Fortnightly	As per manufacturer recommendation & safety codes	SR	
(e)	Alignment /shape	Measurements	As required	B	For each lift of shuttering	As per approved drawings	SR/LB	
(f)	Check form's seam marks and water tightness	Physical	As required	B	Random	As per approved drawings.	SR/LB	
2.5	<u>EMBEDDED PART</u>							
(a)	Position and level of embedded parts	Dimensional	As required	B	100%	As per drawing /Part C of Technical Specifications	SR	

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(b)	Position depth and size of bolt hole	Dimensional	As required	B	At random	As per drawing /Part C of Technical Specifications	SR	
(c)	Location vertically of pipe sleeve/ opening of bolt hole	Dimensional	As required	B	At random	As per drawing /Part C of Technical Specifications	SR	
(d)	Load carrying capacity of supporting fixtures/ Expansion fasteners (for supporting false ceiling/ pipe, grid ducts, cable supports in RCC/ Brickwork etc)	Physical Test	As required	B	3 sets of each type/ lot	1.5 times the design load as per specifications & drawing	SR	
(e)	Welding /tying of embedment to reinforcement	Dimensional	As required	B	At random	As per drawing /Part C of Technical Specifications	SR	

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2.6	<u>PRE-CAST CONCRETE</u>							
(a)	Workmanship free from visual defects	Physical	Visual	B	100%	Tech Spec	Register	The precast units shall be free from defects like honeycombing, reinforcement exposure and should have good finish. All relevant tests like workability, cube test shall be carried out as per IS 456-2000 Same is applicable for cast in situ concrete
(b)	Crushing Strength	Physical	Compressive Strength	A	One sample of six cubes per 50	IS 516 & IS 456	SR/LB	A minimum of three specimen

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			testing machine		m ³ or part there			shall be tested for 28 day compressive Strength.
(c)	Dimension of finish structure	Measurement	As required	B	100%	As per IS:456/ Owner's Tech. specification	SR	If the material already tested of the cast-in-situ concrete and part of the same is used for precast concrete, further testing is not required, otherwise testing is required for every 50 Cum of concrete
(d)	Load Test	Physical	As required	B	100%	IS: 456/ As decided by	Inspection Report	These tests shall be carried

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						Owner's Site Engr. Incharge.		out in case of doubt regarding grade of concrete and poor quality.
3.0	<u>STRUCTURAL STEEL</u> (Fabrication & Erection)							
(a)	Material							
(b)	Visual Examination of raw material	Visual	--	B	100%	Free from surface Defects		
3.1	<u>STAINLESS STEEL LINERS TO BUNKER</u>							
3.1.1	Material and chemical composition	Review of Mfr TC		A	Once per Lot	Grade of steel as per technical specification	SR/LB	
3.1.2	Site fabrication and fit up	Physical	As required	B	Random	Technical specifications/ approved fabrication	SR/LB	Cutting, Bending, welding shall as per technical

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						drawings/ details		specification, WPS approval, fabrication of steel and welder's qualification shall be similar to structural steel (Fabrication and Erection) cl.3.0 of this field quality plan.
3.2	<u>FIT UP</u>							
3.2.1	Marking and Cutting	Visual & Measurement		B	100%	Approved Drawing	Site Register	In case, the material is supplied by Contractor, correlated MTC shall be verified. In the

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								event of non sub- mission of MTC, sample shall be collected and tested for physical and metallurgical properties
3.2.2	Ensure Proper fit up before welding	Measurement	Measurement tape.	B	100%	Drg. & tech. specification dimensional Checking as per Technical Specs	Log book/ site register	Proper Identification mark to be put. If laminations are found during cutting of the material same shall not be used.
3.2.3	Check that the gap is minimum for all fillet welds	- do -	- do -	B	100%	- do -	- do -	

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3.2.4	Ensure that the butt weld joints are properly aligned and the offset does not exceed 10% of the thickness of the thinner part of the joint maximum permitted value is 3.2 mm	- do	- do	B	100%	- do	- do	
3.2.5	Ensure match markings are punched for all trial assembled components	- do -	- do -	B	100%	- do -	- do -	
3.2.6	Check Weld Fit Up.	- do -	- do -		100%	Approved Drg.	- do -	
3.3	<u>PREHEATING</u>							
3.3.1	Ensure pre-heating is carried out wherever applicable	Visual	Thermal Chalk	B	100%	Tech spec	- do -	
3.3.2	Ensure that the preheating temperature is uniform prior to the start of welding	Measurement	- do -	B	100%	- do -	- do -	

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3.3.3	Post Weld Heat Treatment (PWHT)	Time & Temperature	- do -	A	100%	Tech. specification	- do -	
3.4	<u>WELDING</u>							
3.4.1	Ensure that the qualified welders and qualified welding procedures are used for all welding	Testing	- do -	A	100%	Approved WPS/WPS AWS-D1.1/ ASME-IX	Test Report	In case of WPS already available similar base material and filler, records may be submitted for Owner's review, review and approval.
3.4.2	Ensure that the welding consumables used are as per procedure approved by Owner.	Testing	- do -	A	100%	Approved WPS./latest Rationalised list of Electrodes.	SR	WPS to be submitted for Owner's approval and low hydrogen electrodes to be used for

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								welding of high/ medium tensile steel
3.4.3	Ensure proper edge preparation wherever applicable	Visual Measurement	Bevel Protractor	C	100%	Approved Drg. & Tech. Spec.	Site Register	
3.4.4	Ensure proper sequence of welding	Visual		B	100%	- do -	- do -	
3.4.5	Check that the temporary attachment welding are removed and ground	Visual	- do -	B	100%	- do -	- do -	
3.4.6	Check & ensure that the overlap/ excess weld metal is removed by grinding and painting.	Visual		B	100%	- do -	- do -	
3.4.7	Check the measurement of parts/ structures after welding for the correctness of dimensions & and matching, absence of distortion &	Measurement	Measuring tape	B	100%	- do - IS7215/ Approved. Drg.	- do -	

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	alignment.							
3.5	<u>NON DESTRUCTIVE TESTING</u>							
3.5.1	Carry out RT/UT/LP/ Micro etch test	Testing	Testing equipment.	A	Tech Specs	Tech Specs	Protocol Reports	
3.5.2	Trial Assy/Control Assy of Structures.	Assy.	-	B	Tech specification	Tech. Specification & approved Drg	- do -	
3.5.3	Micro etch on production test pieces for main fillet weld of crane girders column and butt welds	Physical	Test set up	A	Test coupons for fillet welds with min. one joint per built up columns and crane girders	AWS D1.1 , ASME –IX , tech specifications	TR/SR	
3.5.4	Mechanical testing of butt weld on production test coupon	Tensile and bend test	-do-	A	Min. one joint per column/ built up beams / girders	Technical specifications IS :1599 & IS:1608	TR / SR	No crack should be visible on weld after the bend test and the tensile strength of the

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								weld should not be less than the present metal
3.6	<u>CLEANING AND PAINTING</u>							
3.6.1	Ensure that the surface are cleaned and painted as specified. Dry Film Thickness				For details please see Appendix II / Relevant painting provisions at tech spec.			
3.6.2	Ensure that the following markings are done	Visual / Physical		C	100%	Technical Specification & approved Drg.	- do -	
(a)	Assembly designation							
(b)	Part number							
(c)	Weight							
(d)	Any other important Identifications							

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3.7	<u>FOUNDATION CHECKS</u>							
3.7.1	Ensure that availability of permanent Bench Mark	Visual	-	C	100%	approved Drg./ Tech. specification	Site Reg.	
3.7.2	Ensure the foundation are cast as per requirements	Measurement	Measurement Tape	B	100%	- do -	- do -	
3.7.3	Check the orientation of the foundation	Visual	-	C	100%	- do -	- do -	
3.7.4	Check the top level of foundation pedestal with respect of the permanent bench mark.	Measurement	Total works station	B	100%	- do -	- do -	
3.7.5	Check the center to center distance of column foundation pedestals with respect to the reference axis.	- do -	Measuring Tape	B	100%	- do -	- do -	
3.7.6	Check the diagonals between columns	- do -	- do -	B	100%	- do -	- do -	

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3.7.7	Check the pitch distance of foundation bolts on both axis & diagonal.	- do -	- do -	B	100%	- do -	- do -	
3.8	<u>COLUMN PRE-ASSEMBLY CHECKUP</u>							
3.8.1	Ensure cleaning of Base Plate & HSFG bolt area	Visual						
3.8.2	Check individual column Flaces for identification No. match mark column No. length camber sweep.	Measurement	Measurement	B	100%	Approved Drg. & Tech. Spec.	- do -	
3.8.3	Ensure columns are pre-assembled as per match marks and center line already punched on the column pieces and respective splices plates, when ever applicable.	Visual	-	B	100%	Drg./ Tech. Spec.	Site Register	
(a)	Interchanging of column pieces and tuning of column by 180 degree is not permitted.							

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(b)	Splice plates are to be positioned as per match mark and placing them Upside down/ turning by 180 degree Shall be totally avoided.							
3.8.4	Check camber, sweep, match mark and total length after trial assembly of columns. Note: Thickness of packer plates shall be decided based on total length of columns and the top level of corresponding foundation.	Measurement	Measuring Tape	B	100%	Technical specifications, IS:7215 and IS:12843	- do -	
3.9	<u>ROOF TRUSS PRE-ASSEMBLY CHECKS</u>							
3.9.1	Ensure roof trusses are pre-assembled as per match mark	Visual	-	C	100%	- do -	- do -	

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	C.G. line punched on top and bottom angles.							
3.9.2	Check the following							
(a)	Camber	Measurement	Measuring Tape	B	100%	Technical specification and as per IS:7215 & IS: 12843	- do -	
(b)	Sweep	Physical						
(c)	Alignment of C.G. line punch mark and the match mark given on the top & bottom angles (permitted deviation) in C.G. line matching is + or – 5 mm)							
(d)	Total length of assembled roof truss between faces of end gusset plates at top & bottom (permitted deviation + or - 5 mm)							

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(e)	End Plates are aligned and in level on both ends							
3.9.3	Ensuring the following during welding of roof truss							
(a)	Proper fit-up	Visual \ Measurement		A	100%	Approved Drg./ Approved WPS	Site Register	
(b)	Qualified welder are engaged and	verification of		A	100%	ASME (Sec IX) / Approved WPS	- do -	
	(i) qualified procedures are employed	record if already qualified by Owner						
(c)	Recommended welding consumables and methods are employed.	Physical		A	100%	- do -	- do -	
3.10	Ensure foundation bolts are free from damages and foundation bolt pocket are free from debris and foreign material	Visual	-	B	100%	- do -	- do -	

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3.11	Ensure the level of bottom of Base Plate.	Visual	-	B	100%	Approved drg	- do -	
3.12	Ensure proper orientation of column	Visual	-	C	100%	- do -	- do -	
3.13	Ensure the center line of base plate coincides with foundation pedestal axis (both in X and Y axis)	Physical	-	C	100%	- do -	- do -	
3.14	Ensure the erection of horizontal beams/ girders and vertical bracings	Measurement	-	B	100%	- do -	- do -	
3.15	Check verticality of columns	Measurement	Plumb bob/	B	100%	- do -	- do -	
3.16	Ensure proper tightening of foundation bolts with lock nuts.	Visual	Total Works Station	C	100%	- do -	- do -	
3.17	Ensure grouting of the base bottom after ensuring verticality of columns.	Visual / Measurement	-	B	100%	- do -	- do -	

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3.18	Ensure erection of second pieces of all columns.	Visual	-	C	100%	- do -	- do -	
3.19	Ensure erection of interconnecting members	Visual	-	C	100%	Approved Drg	Site Reg.	
3.20	Ensure proper Butt Welding at Moment connections and erection Welding	Measurement	--	C	100%	do	do	
3.21	Check verticality to 1st and 2 nd pieces after the erection of connection pieces	do	Plumb bob/ Total Work Station	B	100%	Approved Drg / Tech Specs	do	
3.22	Check the verticality of total erected column	do	-do-	B	100%	do	do	
3.23	Check and ensure the following during Crane girder erection wherever applicable							
(a)	Crane girder bracket top level on the column are aligned (tolerance 5 mm max.)	do	Water level	B	100%	do	do	

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(b)	Top flange level of crane girders are aligned (tolerance 5 mm max)	Measurement	Water level	B	100%	do	do	
(c)	Web axes of crane girders in a row are aligned (tolerance web axis shift in a row 3 mm max.)	do	-do-	B	100%	do	do	
(d)	Center to center distance of crane girders	do	Measuring tape	B	100%	do	do	
3.24	Ensure the following during the erection of roof trusses.							
(a)	Proper handling to avoid damage & distortion to assembled trusses	Visual	--	C	100%	do	do	
(b)	Alignment of bolt holes between column and truss gussets	Visual	--	C	100%	do	do	
(c)	Slope of truss as per drg.	Measurement	Spirit level	B	100%	do	do	

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(d)	Tightness of bolts	Torque Measurement		B	100%	Approved Drg. & Tech. Specification Dimensional checking as per spec.	Site Register /Log book	
(e)	Connection of truss connecting members including purlins	Visual		C	100%	Do	do	
3.25	<u>WELDING & NDE</u>							
(a)	Ensure qualified welders are engaged & qualified procedure are employed	Verification of record if already qualified by Owner		A	100%	ASME Section – IX, AWS D1.1/ Approved . WPS	Site Register	In case of WPS already available for similar base material and filler, records may be submitted for Owner's approval and low hydrogen
(b)	Ensure recommended welding consumables and methods are employed	Physical		A	100%	Do	do	

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								electrodes to be used for welding of High / Medium tensile steel.
(c)	Ensure recommended NDE checks are carried out	Visual /Testing	NDE Test Equipment	A	Tech Specs	Approved Drawing/Tech Spec	do	
4.0	<u>BRICK MASONRY, SHEETING & ALLIED WORKS</u>							
4.1	<u>BRICK MASONRY</u>							
(a)	Test on Bricks Dimensions, soundness, colour, compressive strength, water absorption, war- page, efflorescence,	Measurement /	As required	A	As per relevant IS Code One sample for 30,000 Nos	IS:1077 ;IS:2212 /Relevant IS Code	Inspection Report	Efflorescence shall be done at source

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(b)	Test on Mortar Compressive strength, consistency and water retentivity for each portion of walls, plasters and ceilings	Test	As required	B	At random	IS 2250	do	
(c)	Masonry construction Workmanship, Verticality and alignment	Visual/ Physical	As required	B	100%	IS 2212,IS1905 As per Technical Specifications	SR/LB	
4.2	<u>SHEETING & ALLIED WORKS</u>							
(a)	Materials like Modular aerated panel, Permanently colour coated sheets, metal decking , Pre Engineered buildings and Insulations	Visual / lab test	as per manufacture rs Standards/ Tech. Specs	A	One per each batch	Tech. Spec./ As per approved Manufacturing quality plan / Review of manufacturer's TC	TC/TR	(i) Where fabrication is involved FQP for structural steel is applicable.

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								(ii) For aluminium door/windows, check for anodisation as per Tech. Spec.
								(iii) Fire proof Door shall be procured from FC Approved parties as per relevant IS / Tech
								(iv) For aluminium cladding

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								grade of aluminium to be checked. Testing at manufacturer's works before dispatch.
(b)	Storage at site	Visual	Visual	B	100%	Standard practice and recommendations	SR	
(c)	Installation, lap alignment & workmanship.	Visual / Physical	Visual / Physical	B	100%	As per Tech Specs	Format as per site representative	No gas cutting of sheets acceptable
(d)	Thermal insulation for wall cladding Thickness, density, thermal conductivity at 50 ° C	Testing	As per I.S. Code	B	100%	Tech. Specification. IS : 8183	Test Certificate	

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	and all other tests as per IS:8183							
4.3	Painting of concrete surfaces / Plastered Masonry							
(a)	Under ground structures ,Super structure (RCC Works)	Visual		B	100%	As per Tech Spec./ Drawing / and relevant IS Code.	SR/LB	
5.0	<u>FINISH ITEMS</u>							
5.1	<u>PLASTERING</u>							
(a)	Ensure that the plastering of brick walls shall be of min. 20 mm thick for outside & 12 mm for inside face.	Visual / Measurement	Steel Tape	B	100%	As per IS:1661/ Technical Specifications/ approved drawings	SR/LB	
(b)	Ensure that the plastering of concrete ceiling 6 mm thick (min.) mortar	- do -	Steel Tape	B	100%	- do -	- do -	

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(c)	Ensure that the curing of plastering surface are carried out for 7 days (Min)	Visual		B	100%	- do -	- do -	
(d)	Sand (Grading of sand)	Physical		B	50 Cum	As per IS:1542	- do -	
(e)	Plaster Of Paris	Physical		B	50 Cum	As per Is:2547, IS:2333 / Tech. Specs	- do -	
5.2	<u>FLOORING & FINISHING WORK</u>					As per Technical Specifications		
(a)	Check for levels slope	Measurement	Digital / Total station	B	100%	Drawings	SR/LB	No ponding of water on finished surfaces to be ensured.
(b)	Ensure that the floors are chipped prior to commencement of actual	Visual		C	100%	- do -	- do -	

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	finishing work.							
(c)	Ensure that the cement concrete floors are cured minimum for 7 days	Visual		C	100%	- do -	- do -	
(d)	Ensure that the tiled finished floors are polished as per the requirement.	Visual		C	100%	- do -	- do -	Surveillance by FQA
(e)	(i) Check for material	Review of Manufacture's Test Certificate To match with approved sample	-	B	100%	Relevant IS/ Tech. Specs.	- do -	
	(ii) Check for workmanship	Visual	-	B	100%	Relevant IS/ Tech. Specs.	SR/LB	
(f)	Galvanised hexagonal wire netting for lath plastering	Review of Manufacture's TC	-	B	Each Lot	Manufacturer's TC /conforming to IS:3150/	- do -	

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						Tech. Specs/ Drawings		
5.3	<u>FALSE CEILING</u>							
5.3.1	Materials	Physical/ Mfr TC Review	As per relevant IS/ Tech. Specs./ Mfr's. TC	B	Random for each lot	As per relevant IS and Tech. Specs / Manufacturer's TC	- do -	
5.3.2	Fixing and erection	Visual	- do -	B	Random	- do -	- do -	All supports, hangers, accessories shall be as per Tech. Specification/ approved manufacturer's Recommendations

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5.4	<u>WATER PROOFING MATERIAL</u>							
5.4.1	Materials	Review of Mfr. TC	As per ASTM C836-89& Tech. Specs.	B	Random for each lot	As per ASTM C836-89& Tech. Specs.	SR/LB	
5.4.2	Fixing and Laying	Review of Mfr. TC	As per ASTM C898-89& Tech. Specs.	B	Random	As per ASTM C898-89& Tech. Specs.	SR/LB	Laying and fixing of different layers shall be executed as per Tech. Spec.
5.5	<u>FENCING AND GATES</u>							
5.5.1	PVC coated chain link mesh	Review of Mfr. TC	As required	B	Random for each lot	As per Relevant IS and tech. Specs.	Mfr. TC	
5.5.2	Welded wire mesh	- do -	- do -	B	- do -	- do -	- do -	
5.5.3	Reinforced barbed tape	- do -	- do -	B	- do -	- do -	- do -	
5.5.4	M.S. Gates	- do -	- do -	B	- do -	- do -	- do -	

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5.5.5	Fencing Fixing	Visual/ Physical	-	B	Random	- do -		
5.5.6	Gate fabrication	Visual/ Physical	As required	B	As per Str. Steel FQP	- do -	SR/LB / Mfr.TC	
5.6	<u>PAINING</u>							
(a)	Ensure that the surface are blast cleaned to near white metal surface (sa 2.5)	Visual	-	B	100%	Tech. Specs.	SR/LB	Random to be checked by FQA.
(b)	Painting with inorganic zinc silicate primer (DFT-75 microns)	Visual/ Measurement	Elchometer	B	100%	Tech. Specs.	SR/LB	Random to be checked by FQA.
(c)	1st coat of epoxy based finish polyamide cured painting, DFT - 75 micron	-do-	Elchometer/ As required	B	100%	-do-	-do-	-do-
(d)	2nd Coat of epoxy based finish polyamide cured painting, DFT-75 micron	-do-	Elchometer	B	100%	-do-	-do-	-do-

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(e)	Polyurethane finish paint DFT - 25 micron	-do-	-do-	B	Random	-do-	-do-	-do-
5.7	<u>PAINTING MATERIAL</u>							
(a)	Oil Bound distemper	Review of MFr.TC	As required	B	Random for each Lot	IS:428/ As per Tech Specs./ Correlated Mfr. TC	SR/LB	These shall be procured from accredited vendors acceptable to Engineer-In-Charge duly supported by batch/ consignment wise correlated manufacturer's test certificate Surface preparation and application shall be as per tech. Specs.

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(b)	Acrylic emulsion paint	Review of MFr.TC	As required	B	Random for each Lot	As per Relevant IS and tech. Specs./ Correlated Mfr. TC	SR/LB	-do-
(c)	Chemical Resistant paint (Chlorinated rubber paint)	-do-	-do-	B	-do-	As per Tech Specs./ Correlated Mfr. TC	-do-	-do-
(d)	Oil Resistant paint	-do-	-do-	B	-do-	-do-	-do-	-do-
(e)	Resin & Polymer bonded Granular Decorative Coating	-do-	-do-	B	-do-	-do-	-do-	-do-
(f)	Chlorinated rubber paint primer	manufacturer's test certificate with correlation and sample testing	-	A	Each batch	Tech. Specs.	Manufacturer's test certificate and test report.	-do-
(g)	Inorganic zinc silicate primer	-do-	-	B	-do-	-do-	-do-	-do-

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(h)	Epoxy based polyamide cured paint - Ist coat.	-do-	-	B	-do-	-do-	SR	-do-
(i)	Epoxy based polyamide cured paint - 2nd coat.	Manufacturer's test certificate with correlation and sample testing	-	B	Each batch	Tech. Specs.	SR	-do-
(j)	Polyurethane coating	-do-	-	B	-do-	-do-	-do-	-do-
6.0	Water supply, drainage & sanitation Check for material, fittings, Fixtures colour, dimension & workmanship	Physical	-	B	100%	As per Technical specification & relevant IS	Review of manufacturer's TC	
6.1	Toilets and Pantry blocks	Physical	-	B	100%	As per Technical specification & relevant IS	SR/LB/Mfr. TC	No crack and seepage after installation. Mfr. TC for all materials to be

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								submitted
6.2	GI Pipes and fittings	Review of Mfr. TC / Physical	-	B	Random for each lot	As per IS:1239 Tech. Specs	-do-	
6.3	<u>CONCRETE PIPE & CI PIPES</u>							
(a)	Surface finish	Visual/ Review of Mfr. TC	-	B	5% of each lot	As per relevant IS Code/Tech. Specs.	SR/LB	
(b)	Dimensions & Class	Visual	-	B	5% of each lot		SR/LB	
6.4	<u>WATER PIPES AND GI PIPES</u>					IS: 458, Tech. Specs.		
(a)	Hydraulic Pressure Test and Flow	Physical	As required	B	100%		Inspection Report	
6.5	<u>DRAIN & SEWER PIPES</u>					IS:2065,		
(a)	Smoke, Water and Straightness Test	Physical	As required	B	100%	As per relevant IS Code/Tech. Specs.	Inspection Report	No dripping of water shall be accepted

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(b)	Check for alignment, slope and obstruction	Measurement	Digital Total station	B	100%	Drg/Tech Specs /IS : 2065	SR / LB	
(c)	Ensure proper jointing of each laid length and shall be watertight including service pipes	Visual	-	B	100%	- do -	SR / LB	
6.6	Water Storage Tanks	Review of Mfr. TC/ Visual	-	B	100%	IS:12701 / Tech. Specs	- do -	
7.0	Doors, windows, rolling shutters /grills and fire proof shutters	Visual / Physical	As per IS	B	100%	As per Part C of Tech Spec and relevant IS	TC/SIQ/S R	Manufacturer's TC correlated with the consignment shall be submitted as per the Technical Specifications and relevant IS provision
7.1	Glass & Glazing works for float Glass, Wired Glass,	Visual / Physical /	As required	A	100%	As per IS: 14900, 1081, 5437, 419	Review of Mfr. TC /	- do -

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	Hermetically sealed glasses , curtain glasses and glass block masonry	Review of Mfr. TC				& Tech. Specs.	SR	
7.1.1	Fixing of glasses / glazing	Visual	-	B	Random	As per IS/ Tec. Specs/ approved Mfr's. methodology	- do -	
8.0	<u>SPECIAL ITEMS</u>							
8.1	Vibration Isolation System Installations/ erection	Visual / Physical		A	100%	As per manufacturers standard practice	TR/TC/SR	The installation / erection of VIS shall be carried out by manufacturer of the spring & as per technical specifications
8.2	<u>BITUMASTIC FLOORING</u>							
(a)	Bitumen grade	Visual / TC	as per Tech Specs	B	100%	As per Tech Specs	TC	

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8.3	<u>EARTHING MAT</u>							
(a)	Weld sizes & length	Visual / Tape	Visual / Tape	B	100%	As per Tech Specs		Low hydrogen electrode as per Owner approval shall be used
(b)	DP	Physical	DP kit	A	10% at random	Free from defect	TR	
(c)	Earth test		Earthing test kit	A	100%	Relevant IS	SR	Earthing required as per IS
8.4	<u>COMPOSITE ALUMINIUM PANELS</u>							
(a)	Materials	Review of Mfr. TC	-	A	Random for each lot	As per IS / Tech. Specs	SR/LB	
(b)	Installation	Physical / Visual	-	A	Random	-do-	-do-	To be carried out by a specialist agency with SS

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								Screws as per Tech Specs
9.0	<u>PILING WORKS</u>							
9.1	<u>PILE LAYOUT</u>	Measurement	Total station	C	100%	As per approved drawings	SR/LB	
9.1.1	Recording ground level.	Measurement	As required	B	Random	As per approved drawings	SR/LB	
9.1.2	Cleaning/flushing of pile bore at 3 stage- after completion of bore, after lowering reinforcement cage and just before placing concrete.	Visual	As required	B	Random	As per IS: 2911 (relevant part)/ Tech. Specs.	SR/LB	
9.1.3	Size of bore and During boring of pile record commencement of SPT / core recovery to ensure socketing	Measurement	As required	B	100%	As per approved drawings/ Tech. Specs.	SR/LB	

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	length equivalent in terms of the Diameter of the pile below the socketing horizon.							
9.1.4	Pouring of sound concrete of required grade from pile termination level to project above cut off level.	Measurement	As required	B	100%	As per approved drawings / Tech. Specs.	SR/LB	Tremie method with relevant IS: 2911 provisions & Tech. Spec. Shall be followed
9.1.5	Pile termination level	soil data	SPT & core recovery	A	As per specifications	As per specifications	SR	
9.2	<u>TESTING</u>							
9.2.1	Bentonite	Physical	As required	B	once per source	As per IS: 2720/ Tech. specs	SR/LB	
9.2.2	Density check on sample of mud collected from pile bore bottom	Physical	sample collection	A	Random	As per Tech Spec	SR/LB	Tests to be done before placing concreting. Samples to be collected from

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								pile bore bottom.
9.2.3	Slump test of concrete	Physical	Slump test cone.	B	100%	As per Tech Spec IS:2911	SR/LB	
9.2.4	Initial pile load tests. Vertical (Compression), Lateral (horizontal) and Uplift (tension)	Testing	Calibrated dial gauges etc. as required	A	100% for 3 nos. for each type.	IS:2911 & Tech Specs	SR/LB & interpretation as per IS: 2911 (Part 4)	In case of compression test method the loading shall be cyclic.
9.2.5	Routine pile tests, compression and horizontal	Testing	Calibrated dial gauges etc. as required	A	100% for 0.5% of the total number of piles provided for each type of test	IS:2911 & Part B of Tech Specs	SR/LB & interpretation as per IS: 2911 (Part-4)	Routine Test shall be conducted by direct loading method.
9.2.6	Integrity tests	Testing	NDT	A	100%	As per technical specs & suppliers manual	Interpretation of test results	

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10.0	<u>GROUTING</u>							
10.1	Grouting Pressure	Physical	Test set up	B	At random	Approved Drawings		
10.2	Composition of grout	Physical	-do-	B	Each Lot/Batch	As per manufacturer's specification		
10.3	Compressive strength	Measurement	-do-	A	Each lot / Batch	Technical specifications		
11.0	<u>BOUGHT OUT ITEMS</u>							
	All bought out items to be procured from the approved vendor and on approval of Owner, FQA	Verification of TC and Testing	-	B	100%	As per approved scheme	SR/LB	List of bought-out items to be enclosed. The TC submitted should bear proper identification or correlation with the batch of material supplied and same shall be

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								brought out in the challan consignment note.
11.1	(a) Ensure that the surface are blast cleaned to near white metal surface (say 2 1/2)	Visual	-	B	100%	Tech Specs	SR/LB	
	(b) Painting with inorganic zinc silicate primer (DFT – 75 microns)	Visual / Measurement	Elchometer	B	100%	Tech Specs	SR/LB	Random to be checked by FQA
	(c) 1st coat of epoxy based finish polyamide cured painting DFT - 75 micron	Visual / Measurement	Elchometer As required	B	100%	Tech Specs	SR	
	(d) 2nd coat of epoxy based finish polyamide cured painting DFT - 75 micron	Visual / Measurement	Elchometer	B	100%	Tech Specs	SR	
	(e) Polyurethane finish paint DFT - 25 micron	Visual / Measurement	Elchometer	B	Random	Tech Specs	SR	

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11.2	<u>PAINING MATERIAL</u>							
(a)	Chlorinated rubber paint primer	manufacturer's test certificate and sample testing		A	100%	Tech Specs		manufacturer's test certificate and test report
(b)	Inorganic zinc silicate primer			B	100%	Tech Specs		
(c)	Epoxy based polyamide cured paint - 1st coat			B	100%	Tech Specs	SR	
(d)	Epoxy based polyamide cured paint - 2nd coat			B	100%	Tech Specs		
(e)	Polyurethane coating			B	100%	Tech Specs		
12.0	<u>EARTH/ ASH EMBANKMENT</u>							
12.1	<u>ASH/SOIL BORROW AREA</u>							
(a)	Grain size analysis	Physical	As required	B	Once for every	IS:2720	SR/TR	

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					50,000 cu.m of earth or part thereof from each borrow area	Technical Specification		
(b)	Specific Gravity	Measurement	As required		Once for every 50,000 cu.m of earth or part thereof from each borrow area	IS:2720 Technical Specification	SR /TR	
(c)	Moisture Content		As required		Once for every 50,000 cu.m of earth or part thereof from each borrow area	IS:2720 Technical Specification	SR/TR	
(d)	Standard Proctor Density		As required	A	Once for every 20,000 cu.m of earth or part	IS:2720 Technical	SR/TR	

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					thereof from each borrow area	Specification		
12.2	<u>ASH/EARTH WORK IN EMBANKMENT</u>							
(a)	In-situ Dry Density	Measurement	As required	A	(i) Once for every 400 cu.m for ash or part thereof (ii) Once for every 2000 cu.m for earth or part thereof separately for cut off trench, homogeneous embankment	IS:2720 Part-II, VIII and XXIX 95% of max. dry density (Standard Proctor) for homogeneous embankment and outer shells, 98% for cut off trench and for impervious core and 100% for filling in pipe trenches. If less, additional	SR/TR	

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					t and core and outer shells of zoned embankmen t (iii) Once for every 200 sq.m of area on the trimmed slopes. (iv) Once every 250m length of dyke in each layer separately for cut off trench, embankmen t and core	rolling to be done till specified density is achieved.		

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					and outer shells. (v) Once for every 50m width or part thereof dyke in each layer separately for core/shell			
(b)	Moisture Content	Measurement	As required	A	-do-	IS:2720 The coefficient of permeability, K shall be less than 1x10 ⁻⁶ cm/sec.	SR/TR	
(c)	Permeability	Measurement	As required	A	Once for every 5000 cu.m for	IS:2720	SR/TR	

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					cut off trench and core (for clayey soil as well as soil-bentonite mix.)	A suitable template may be used for the desired slope.		
(d)	Measurement of slope of embankment Up stream and down stream side after trimming	Physical	As required	B	Once for every 50 mtr. length of dyke		SR	
12.3	<u>FOUNDATION AFTER PREPARATION</u>							
(a)	Visual inspection to see that all voids have been filled up and no cracks are exposed	Physical		B	Once for every 2000 sq.m of foundation area	IS:2720	SR	
12.4	<u>ROCK MATERIAL FOR RIP-RAP AND ROCK TOE</u>							
(a)	Specific Gravity	Measurement	As Required	B	Once for every source	IS:1122 Minimum 2.50	SR/TR	

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(b)	Sulphate Soundness	Measurement	As Required	B	Once for every source	IS:1126 Maximum 10% weigh loss after five cycles	SR/TR	
(c)	Impact Value	Measurement	As Required	B	Once for every source	IS:2386 Maximum 30%	SR/TR	
(d)	Water absorption	Measurement	As Required	B	Once for every source	IS:2386 Maximum 2.5%	SR/TR	
(e)	Slake Durability	Measurement	As Required	B	Once for every source	IS:10050 Minimum 85% after 2 cycles of 10 minutes.	SR/TR	

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ANNEXURE-III**QUALITY ASSURANCE PLANS FOR BOUGHT-OUT ITEMS OF NDCT**

The format of Q.A. plans for various bought out items are enclosed in this specification. Bidder has to procure the information from vendors in these formats of Q.A. plans only, no other format will accepted by M.S.P.G.C.L. Also it is to note here that to ensure smooth progress and timely completion of supply and erection of works, Bidder shall obtain all the vendors' approval within 5 months from the date of work order and start the procurement activity.

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TYPICAL QUALITY ASSURANCE PLAN FOR A.C. PIPES & A.C. COUPLINGS

Sr. No.	DESCRIPTION	REF.DOC/STANDARD	SAMPLING	ACCEPTING LEVEL	FORMAT OF RECORDS	CHECK QTY	Agency		
1.0	<u>MATERIAL</u>						Mfr	MSPG CL Consul	Contractor
(a)	Cement	43 Gr OPC conforms to IS:8112	MTC	MTC	MTC	100%	V	V	V
(b)	Asbestos fibre	MTR	MSQP	MSQP	MSQP	100%	V	V	V
(c)	Rubber rings & Accessories	IS:5382/IS:10292(PART-1)	MTC	MTC	MTC	100%	V	V	V
(d)	Pozzolana material	IS:3812(PART-I)2003	Monthly	Independent lab test report	Test report	100%	V	V	V
2.0	Manufacturing process	Mazza process as per contract spec.		MTC	MTC	100%	P	R	V
3.0	<u>DIMENSIONAL CHECK</u>								
(a)	Thickness of wall & external diameter	IS:1592-2003	IS:7639	IS:1592-2003	MTR	100%	P	W.V	W.V

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Sr. No.	DESCRIPTION	REF.DOC/STANDARD	SAMPLING	ACCEPTING LEVEL	FORMAT OF RECORDS	CHECK QTY	Agency		
(b)	Length	IS:1592-2003	IS:7639	IS:1592-2003	MTR	100%	P	W.V	W.V
4.0	<u>MECHANICAL TEST</u>		IS:7639				P	W.V	W.V
(a)	Bursting test	Cl no:3.4.3.1 of IS:1592-2003	IS:7639	Cl no:3.4.3.1 of IS:1592-2003	MTR	As per STI of BIS	P	W.V	W.V
(b)	Crushing test	Cl no:3.4.3.2 of IS:1592-2003	IS:7639	Cl no:3.4.3.2 of IS:1592-2003	MTR	As per STI of BIS	P	W.V	W.V
5.0	Hydrostatic pressure test as per IS-5913	Cl no:3.4.a.1 of IS:1592-2003	IS:7639	Cl no:3.4.a.1 of IS:1592-2003	MTR	100%	P	W.V	W.V
6.0	Dimensional check of coupling	As per Mfrs' Dimension	IS:7639	IS:7839	MTR	100%	P	W.V	W.V
7.0	Marking for pipes & couplings	Cl no:3.6.1 of IS:1592-2003	Each No	Cl no:3.6.1 of IS:1592-2003	MTR	100%- As per STI of BIS	P	W.V	W.V
LEGEND MTR-MANUFACTURER'S TEST RECORD P-PERFORM, W-WITNESS, R-REVIEW, V-VERIFICATION MTC-MANUFACTURER'S TEST CERTIFICATES MSQP-Mfr's SHOP QUALITY PROCEDURES									

CONSULTANT : PROCON ENGINEERS

TYPICAL Q.A.P FOR BUTTERFLY VALVES

Sr. No.	Component & Operation	Category	Types of Check	Quantum of check	Reference Documents	Acceptance Norms	Format of Record	Agency		
								M	C	I
1.0	<u>RAW MATERIAL</u>									
1.1	Body	MA	Mechanical	ONE PER HEAT	IS210 GR FG 260	IS210 GR FG 260	Foundry test certificate	P3	V2	V21
1.2	Disc	MA	Mechanical	ONE PER HEAT	IS 1865 GR 500/7	IS 1865 GR 500/7	Foundry test certificate	P3	V2	V21
1.3	Drive & stub shaft	MA	Mechanical	100%	ASTM A479 TY 410	ASTM A479 TY 410	Mill test certificate /lab test certificate	P3	V2	V21
			Chemical	100%	ASTM A479 TY 410	ASTM A479 TY 410	Mill test certificate /lab test certificate	P3	V2	V21

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Sr. No.	Component & Operation	Category	Types of Check	Quantum of check	Reference Documents	Acceptance Norms	Format of Record	Agency		
								M	C	I
1.4	Seat ring	MA	Mechanical	100%	ASTM A240 TY 316	ASTM A240 TY 316	Mill test certificate /lab test certificate	P3	V2	V21
			Chemical	100%	ASTM A240 TY 316	ASTM A240 TY 316	Mill test certificate /lab test certificate	P3	V2	V21
1.5	Clamping ring segment	MA	Mechanical	100%	ASTM A351 CF8M	ASTM A351 CF8M	supplier test certificate	P3	V2	V21
		MA	Chemical	100%	ASTM A351 CF8M	ASTM A351 CF8M	supplier test certificate	P3	V2	V21
2.0	<u>IN-PROCESS</u>									
2.1	Body & disc	MA	Visual	100%	GA DRAWING	GA DRAWING	Inspection report	P2	V2	V21

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Sr. No.	Component & Operation	Category	Types of Check	Quantum of check	Reference Documents	Acceptance Norms	Format of Record	Agency		
								M	C	I
			Dimensional	100%	GA DRAWING	GA DRAWING	Inspection report	P2	V2	V2-1
2.2	Drive & stubb shaft	MA	D.P.check	100%	PLANT STD (FPS-92)	PLANT STD (FPS-92)	Inspection report	P2	V2	V2-1
			Dimensional	100%	Comp Drawing	Comp Drawing	Inspection report	P3	V2	V2-1
3.0	<u>BOUGHT-OUT ITEMS</u>									
3.1	Gear box	MA	VISUAL	100%	CONTRACT SPEC/ MANUFACTURER S STD	CONTRACT SPEC/ MANUFACTURER S STD	MANUFA CTURER' S TEST CERTIFIC ATE	P3	V2	V2-1
			DIMENSION AL	ONE LOT PER	CONTRACT SPEC/ MANUFACTURER S STD	CONTRACT SPEC/ MANUFACTURER S STD	MANUFA CTURER' S TEST CERTIFIC ATE	P3	V2	V2-1

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Sr. No.	Component & Operation	Category	Types of Check	Quantum of check	Reference Documents	Acceptance Norms	Format of Record	Agency		
								M	C	I
3.2	Seal (Nitrile rubber)	MA	VISUAL	100%	PLANT STANDARD	PLANT STANDARD	SUPPLIER TEST CERTIFICATE	P3	V2	V21
			HARDNESS CHECK	100%	PLANT STANDARD	PLANT STANDARD	SUPPLIER TEST CERTIFICATE	P3	V2	V21
4.0	<u>FINAL INSPECTION</u>									
4.1	Assembled valve	MA	OVERALL DIMENSION	100%	APPROVED G.A DRAWINGS	APPROVED G.A DRAWINGS	INSPECTION REPORT	P1,2	W1,2	
			HYDRO-TEST	100%	GA DRAWINGS/TEST SEQUENCE DRAWING	GA DRAWINGS/TEST SEQUENCE DRAWING	PRODUCT TEST CERTIFICATE	P1,2	W1,2	
			PERFORMANCE (OPEN/CLOSE WITHOUT	100%	GA DRAWINGS/TEST SEQUENCE DRAWING	GA DRAWINGS/TEST SEQUENCE DRAWING	PRODUCT TEST CERTIFICATE	P1,2	W1,2	

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Sr. No.	Component & Operation	Category	Types of Check	Quantum of check	Reference Documents	Acceptance Norms	Format of Record	Agency		
								M	C	I
			WATER)							
		MA:	MAJOR		1	AT SHOP FLOOR				
		MI:	MINOR		2	AT SITE				
		P:	PERFORM		3	AT APPROVED THIRD PARTY LAB.				
		V:	VARIFICATION							
		W:	WITNESS							
		M:	Manufacturer							
		C:	MSPGCL /CONSULTANT							
		N:	CONTRACTOR							

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TYPICAL Q.A.P FOR PVC FILM FILLS

Sr. No.	Component & Operation	Characteristic	CLASS	Types of check	Quantum of check	Reference Documents	Acceptance Norms	Format of record	Agency		
									M	C	N
1.0	RAW MATERIAL	PVC	MA	CHEMICAL	ONCE PER LOT	AS PER SPECIFICATION	VIRGIN PVC	ORIGINAL MANUFACTURER'S TEST REPORT	V	V	V
2.0	<u>IN PROCESS STAGE</u>	PVC COMPOUND	MA	CHEMICAL & PHYSICAL	ONCE PER LOT	CTI CODE STD-136	CTI CODE STD-136	THIRD PARTY LABORATORY REPORT	P3	V	V
2.1	<u>PHYSICAL PROPERTIES</u>	TENSILE STRENGTH	MA	PHYSICAL	ONCE PER DAY	ASTM D 882	MIN-390 KG/Sq cm	TEST CERTIFICATE	P1, P3	W, V	V, V
(a)		DENSITY	MA	PHYSICAL	ONCE PER DAY	ASTM D 792	MIN-1.4 gm/cc	TEST CERTIFICATE	P1, P3	W, V	V, V
(b)		VICAT SOFTENING TEMPERATURE	MA	PHYSICAL	ONCE PER DAY	DIN 53460 A/50/ASTMD 1525	MIN 80 DEGREE C	TEST CERTIFICATE	P1, P3	W, V	V, V

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Sr. No.	Component & Operation	Characteristic	CLASS	Types of check	Quantum of check	Reference Documents	Acceptance Norms	Format of record	Agency		
									M	C	N
(c)		FLAMMABILITY	MA	PHYSICAL	ONCE PER DAY	ASTM D 635	MATERIAL TO BE SELF EXTINGUISHING AFTER A TIME OF BURNING OF 5 SEC. MAX	TEST CERTIFICATE	P1, P3	W, V	W, V
(d)		IZOD IMPACT	MA	PHYSICAL	ONCE PER DAY	ASTM D 256	MIN.35.6 J/m	TEST CERTIFICATE	P1, P3	W, V	W, V
(e)		ELASTIC MODULAS	MA	PHYSICAL	ONCE PER DAY	ASTM D 882	MIN 24600 kg/sq cm	TEST CERTIFICATE	P1, P3	W, V	W, V

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Sr. No.	Component & Operation	Characteristic	CLASS	Types of check	Quantum of check	Reference Documents	Acceptance Norms	Format of record	Agency		
									M	C	N
(f)		TENSILE ELONGATION	MA	PHYSICAL	ONCE PER DAY	ASTM D 882	MIN 7%	TEST CERTIFICATE	P1, P3	W, V	W, V
(g)		ULTRA VIOLET LIGHT RESISTANCE (500 HRS EXPOSURE)	MA	PHYSICAL	ONCE PER DAY	ISO-4892	VARIATION IN VALUES OF IZOD IMPACT TEST BEFORE AND AFTER UV LIGHT EXPOSURE SHALL BE WITHIN $\pm 10\%$	THIRD PARTY LABORATORY REPORT	P1, P3	W, V	W, V
3.0	<u>ON FORMED SHEETS</u>	COLOUR	MA	VISUAL	RANDOM, EVERY	TENDER SPECIFICATION	BLACK	SHOP INSPECTION RECORD	P1, P2	W, V	W, V

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Sr. No.	Component & Operation	Characteristic	CLASS	Types of check	Quantum of check	Reference Documents	Acceptance Norms	Format of record	Agency		
									M	C	N
					ONE HR.						
(a)		DIMENSIONS	MA	PHYSICAL	RANDOM, EVERY ONE HR	AS PER IS-6307 AND PRODUCT DRAWING	TOLERANCES AS PER DRAWING SHEET THICKNESSES SHALL BE MIN .25 AND .5 AT THE EDGE	SHOP INSPECTION RECORD	P1, P2	W, V	V, V
(b)		SURFACE FINISH	MI	VISUAL	RANDOM, EVERY ONE HR.	GOOD WITHOUT PIN HOLES AND SURFACE DEFECTS	FREE FROM SURFACE DEFECTS	SHOP INSPECTION RECORD	P1, P2	W, V	V, V
4.0	GLUE	CHEMICAL COMPOSITION	MA	CHEMICAL	EVERY BATCH	AS PER MANUFACTURER	ORIGINAL	ORIGINAL MANUFACTURER'	V	V	V

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									M	C	N
						RER'S RECOMMENDATION & RELAVANT CODES	MANUFACTURER'S TEST REPORT	S TEST REPORT			
5.0	<u>FILL MODULE</u>	DIMENSION	MA	PHYSICAL	ONCE PER DAY AT RANDO M (10 SAMPLE S)	AS PER SPECIFICATIO N AND PRODUCT DRAWING	AS PER APPROVE D PRODUC T DRAWIN G	FABRICATORS INSPECTION RECORD	P2	W, V	W, V
(a)		WEIGHT	MA	PHYSICAL	ONCE PER DAY AT RANDO M (10 SAMPLE S)		MIN-28.6 KG/m3	FABRICATORS INSPECTION RECORD	P2	W, V	W, V

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Sr. No.	Component & Operation	Characteristic	CLASS	Types of check	Quantum of check	Reference Documents	Acceptance Norms	Format of record	Agency		
									M	C	N
(b)		STRENGTH	MA	PHYSICAL	RANDOM SAMPLE SELECTED BY MSPGCL	100 KG LOAD ON ONE MODULE(USE WOODEN PLANK TO AVOID LOCAL DAMAGE)	GLUED JOINT SHOULD NOT FAIL AND MODULE SHALL NOT DEFORM	TEST REPORT	P2	W, V	W, V
	MA:MAJOR			1. AT SHOP FLOOR		NOTE:					
	MI:MINOR			2. AT SITE		1. The sample s selected at random by the MSPGCL on selected day(s) would be sealed in presence of MSPGCL officials.					
	P:PERFORM			3. AT APPROVED THIRD PARTY LAB		2. MSPGCL shall send the sealed sample to third party laboratory directly and the charges for testing shall be paid by contractor.					
	V:VERIFICATION					3. The test results shall be directly sent to MSPGCL by the third party laboratory in a sealed envelope.					

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Sr. No.	Component & Operation	Characteristic	CLASS	Types of check	Quantum of check	Reference Documents	Acceptance Norms	Format of record	Agency		
									M	C	N
	W:WITNESS,					4. The fill supplied to the site shall be rejected for the entire batch if test reports are found not in order.					
	R:REVIEW					5. The fill supplied to the site shall be rejected if the same are found physically not acceptable after inspection.					
	C:CONSULTANT/MSPGCL					6. The fill (sheets) supplied to the site shall be inspected by MSPGCL before glueing					
	N:CONTRACTOR M:MANUFACTURER					7. .Storage instruction shall be provided by the manufacturer and the contractor shall strictly follow the storage instructions at site.					
						8. Quantum of check shall be once per lot for P3.The contractor shall define the quantity per lot.					

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TYPICAL Q.A.P FOR NOZZLES.

Sr. No.	Component & Operation	Characteristic	CLASS	Types of check	Quantum of check	Reference Documents	Acceptance Norms	Format of record	Agency		
									M	C	N
1.0	RAW MATERIAL	POLYPROPYLENE (PP)	MA	CHEMICAL	ONCE PER LOT	AS PER SPECIFICATION	VIRGIN MATERIAL	ORIGINAL MANUFACTURER'S TEST REPORT	P3	V	V
2.0	IN PROCESS STAGE	PP COMPOUND	MA	CHEMICAL & PHYSICAL	ONCE PER LOT	MANUFACTURER'S STANDARD PRACTICES.	FOOD GRADE PLASTIC	THIRD PARTY LABORATORY REPORT	P3	V	V
3.0	<u>FINISHED PRODUCT</u>	DIMENSION	MA	PHYSICAL	ONCE PER DAY AT RANDOM (10 SAMPLES)	AS PER SPECIFICATION AND CONTRACTOR'S PRODUCT DRAWING.	AS PER APPROVED PRODUCT DRAWING	FABRICATORS INSPECTION RECORD	P1,	W, V	W, V
(a)		WEIGHT	MA	PHYSICAL	ONCE PER	CONTRACTOR'S CATALOGUE.	AS PER APPROVED	FABRICATORS INSPECTION	P1,	W, V	W, V

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Sr. No.	Component & Operation	Characteristic	CLASS	Types of check	Quantum of check	Reference Documents	Acceptance Norms	Format of record	Agency		
									M	C	N
					DAY AT RAND OM (10 SAMPL ES)		PRODUCT DRAWING	RECORD			
(b)		STRENGTH	MA	PHYSICAL	RAND OM SAMPL E SELECT ED BY MSPGC L	30 KG DOWNWARD LOAD ON NOZZLE AFTER FIXING THE SAME TO A CARRYING PIPE.	NOZZLE ADOPTER SHOULD NOT FAIL /GET DISPLACE D	TEST REPORT	P1,	W, V	W, V
4.0	PERFORMA NCE	SPRAY CHARACTERIS TICS	MA	PHYSICAL DEMONST ATION	RAND OM SAMPL E SELECT ED BY	AS PER SPECIFICATIO N AND CONTRACTOR S DRAWINGS, BROCHURES	AS PER APPROVED DRAWING / DOCUMEN TS	TEST REPORT	P1,	W, V	W, V

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									M	C	N
					MSPGCL	AND DOCUMENTS.					
	MA:MAJOR		1. AT SHOP FLOOR	NOTE:							
	MI:MINOR		2. AT SITE	1. The sample s selected at random by the MSPGCL on selected day(s) would be sealed in presence of MSPGCL officials.							
	P:PERFORM		3. AT APPROVED THIRD PARTY LAB	2. MSPGCL shall send the sealed sample to third party laboratory directly and the charges for testing shall be paid by contractor.							
	V:VERIFICATION			3. The test results shall be directle sent to MSPGCL by the third party laboratory in a sealed envelope.							
	W:WITNESS			4. The NOZZLE supplied to the site shall be rejected for the entire batch if test reports are found not in order.							
	M:MANUFACTURER/ MSPGCL			5. The NOZZLE supplied to the site shall be rejected if the same are found physically not acceptable after inspection.							
	C:CONSULTANT			6. The NOZZLE supplied to the site shall be rejected for the entire batch if test reports are found not in order & also if the nozzles are found physically not acceptable after inspection							

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Sr. No.	Component & Operation	Characteristic	CLASS	Types of check	Quantum of check	Reference Documents	Acceptance Norms	Format of record	Agency		
									M	C	N
	N:CONTRACTOR				7. The contractor shall define the size of lot..						
					8. The. Alignment of drill holes in the AC pipe for fixing nozzle shall be within $\pm 1''$ accuracy						

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TYPICAL Q.A.P FOR SLUICE GATES

Sr. No.	Component & Operation	Characteristic	CLASS	Types of check	Quantum of check	Reference Documents	Acceptance Norms	Format of record	Agency		
									M	C	N
1.0	<u>MATERIAL INSPECTION</u>										
1.1	GATE,BODY, FRAME, HEAD STOCK, HAND WHEEL, AND GEAR BOX	PHYSICAL TEST	MA	VERIFICATION OF MATERIAL TC'S	AS PER MATERIAL SPEC	C.I CONFORMING IS:210 Gr FG260	CI CONFORMING IS:210 Gr FG260	TEST REPORT/MTC'S	V	V	V
		VISUAL & DIMENSIONAL	MA	VISUAL & MEASUREMENT	100%	As per drawing	As per drawing	INSPECTION REPORT	V	V	V
1.2	SPINDLE/EXTENSION SPINDLE	CHEMICAL & PHYSICAL TEST	MA	VERIFICATION OF MATERIAL TC'S	AS PER MATERIAL SPEC	SS AISI-316/EN-8	SS AISI-316/EN-8	TEST REPORT/MTC'S	V	V	V
		VISUAL & DIMENSION	MA	VISUAL & MEASURE	100%	As per drawing	As per drawing	INSPECTION REPORTS	V	V	V

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									M	C	N
		AL		MENT							
1.3	SEAT FACING (BODY GATES) &	CHEMICAL & PHYSICAL TEST	MA	VERIFICATION OF MATERIAL TC'S	AS PER MATERIAL SPEC	SS AISI-316	SS AISI-316	TEST REPORT/MTC'S	V	V	V
		VISUAL & DIMENSIONAL	MA	VISUAL & MEASUREMENT	100%	As per drawing	As per drawing	INSPECTION REPORT	V	V	V
1.4	FASTNERS	CHEMICAL & PHYSICAL TEST	MA	VERIFICATION OF MATERIAL TC'S	100%	C.S TO IS:1363.CL4.6/C.L.4.0	C.S TO IS:1363.CL4.6/C.L.4.0	TEST REPORT/MTC'S	V	V	V
		VISUAL & DIMENSIONAL	MA	VISUAL & MEASUREMENT	100%	As per drawing	As per drawing	INSPECTION REPORT	V	V	V
2.0	<u>IN PROCESS INSPECTION</u>										

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Sr. No.	Component & Operation	Characteristic	CLASS	Types of check	Quantum of check	Reference Documents	Acceptance Norms	Format of record	Agency		
									M	C	N
2.1	MACHINING OF BODY STEM	DIMENSIONS	MA	VISUAL & MEASUREMENT	100%	As per drawing	As per drawing	INSPECTION REPORT	P	V	V
3.0	<u>FINAL INSPECTION</u>										
NOTE: FINAL ACCEPTANCE WILL BE GIVEN AFTER INSPECTION AT SITE BY ENGINEER –IN-CHARGE.											
3.1		HYDROSTATIC BODY, HYDROSTATIC SEAT/ DISC, LEAK SEAT	CRITICAL	LEAK TIGHTNESS	100%	AS PER IS:3042	AS PER IS:3042	TEST REPORT	P	W,V	W,V
3.2		OVERALL DIMENSIONS	MA	VISUAL & MEASUREMENT	100%	As per drawing	As per drawing	INSPECTION REPORT	P	W,V	W,V

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LEGEND: MA-MAJOR
P-PERFORM
V-VERIFICATION
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SECTION – 3

SPECIFIC DESIGN REQUIREMENT – STRUCTURAL

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CLAUSE NO. DESCRIPTION

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2.0	LOADS
3.0	LOAD COMBINATIONS
4.0	PIPE AND CABLE RACK STRUCTURES
5.0	OTHER SPECIFIC REQUIREMENTS

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1.0	<u>STRUCTURAL STEEL DESIGN</u>	
1.1	Structural steel design will be carried out as per the National Building Code with specific consultation to IS-800 unless noted otherwise. Design of structures in electrical substation will be as per IS-802.	
1.2	Lateral forces along the length of the building will be resisted by bracings in horizontal and vertical frames. The transverse lateral load will be resisted by stiff jointed frame action. Additional bracing or moment connection will be used to assure stability of the structures.	
1.3	Structural steel shall conform to Grade A of IS:2062 for rolled steel members or plates up to 20 mm thickness. For plates above 20 mm thickness and welded construction, steel conforming to Grade B (Killed and normalized) of IS: 2062 shall be used except for crane girders where Grade C (Killed and normalized) (IS: 2062) steel shall be used. All structural steel plates and sections shall be of main producer of such as "SAIL" or "TATA STEEL" or "RINL" or "JINDAL" make or vendor approved by MAHAGENCO.	
1.4	Shop connections will be all welded and field connections will generally be bolted unless specified otherwise. Field bolts, wherever provided shall be high tensile of 20 mm dia. or of higher diameter and of property class 8.8 as per IS-1367 for all major connections. The bolted joints shall be designed for friction type connection and the H.T. bolts shall be tightened to develop the required pretension during their installation. However, the nominal connections in the field like purlins, stairs, wall beams etc. will be done by 16 mm dia. M.S. black bolts (minimum 4.6 grade) conforming to IS-1363 unless specified otherwise.	
1.5	Welding shall be in accordance with the recommendations of IS-816 - Code of Practice for use of metal arc welding for general construction in mild steel and IS-9595 – Recommendation for Metal Arc Welding of Carbon and Carbon Manganese Steels. Built-up members will be fabricated using submerged arc welding procedure unless manual arc welding is specifically required. All butt welds in plate girders and columns will be full penetration. All butt welds will be radio graphically or ultrasonically tested as per relevant IS codes and standard practice. The bare wire electrodes for submerged arc welding shall be as follows:	

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Filler wire: AWS-A-5.17-EH14 Flux will be agglomerated type of classification AWS-A-5.17-F7A2EH14 1.6 All structural steel members for GIS substation shall be hot dip galvanised in accordance with IS-4759. The fasteners shall also be galvanised in terms of IS-5358. Galvanizing of steel structure shall be done after all fabrication work is completed. Zinc coating over galvanized surface of structural members and threaded fasteners shall not be less than 610 gm/sqm and 375 gm/sqm of surface area respectively. However, fasteners may be tapped or re-run after galvanizing. Threads of bolts and nuts shall be capable of developing the full strength of the bolt. The spring washers shall be electro-galvanized as per IS-1573. All galvanizing shall be uniform and of standard quality and shall withstand tests in accordance with IS-2633. 1.7 Shop primer paint will be single coat of red oxide zinc- chromate primer conforms to IS-2074. The surface preparation will be done in accordance with IS: 1477 (Part I & II) – Code of Practice for Finishing of Ferrous Metals in Buildings. Second coat of primer shall be applied after erection and final alignment of the erected structures. Two or more coats of synthetic enamel paint conforming to IS: 2932 of approved shade and quality shall also be applied after erection. Total Dry film thickness of the finished paint shall not be less than 110 microns. 1.8 All welding electrodes shall be of Low Hydrogen type conforming to IS: 814 and shall be EB5426H3JX type. All electrodes, flux, wire etc. shall be of ADOR Welding Ltd., or ESAB India Ltd., or D & H Secheron Electrodes Pvt. Ltd. or Modi electrodes or equivalent as approved by MAHAGENCO. Alternatively, flux coated arc welding (FCAW) conforming to AWS- E70T-5 which is a modified procedure of MIG/CO₂ (solid wire) can be used. If submerged arc welding is used, the bare wire electrodes shall be as follows: (a) Filler wire : AWS-A-5.17-EH14 (b) Flux : agglomerated type of classification AWS-A-5.17-F7A2EH14		

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1.9 Minimum preheat & inter pass temperatures for welding over 40mm to 63mm (thickness of the thicker part at the point of welding) will be 66⁰C and for over 63mm, it will be 110⁰C. However, higher preheat & inter pass temperatures may be required due to joint restraint etc. and will be followed as per approved welding procedure. 1.10 Minimum tests to be carried out during fabrication and erection of structural steel shall be as follows: (a) Steel Ultrasonic Test: Plates above 25mm thick will be subjected to ultrasonic test as per ASTM-A435 or equivalent to check the presence of lamination. (b) Fillet weld Dye Penetration Test: 10% of the total length, Dye penetration will be carried out to the root run. (c) Butt weld Dye Penetration Test: 10% of the total length, Dye penetration will be carried out to the root run after back gouging. Radiographic Test: Splicing should not be provided in tension flange of Bunker Girders and crane girders. Spot radiography shall be carried out on 100% joints in tension zone and 10% joints in compression zone. Minimum 300mm length will be spot radiographed. When radiograph is not possible, ultrasonic test will be carried out after grinding the surface. Ultrasonic Test: 10% of all other Butt welds except crane girder and bunker girder shall be subject to spot radiographic test and the entire balance butt weld for ultrasonic test.		

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1.11 <u>CONNECTIONS</u> Connection of vertical bracings with connecting members and diagonal truss members shall be designed for full tensile capacity of the bracings. Size of fillet weld for flange to web connection for built up column section will be as follows: Full shear capacity for box section. 80% of full shear capacity or actual shear (if indicated in drawings) or 0.5 times of the web thickness which ever is more for I section. Weld will be double fillet. All welds will be continuous. The minimum size of fillet weld will be as per relevant IS code. Shear connections shall be designed for 75% of section strength for rolled sections and 80% of section strength for built up section or rolled section with cover plates. Design shear force should be more than actual shear. Moment connections between beam and column will be designed for 100% of moment capacity of the beam section. All butt welds shall be full penetration butt welds. Connection of base plate & gusset members with the columns will be done considering that total load gets transferred through weld. All splicing work shall be of full strength. Shop splicing for all sections other than rolled sections shall be carried out by full penetration butt welds. Shop splicing of all rolled sections shall be carried out using web and flange cover plate. Following connections will be provided during erection: 1.11.1 Welded Connection (a) Connection of secondary beam to main beam		

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(b) Connection of bracing to column (c) Connection of bracing to longitudinal tie beam (d) Connection of longitudinal tie beam to column (e) Connection of spandrel beam to column (f) Connection of other secondary structures 1.11.2 HSFG Connection (Grade 8.8 bolts) (a) Splicing of column/transverse frame beam/ longitudinal tie beam (b) Connection of frame beam to column (c) Connection of Crane Girder to column (d) Connection between crane girders (e) Other major connections 1.11.3 Bearing Type Connection (HT bolts Grade 8.8) (a) All removable type connections 1.11.4 M.S. bolts (Grade 4.6) (a) Purlins, stairs, wall beams etc 2.0 LOADS Loads as defined under clause 3.00.00 Section-II will be applicable. In addition following should be considered. (a) Elevator Loads Elevator support systems shall be designed to accommodate the		

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capacity load of the elevator plus the weight of the cab and accessories. (b) Coal and Coal Bunker Loads (i) Coal Weight : 8.0 kN/Cu.M for storage volume calculation : 12.0 kN/Cu.M for load calculation Angle of internal friction = 31° (as per IS-9178 Part-I) 3.0 <u>LOAD COMBINATIONS</u> While designing, consideration shall be given to the following load combinations: (a) DL + LL (b) DL + LL + PL + Equip $\pm$ TL (c) DL + LL + PL + Equip + Cb + CtLA $\pm$ CS $\pm$ TL (d) DL + LL + PL + Equip + Cb + CtLB $\pm$ CS $\pm$ TL (e) 0.9*DL $\pm$ EL (for DL only) (f) 0.9*DL $\pm$ WL1 $\pm$ TL (g) 0.9*DL $\pm$ WL2 $\pm$ TL (h) 0.75 (DL + LL + PL + Equip + Cb + Ct $\pm$ EL $\pm$ TL) (*Appropriate portion of LL which is considered for working out EL shall only be taken) (i) 0.75 [DL+LL+ PL + Equip + Cb + CtL1 $\pm$ (CS1+WL1) $\pm$ TL] (j) 0.75 [DL+LL+ PL + Equip + Cb + CtL1 $\pm$ (CS1+WL2) $\pm$ TL] (k) Where the above loads are:		

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(i) DL = Dead load of structures, floors, walls etc (ii) LL = General live load on floors (iii) PL = Pipe load (iv) Equip = Equipment loads (v) Cb = Crane Bridge (vi) Ct = Crane trolley positioned at middle of bridge (vii) CtLA = Crane trolley + Load near one row (viii) CtLB = Crane trolley + Load near other row (ix) CtL1 = Crane trolley + Half load lifted at centre of bridge. (x) CS = Crane surge for full load (xi) CS1 = Crane surge for half load lifted (xii) WL1 = Wind load with internal suction of 0.2P, left to right (xiii) WL2 = Wind load with internal suction of 0.2P, right to left (xiv) EL = Earthquake load (xv) TL = Temperature load Appropriate allowable increase in permissible stresses as per IS codes, may be taken except where as per above load combinations load factors are used in combinations (vii) to (ix) above. Appropriate impact factor shall be considered as per IS: 875 (Part 2) - 1987 while calculating crane loads.		

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In calculating wind loads, appropriate internal thrust/suction shall be considered along with external pressures as per IS: 875 (Part 3) - 1987. All possible load conditions considering external and internal pressures shall be considered in analysis and design for each combination number (vi), (vii), (ix) & (x) above to assess worst effect on whole structure as well as its components.

4.0 PIPE AND CABLE RACK STRUCTURES

The pipe and cable rack structures shall accommodate the pipes/cables with proper access and adequate working space for erection and maintenance. These shall be designed to carry safely all the loads acting on them (DL, LL, WL, EQL, forces from pipe lines etc.). The structures shall be adequately rigid to carry the forces from the pipelines at anchor points without undue deflection so that the pipe lines are really anchored at the anchor points.

It is envisaged that pipe/cable rack under this Package will have to accommodate some additional pipes and cables (such as Plant Water System etc.), which are not in the scope of this Package. The Contractor shall in his offer keep reasonable margin for accommodating such additional pipes/cables in the rack structure, details of which will be furnished to him during the detailed engineering stage.

5.0 OTHER SPECIFIC REQUIREMENTS

All steel framed structures shall be either "rigid frame" or "simple space frames" or combination of two.

Lateral forces shall be resisted by stiff jointed moment connections in rigid frame design. The column bases shall generally be fixed to concrete foundation pedestal by providing moment resistant base detail.

Simple space frame design utilizes single-span beam systems, vertical diagonal bracing at main column lines and horizontal bracing at the roof and major floor levels.

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Interaction ratio shall be restricted to 0.9

The most of plant steel buildings such as Main Power House, Mill Building, CW and ACW Pump House etc. shall be designed as space frame structures. The turbine building design shall be a combination of rigid frame in transverse direction and simple frame in longitudinal direction.

Concrete floors shall be considered to provide continuous lateral support to the top (compression) flange of the support beams. **However, wherever large cut outs (area more than 1.0 m²) are provided in the floor slabs, horizontal floor bracing shall be provided.** Grating/chequered plate floor shall neither be considered to provide lateral support to the top flange of supporting beams nor to provide a shear diaphragm. Adequate lateral support in the form of shear connector and horizontal bracing shall be provided as required.

Floors for vibrating machines of all kind together with supporting framework shall be adequately braced in both horizontal and vertical planes. Floors or structure supporting mechanical equipment shall be designed to minimise vibration, avoid resonance and maintain alignment and level.

Chequered plates shall conform to IS 3502.

All indoor gratings shall be electro forged type and outdoor gratings shall be welded type. Minimum thickness of grating shall be 40mm for indoor installation and 32 mm for outdoor installation. The opening size shall not be more than 30mm x 100 mm. The minimum thickness of the main bearing bar shall be 4mm. All gratings shall be hot dip galvanized @ 610 gm/sqm.

Where a steel beam or member is to be connected on RCC structure, it shall be connected using an insert plate and through shear connection.

For crane girders, welding between web and flange plates shall be carried out by submerged arc welding process. Full penetration of weld between web plate and top flange shall be ensured. Intermediate stiffeners shall be connected with top flange plate by full penetration butt weld. Welding across tension flange will not be permitted. Bearing edges of crane girders shall be machined.

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The working point of the bracing connection shall be the centre of column and girder to which it connects, where practical. The connections of gusset plates to column and girders shall be made to include provisions for eccentricity in connection. The double angle back-to-back with gusset plate in between shall not be used in dust-laden areas. Where double angles are not adequate, beam sections with web in the plane of bracing are used. Permissible stresses for different members shall be allowed to exceed up to 33.33% only under normal loads along with wind and seismic conditions. However, members which are designed primarily to resist wind such as bracing members, no increase in permissible stresses will be permitted. However, permissible stresses in bolts and welds shall be allowed to exceed up to 25% only under wind and seismic conditions 5.1 <u>PERMISSIBLE DEFLECTIONS</u> The permissible deflections of various steel members under normal loading conditions shall be as specified below. For calculation of deflections in structures and individual members, dynamic effects shall not be considered, unless specified otherwise. Also, no increase in deflection limits shall be allowed when wind or seismic load are acting concurrent with normal loading conditions. 5.2 <u>VERTICAL DEFLECTION</u> (a) For beams supporting dynamic equipment : Span / 500 (b) For beams supporting floors / masonry : Span / 325 (c) For beams supporting pipes (pipe racks) : Span / 400 (d) For roofing and cladding components : Span / 250 (e) For gratings and chequered plates : Span 250 subject to a maximum of 6 mm		

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For crane gantries or any member subjected to working loads, the maximum deflection under dead load and live load excluding impact shall not exceed the following values: (a) For manually operated cranes & monorails : Span / 500 (b) For electric overhead cranes (i) up to 50 t capacity : Span / 750 (ii) over 50 t capacity : Span / 1000 5.3 <u>HORIZONTAL DEFLECTIONS</u> The permissible horizontal deflections shall be as per following unless specified otherwise: (a) Single storey building : Height / 325 (without crane load) (b) Multistoried building : Height / 500 (without crane load) (c) Pipe rack columns : Height / 200 (d) Open Structures : Height / 200 (e) Crane gantry girder due to surge : Span/2000 limited to maximum of 15 mm (f) Building main columns at crane rail level due to action of crane surge load only : Height /2500 limited to maximum of 10 mm (g) Open gantry columns at crane rail level due to action of crane surge load only : Height /4000 limited to maximum of 10 mm		

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Provisions of IS: 800 and relevant IS Code shall be followed for limiting deflections of structural elements not listed above.

5.4 MINIMUM THICKNESS OF STEEL ELEMENTS

The minimum thickness of various components of a structure and hot rolled sections shall be as follows. The minimum thickness of rolled shapes shall mean flange thickness regardless of web thickness. Structural steel members exposed to significantly corrosive environment (Exposed to open air i.e., to Rain; Contact with Soil, Coal, ash, Contact with drained liquid or contaminated water, acid/alkali etc.) shall be increased suitably in thickness or suitably protected otherwise as per good practice and sound engineering judgment in each instance.

(a)	Trusses, purlins, girts and bracing	: 6 mm
(b)	Columns and beams	: 8 mm
(c)	Gussets	: 8 mm
(d)	Stiffeners	: 8 mm
(e)	Base plates	: 10 mm & above
(f)	Chequered plates	: 6 mm o/p & above
(g)	Grating flats	: 5 mm
(h)	Minimum thickness of structural members other than gratings and chequered plate directly exposed to weather and inaccessible for painting and maintenance shall be 8 mm.	

5.5 MINIMUM SIZES OF STEEL ELEMENTS

The flange width of purlins supporting light weight concrete slab shall not be less than 65 mm and for those supporting roof sheeting and wall cladding it shall not be less than 50 mm. Width of steel rolled section connected to other member shall be at least 50 mm. The depth of beams for platform of all structures shall not be less than 125 mm.

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Slenderness and Depth Ratio

The slenderness ratio of main members in tension, compression or bending shall be in accordance with IS:800.

The following limiting ratios of depth to span shall considered as a general guide.

(a)	Truss	:	1 / 10
(b)	Rolled beams and girders for Ordinary floors and rafters	:	1 / 24
(c)	Supporting floor beams for vibrating Machinery / equipment	:	1 / 15
(d)	Roof purlins and girts	:	1 / 45
(e)	Gable columns	:	1 / 30

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SECTION - 4

SPECIFIC DESIGN REQUIREMENTS – ARCHITECTURAL

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1.0	<u>SCOPE</u>	
The architectural services shall cover finishing work of all main and auxiliary buildings included under the specification starting from brick work, partition walls, roof protection, finishing of walls, floors and ceilings, false ceiling as required, potable water system, sanitation etc.		
2.0	<u>DESIGN REQUIREMENTS</u>	
2.1	<u>ARCHITECTURAL CONCEPTS</u>	
(a) Layout of the plant area shall have definite hierarchy of road network depending upon its usage, aesthetic, visual sensibilities for creating road vistas, focal points, building back drops, building frames. General layout shall be evolved taking over the basis of landform & local climate & due consideration shall be given to orientation and wind direction. The resulting built mass shall present a definite image width in distinct vocabulary in the form of landmarks, nodes & skyline. (b) All plant building shall be architecturally treated in such a way that it retains a monumental scale, yet presents a pleasing composition of mass and void with suitable and functionally designed projections and recesses. The overall impact of the building shall be one of aesthetically unified architectural composition having a comprehensible scale, blending tonal values with the surroundings and taking full consideration of the climatic conditions, the building orientation and the existing structures nearby. (c) Overall colour scheme of the plant and other buildings shall be designed judiciously and in a comprehensive manner taking into account the mass and void of buildings, its facade, equipments, exposed structural elements, piping, trestles, bus ducts and other service elements. (d) Overall emphasis shall be on developing eco-friendly architecture, merging with the nature with its own sustainable energy management systems.		

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The scheme shall be conceptually finalized in totality including that of equipments so that the proper co-ordination with other agencies can be taken up at appropriate time. 2.1.1 Architectural Design (a) Natural light shall be used to the maximum extent especially in the form of north light/skylight. For adequate light and ventilation, National Building Code recommendation shall be followed. (b) Entrance canopies, chajjas (projections, recesses) over openable windows and door openings on exterior facades shall be provided. (c) All the buildings shall be architecturally designed to meet the National Building Code (SP: 7) norms and local building bye laws, wherever applicable. (d) Architectural design and detailing aspects of all the buildings shall be rendered through professional services of an Architect Statutory requirement and any clearances from local authority may be required to be met with, wherever essential. The Architect Consultant shall be of national/international repute having experience in similar kind of works. The consultant shall evolve the design philosophy and shall present it in the form of presentation drawings, prospective views, 3-D Models & detail drawings. (e) A comprehensive interior design scheme shall be conceived with the intention of projecting a definite theme and aesthetic appearance to inside working environment. It shall take into account the multidisciplinary engineering activities involving power plant technology and architectural & civil engineering for a smooth control hierarchy and man machine interface. The Bidder shall develop the architectural layout of all the buildings listed in this document as per the final approved equipment disposition and other layout considerations indicated elsewhere in this specification. These drawings shall need the approval of the owner before construction. The contractor shall also have to submit		

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perspective views if so desired by the owner at no expenditure to the owner. Approval from statutory authorities, e.g. Factories Inspector, Explosives Inspector, Loss Prevention Association of India/Tariff Advisory Committee etc. shall be the responsibility of the contractor without any obligation of the owner. The entire complex shall have an architectural character and style of its own and shall be visually and functionally integrated with the existing landscape. The bidders must visit the site and have a feel of the overall environment, so that a harmonious as well as integrated architectural concept of the proposed phase of development is achieved. Special care must be taken to enhance the visual and technological quality of development by adopting updated technology, materials, finish etc. Special attention should be given in developing Architectural design of the Powerhouse, Service building & Gate complex. Architectural design must take care of its visual quality as landmark, aesthetic balance in its composition particularly in façade design, appropriate physical and functional integration. Entrance shall be suitably designed along with a lobby, which shall also be aesthetically pleasing. 2.1.2 Architectural Work: Architectural design of the buildings shall be in conformity with the following: (a) Architectural design basis. (b) National Building Code of India. (c) Local Municipal or other authority by-laws. (d) Relevant State Government Factory Acts. (e) Tariff Advisory Committee (TAC) regulations/Loss Prevention Association of India(LPA) regulations (f) Any other relevant information included elsewhere in this Specification.		

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2.2 GENERAL ARCHITECTURAL SPECIFICATIONS

2.2.1 Powerhouse Building

Powerhouse shall be of structural steel framed with RCC floor and Brick Wall & insulated metal cladding construction. Operating floor being the heart centre of Powerhouse shall be designed as a very impressive floor having high quality finish, material and appropriate ambience.

External facade shall be with full brick thick wall up to approximately 3.0m high, plastered and painted. From 3.0m-up to roof, external façade shall be clad with insulated metal cladding on A Row & Gable ends, on C Row and any other external exposed surfaces, single skin metal sheet cladding over brick work shall be installed where brick work is technically required. Fire Wall facing towards Transformer yard, shall be minimum 6.0M high and 1½ brick thick wall or 250mm thick RCC wall as per Fire Prevention regulation.

Single skin metal cladding similar to the Top sheet of Insulated Metal Cladding used for other part of the facia shall be applied over the Fire wall to match the overall elevation treatment.

Sufficient natural light and ventilation has to be ensured for every part of the building unless prevented due to technical reasons. Operating floor may have large glazed area made with Structural glazing system. At Crane girder level, windows on A Row, B Row and gable ends shall be provided.

Rain-water pipes or sanitary pipes shall not be visible from outside. Provision of pipe ducts shall be made to ensure pipe routing.

Steel columns within fire hazardous areas like electrical room, switch gear room shall be encased with brick work or concrete. All steel columns shall have 150mm high concrete base to ensure proper floor finishing work and to protect the column base.

Minimum 2.1m high headroom clearance has to be maintained at every part of the building.

Where false ceiling is to be provided, provision of human access has to be made to maintain the HVAC, Electrical and other service lines above false

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ceiling. If the height between false ceiling and bottom of beam is more than 2.1M then steel grid system (1.2M X 1.2M span) with catwalk to be provided to support the false ceiling system and human access respectively. Minimum 1.5M wide passage is to be marked on the floor as safety exit route. Such passages shall lead to Fire-escape staircases or fire-safe zones. Doors of fire-hazardous rooms or areas shall open towards safety exit passage. All external doors shall open towards outside. Fire escape staircases shall be located as per fire-code. 2.2.2 Mill & Bunker Building This shall be of steel framed structure having single skin metal cladding to clad Tripper floor only. The colour and pattern of the sheeting should match the overall ambience of Power Island. Sufficient natural light and ventilation should be provided for tripper floor. Provision of roof access through stair should be made. 2.3 ROOF INSULATION AND VENTILATION The roof of all buildings shall be insulated with foam concrete. Extractor fans will be provided over roof of turbine hall for ventilation. For ventilation requirements, relevant section of the specification shall be referred. 2.3.1 Other Plant Buildings Structures of Other plant buildings shall be as per description stated elsewhere in this Civil/Structural Specification. Architectural concepts of structures shall offer its own identity and will be aesthetically blended to give pleasing appearance maintaining harmony of the plant complex. Functional needs of each building shall be maintained. 2.4 <u>GENERAL</u> (a) Minimum 1000 mm high (from floor/ roof level) hand railing shall be provided around all floor/roof openings, projections/balconies, walkways, platforms, steel stairs, etc., Hand railings at higher elevations (more than 6.0m from ground level or nearest floor level) shall be 1200mm high. All handrails and ladder pipes (except at		

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	operating floors) shall be 50 mm nominal bore MS pipes (medium class) conforming to IS: 1161 and shall be galvanized as per IS: 4736 treated with etch primer and finished with suitable paint. All rungs and ladders shall also be galvanized. Minimum weight of galvanizing shall be 610 g/sqm. For stairs and around all floor openings at operating floors, 1000 mm high hand railing with 32 NB (polished) stainless steel pipe shall be provided. (b) All stairs shall have a maximum riser height of 180 mm and a minimum tread width of 250 mm. Minimum clear width of stair shall be 1200 mm unless specified otherwise. (c) All buildings having metal cladding shall be provided with a 150 mm high RCC toe curb at the edge of the floor along the metal cladding. 1000 mm high hand railing shall be provided on this RCC curb, wherever required from the safety point of view. (d) In all buildings, structures, suitable arrangement for draining out water collected from equipment blow downs, leakages, floor washings, fire fighting, etc., shall be provided for each floor. All the drains shall be suitably covered with grating or pre-cast RCC panels. (e) RCC staircase shall be provided for all RCC construction buildings and structural steel staircase for all structural steel buildings. (f) Parapet, Chajjas over window and door heads, architectural facia, projections, etc., shall be provided with drip course in cement sand mortar 1:3. (g) All fire exits shall be painted with P.O red/signal red colour shade which shall not be used anywhere except to indicate emergency or safety measure. Fire safety norms shall be followed as per National Building Codes and fire safety requirements for providing fire exits, escape stairs and fire fighting equipment. In detailing of all buildings, fire safety requirements conforming to IS: 1641 and IS: 1642 shall be followed.	

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(h) All roofs shall be accessible by means of staircase or by ladder for maintenance purpose. If there are any mechanical equipment on roof top then for roof access staircase shall be provided. 2.5 <u>WALLS</u> All walls shall be non-load bearing infill panel walls. For initial height up to 3000 mm from ground level, minimum one brick thick masonry wall shall be provided where ever metal cladding is specified. TAC requirements shall also be complied with for all other buildings while deciding cladding type & thickness. However, TAC requirements shall also be followed wherever applicable. RCC vertical posts and horizontal lintels shall be provided wherever necessary to reinforce masonry work. For half brick thick wall 2 nos. 8 mm diameter bars shall be used at every third layer. Bricks used shall be solid fly ash lime bricks conforming to IS: 12894 – 1990 in cement sand mortar. Generally 230 mm thick bricks shall be used. 2.6 <u>EXTERNAL WALLS</u> All external walls shall be one brick thick masonry work with 1:6 cement sand mortar, and/or pre-coated metal cladding as per requirement. For walls requiring periodic temporary removal, necessary arrangements shall be made. Masonry work facing any transformer yard up to a required height shall be fire resistant as per code/LPA requirement. Minimum thickness of firewalls shall be 345 mm for brick walls and 200 mm for concrete walls. For external face of the building, where, permanent external finish is to be provided with fire clay bricks, half brick thick fire clay brick cladding (conforming to IS: 6) in cement mortar shall be provided and shall be finished with recessed pointing. 2.7 <u>INTERNAL WALLS</u> In plant buildings, all internal walls shall be one brick thick masonry in cement mortar 1:6. Internal toilet walls and office walls shall be half brick thick masonry with 1:4 cement sand mortar. In non-plant buildings, all internal		

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walls shall be half brick thick masonry with 1:4 cement sand mortar unless otherwise noted. In control rooms and other specified areas, Glazed partitions with anodized aluminium frame box sections shall be used. External face of Toilets, Air-conditioned and pressurized areas shall be provided with internal masonry wall as per functional/aesthetic requirements inside the metal cladding wherever provided. 2.8 <u>METAL CLADDING</u> (a) Permanent colour coated (non-insulated) metal cladding system Troughed galvanized M.S. sheets having 0.6 mm minimum Base Metal thickness with minimum rate of galvanization of 275 gms./sq.m. (or High tensile steel sheet coated with zinc aluminium alloy @ 150 gms./sq.m. of 0.5 mm minimum Base Metal thickness and having minimum yield strength of 350 MPa) shall be used for the cladding system. The outer side (exposed face) shall be permanently colour coated with Silicon modified polyester paint of minimum DFT 20 microns over primer, of approved colour/shade and the inner side (internal face) shall be coated with same paint of minimum DFT 20 microns over primer of off-white shade. These shall be fixed with concealed fixing system or any other compatible method approved by the Engineer. The sheets shall meet the general requirement of IS: 14246 and shall conform to class 3 for the durability. (b) Flashings, caps, trim closures etc. for jambs, lintels, softies, and cornices All flashings, trim closures, caps etc. required for the metal cladding system shall be made out of plain sheets having same material and any weather/moisture sealants with appropriate material and coating specification as mentioned above for the outer face of the sandwiched metal cladding. Overlap shall be min. 100 mm or as specified by manufacturer. 2.9 <u>ANTI - TERMITE TREATMENT</u> Anti - termite treatment shall be done with insecticide emulsion at the rate of 5 liters/m² as per IS: 6313 (Part – II) 1981 for all structures.		

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2.10 DAMP PROOF COURSE

Exposed surfaces of cement concrete, lime concrete or brickwork to be treated for waterproofing by the resin based application shall be thoroughly cleaned and the epoxy resin based material to be applied as directed by the manufacturer.

2.11 PLASTERING

(b) External : 20 mm thick 1:4 Sand faced cement plaster to be laid in two courses to all external surfaces.

(c) Plaster of Paris : 2 mm thick plaster of Paris punning (Gypsum anhydrous) conforming to IS: 2547 shall be provided over internal plaster to all air-conditioned areas and control rooms. White cement putty of 2mm thickness may be used instead of POP.

(d) Ceiling : 6 mm thick 1:3 Cement: Sand Plaster below all RCC slabs (except areas provided with false ceiling, cable vault ceiling and metal decking)

(e) RCC walls : 12 mm thick 1:6 Cement: Sand Plaster

Groove of uniform size 12 x 12 mm up to 20 x 15 mm in plastered surface as per approved pattern shall be provided as per approved drawing.

All plastering work shall conform to IS: 1661.

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2.12 <u>FLOOR FINISH AND SKIRTING</u> (a) The nominal total thickness of floor finish shall be 40 mm i.e. under bed and topping. The floor shall be laid on an already laid and matured concrete base. The under bed for floors and similar horizontal surfaces shall consist of cement concrete (1 part cement, 2 part sand and 4 part stone chips by volume). Stone chips shall be 12.5 mm down well graded. (b) Sunken RCC slab shall be provided in false flooring area and all toilet areas so as to keep the finished floor level of these areas 12 mm below as that of the surrounding area. For toilet area, sunken slabs shall be made watertight by suitable water proofing treatment. (c) Polished heavy duty white cement concrete tiles (carborundum) of size 300 x 300 x 25 mm thick (minimum) as per IS: 1237, using colour pigments and hard chips like carborandum shall be used. Laying of tiles shall be as per IS: 1443. (d) For battery room, battery charger room, chemical laboratories, chlorination room etc. handling corrosive liquids, fumes/vapors, 25 mm thick acid and alkali proof tiles as per IS: 4457 will be set with acid and alkali proof epoxy mortar under bed as per IS: 4832. Silica based epoxy mortar which is chemical resistant shall be used for dado up to 1500 mm above floor level. (e) All wet areas e.g. pantry, kitchen, locker, laboratory, toilet including W.C, urinal and shower shall have matt finish ceramic tile floor and dado shall be glazed ceramic tiles of minimum 6 mm thickness up to 2200 mm height from floor level as per approved colour pattern. The total thickness of flooring shall be 40mm. Dust pressed ceramic tiles (heavy duty) Group-V conforming to IS: 13755 of size 300 x 300 x 7 mm thick (minimum) of reputed manufacturer and of approved finish shade and colour to be used. (f) Control room shall have 2mm thick heavy duty antistatic vinyl tile flooring over 40 mm thick IPS flooring. PVC flooring, wherever used, shall be minimum 2 mm thick (virgin) as per IS: 3462. The laying of		

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	flooring shall be as per IS: 5318. 2 mm thick 150 mm high PVC tile skirting shall be provided. Penetrations for cables and pipes shall be arranged. (g) Wherever required, fully vitrified ceramic tiles shall be provided in conference room of main control room complex. (h) Floor/Staircase in areas prone to slippage due to oil spillage etc. shall be provided with anti-skid floor finish like brush-wash and chequered finish. Edge angle shall be provided to steps. (i) Risers and treads of concrete staircase shall be provided with cast-in-situ terrazzo in white cement in general. Staircase up to Control room shall have polished Granite stone of approved colour and design. (j) Office and circulation areas in plant and non-plant buildings shall have terrazzo tiles in white cement laid as per IS: 2114/fully vitrified tiles. Vitrified ceramic tiles of size 400mm x 400mm or 600mm x 600mm (Matte or Mirror Polished) and of specified thickness (8mm minimum) from reputed manufacturer shall be used. The finish, shade and colour and pattern shall be as approved. Total thickness of flooring shall be 40 mm. (k) The main entrance of powerhouse, technical/service building, control room and other important areas shall have high quality finish to floors, walls, ceilings etc. (l) Main stairs and landing shall be equally treated. (m) Inter locking concrete blocks used for paving shall be of minimum M 30 grade of concrete, and of thickness 80 mm, of approved colour and pattern. It shall be laid on the sub base and bedding as per recommendation of manufacturer of inter locking concrete blocks. (n) Acid/Alkali Resistant Lining The material shall conform to the following:	

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(i) Bitumen primer shall conform to IS: 158. (ii) Bitumastic compound shall conform to IS: 9510. Where the height of bitumastic layer on vertical surface is more than 2.0 m, the bitumastic layer shall be reinforced with diamond pattern expanded metal steel sheets conforming to IS: 412. (iii) A.R. Bricks/Tiles shall conform to class II of IS: 4860 & IS: 4457 respectively. (iv) Mortar: Potassium silicate & resin type mortars shall conform to IS: 4832 Part- I&II respectively. 2.13 <u>DOORS, WINDOWS, VENTILATORS & LOUVERS</u> (a) Maximum size of single shutter door shall be 1200 mm x 2100 mm. For higher widths double shutters shall be restricted to 2000 mm x 2500 mm beyond which Rolling shutters shall be used. Doors to showers and W.C. shall be 800 mm wide and office areas minimum width shall be 1000 mm. The bottom of lintel for all doors shall be generally 2100 mm unless otherwise mentioned. (b) Personnel Doors In plant buildings, personnel doors shall be 45 mm (min.) thick insulated 16 gauge double plated hollow metal steel flush door shutter with 18 gauge pressed steel frame, factory galvanized, primed and field painted. The two outer sheets shall be rigidly connected with continuous vertical 1.0 mm stiffeners at the rate of 150 mm center to center. Side, top and bottom edges of shutters shall be reinforced by continuous pressed steel channel of minimum 1.2 mm thickness. All steel doors and frames shall conform to IS: 1038 and IS: 4351. The cavity shall be filled with mineral wool/glass wool insulation. Doors shall be complete with all hardware and fixtures like door closer, tower bolts, handles, stoppers, aldrops, locks etc. In non-plant buildings, solid core commercial flush doors shall be used unless otherwise mentioned.		

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(c) Main entrance doors of control room, control equipment room, computer room, etc. shall be provided with air-locked lobby with provision of double doors of aluminium framework with glazing. Doors shall be of double action floor springs mounted. For control room, control equipment room, etc. glazed partitions with aluminium frame shall be provided between air-conditioned and non-air-conditioned areas and on the side of control room facing the operating floor to have a clear view. Glazed panel with aluminium framework shall also be provided as partition between two air-conditioned areas where clear view is necessary. All aluminium sections used shall be heavy gauge of minimum 3 mm thickness and of approved make HINDALCO or equivalent and black powder coated. All aluminium doors shall have heavy gauge box sections with weather seals. (d) Doors of wet areas like W.C., showers shall be hinged type single leaf shuttered FRP (fiber reinforced polyester) doors with heavy-duty aluminium box section frame black powder coated. (e) Fire Doors Fire proof doors shall be provided on division walls of cable spreader rooms and at all fire exit points as per recommendation of Tariff Advisory Committee. These shall be as per IS: 3614. Fire resistance grade of the doors shall be as per TAC requirements. However, minimum fire resistance grade shall be for 2 (two) hours. Fire Doors shall be hollow metal steel flush door with appropriate filler to meet fire rating. All such doors shall have panic bars. (f) Exterior Doors All outside doors shall have door closer as per IS: 3564. All exterior doors located in ground floor shall swing out. Hardware of all doors shall be heavy duty. All exterior doors exposed to weather at all elevations shall also swing out.		

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(g) Interior Doors Wooden doors in finished office areas shall be 45 mm thick full flush, solid core, veneer faced. All wooden doors shall be mortised and reinforced at the factory. All interior doors in general shall swing in unless otherwise required for functional and egress requirements. Doors shall have glazed vision panels where required. Heavy-duty locks shall be provided to both exterior and interior doors as required by the Owner. (h) Weather stripping shall be provided to all outside doors as well as air-conditioned areas and all other doors where dust-free environment is required (i) All windows and ventilators in general shall be heavy duty extruded aluminium sections with fixed, sliding or swing shutters conforming to IS: 1948 and IS: 1949. All aluminium sections used shall be black powder coated. All aluminium windows shall have heavy gauge box sections with weather seals. Windows at ground floor level shall be lockable and furnished with security grills. All window hardware shall be substantially made, smooth finished, accurately fitted, and smooth in operation. Aluminium windows with double glass filled with vacuum shall be provided in all air-conditioning rooms. (j) Hollow extruded section of minimum 3 mm wall thickness as per IS: 1285 shall be used for all aluminium doors, windows and ventilators. Steel windows and ventilators shall be as per IS: 1361 and IS: 1038. (k) All toilet windows shall be adjustable glazed louvers with powder coated aluminium box frames/ventilators. (l) Louvers shall be aluminium Z or S section type, storm proof, complete with bird screen, MS frame, and mullions where long louver is required. Operating damper shall be provided behind boxed louver where closing of louver openings is required. (m) In Powerhouse building, full glazed windows and ventilators in minimum 15 micron anodized aluminium window frame shall be		

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provided with 4 to 6 mm thick (depending on the size of panel) clear float glass and 6 mm thick clear wired/laminated glass where required from safety point of view. For operating floor of Power House, structural glazing may be considered as an important façade element. In other areas aluminum windows with 4 mm thick clear float glass shall be provided. The window area shall be so decided as to allow adequate natural ventilation and light. Note: Glass thickness and member sizes of Aluminium Glazed doors and windows shall be designed by the manufacturer and to be submitted for approval by the Contractor before execution 2.14 <u>ROLLING SHUTTERS</u> Rolling shutters as per IS: 6248 with suitable operating arrangement (manual, mechanical and/or electric) according to sizes shall be provided in buildings to facilitate handling and transportation of equipment. M.S. rolling shutters shall be made of interlocking lath section formed from bright cold rolled, annealed M.S. strips not less than 0.90mm thick for shutters up to 3.5m width & not less than 1.20mm thick for shutters above 3.50m width, with weather seals and wind lock and shall have grills for ventilation where necessary. Its components shall be factory galvanized, primed and field painted. They shall be manually or motor operated as required to meet functional requirement and operating convenience. Rolling shutter with area up to 9 sq.m shall be push and pull type manually operated while for area above 9 sq.m. Rolling shutter will be mechanically/ electrically operated, as per IS specifications. 2.15 <u>GLAZING</u> (a) 6 mm thick float clear glass shall be provided for accessible level operable windows and 6 mm thick wired glass for fixed portion of high level windows and ventilators where frequent replacement is not feasible as per IS: 5437.		

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	(b) All windows shall be glazed and fully flashed and sealed for water tightness. (c) 3 mm thick translucent glass louvers shall be provided in all toilet windows. (d) Glazing in control room between AC and non AC areas shall be with glazed wall panels with 6 mm thick double toughened glass as per IS: 2835. Double-glazing shall consist of two 6 mm thick toughened glass hermetically sealed and separated by 12 mm gap to provide thermal insulation. The outer side of the glazing shall be of tinted glass where exposed to sunrays. (e) Vision panels in doors shall have 4 mm thick clear float glass. (f) 6 mm thick float glass shall be provided for glazed doors and partitions. (g) In fire prone areas toughened glass of minimum thickness 6 mm as per IS: 5437 shall be used. (h) All glazing work shall conform to IS: 1083 and IS: 3548. (i) The sky light/north light shall have 6mm thick Multiwall Polycarbonate sheet fixed with anodized aluminium frame of approved colour & the same shall be made leak proof. The Multiwall Polycarbonate sheets shall be fire and u/v resistant, and suitable for continuous use up to a temperature of 1000C. Suitable aluminium beading shall be used. The open ends of the sheet shall be sealed as per manufacturer's recommendations.	
2.16	<u>HAND RAILING</u> (a) Minimum 1000 mm high (from floor/roof level) hand railing shall be provided in all staircases (Steel and Concrete), corridors, walkways and platforms and around all floor and all roof cutouts at all elevations. (b) All handrail pipes shall be 50 mm nominal bore (medium class) MS Pipes as per IS: 1239. Hand railing shall consist of two-rail system with	

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the top rail 1065 mm above the walkway surface and the intermediate rail of 32 mm NB shall be 535 mm below the top rail. Spacing of handrail post shall be limited to 1200 mm as far as possible but can be adjusted to suit the length of railing. In non-plant areas, total height of handrail shall be 1000 mm from finished floor level. (c) Removable type hand railing shall be provided in areas like loading/unloading bay, equipment handling platforms etc. (d) For RCC stairs and around all floor openings at operating floors, 1000 mm high hand railing with 32 NB (polished) stainless steel pipe shall be provided. (e) For powerhouse building upto operating floor + half landing, main stair & lobby shall have 40mm diameter stainless steel railing with minimum 3mm thick SS posts & decorative minimum 3mm thick seamlessly joined SS handrails. Stainless steel pipe handrail in shall be of approved design to meet the functional requirement as well as very good aesthetic appearance. (f) For Technical Service building, stainless steel railing with SS posts & decorative SS handrails or CP teak wood rails shall be provided. (g) For any other RCC stairs of non-plant buildings 20mm square MS bar post with suitable MS flat and CP teakwood handrails are to be provided. (h) For any other floor of powerhouse building, plant & non-plant buildings, unless otherwise indicated in the specification the post and handrails of stairs, railings, etc. shall be of 32 mm dia G.I. pipes as per IS-1239-part (I). 2.17 <u>STAIRS</u> (a) Stairs/Cage Ladders shall be provided from grade level to highest operating level. All buildings with flat roof shall be made accessible. (b) All stairs shall have not more than twelve (12) risers in one flight. Height of risers and width of treads shall be 180 mm (maximum) and		

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	250 mm (minimum) respectively. Minimum width of stairs shall be 1200 mm. Minimum headroom of 2500 mm to be maintained in all staircases. (c) M. S. Angle/aluminium nosing shall be provided for edge protection in RCC stairs. (d) All staircases shall be in structural steel unless otherwise noted. (e) Escape staircase shall be provided in plant and non-plant buildings as per Fire Regulation Rules in suitable locations. Fire escape stairs shall be provided of width 1000mm. (f) Minimum 900 mm wide Platform in front of doors shall be provided with Door Steps at Ground floor for easy operation of door.	
2.18	<u>OPERATING PLATFORMS, MAINTENANCE WALKWAYS ETC.</u> Maintenance walkways and stairs shall not be less than 920 mm wide. Headroom shall be min of 2500 mm. Space for piping, conduits, lighting fixtures shall be above the headroom. Access platforms shall have min width of 750 mm and min area of 1.1 sqm. No ladders shall be permitted, except for large field erected tanks and secondary means of egress from isolated areas where placement of stair is not practical, ladder may be used. Platforms shall be connected with walkways where necessary. All platforms shall have kick plates at edge of platform. Operating platforms shall not be less than 1000 mm wide. Emergency escape ladders shall be provided for platforms with dead ends. All Platforms from the elevator lobby shall extend to main staircases. Headroom shall be minimum of 2500 mm. Space for piping, conduits, lighting fixtures shall be above the headroom.	
2.19	<u>RAMPS</u> (a) Ramps shall be provided in front of all ground floor rolling shutters. (b) Generally 1:8 slope shall be given to ramp, 1:6 slope being maximum allowable. (c) Ramps shall have neat cement finish with chequered pattern for anti-	

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skid. 2.20 <u>LIFTS AND ELEVATORS</u> Lifts shall be provided in (a) Service Buildings up to roof level. (b) Power house in de-aerator bay up to de-aerator floor level. Lifts shall not be considered as fire exits. 2.21 <u>FALSE CEILING</u> Aluminium false ceiling shall be provided in all air-conditioned areas and other areas where false ceiling is required, gypsum board false ceiling shall be provided. (a) Aluminium panel/lineal false ceiling system Aluminium panel (coil coated) lineal/panel ceiling system shall consist of rolled formed, coil coated aluminium pre-coated magnesium alloy (Al-Mg AA 5050) carrier and panels of minimum 0.9 mm and 0.5 mm thickness respectively. The ceiling system shall be of approved pattern. The system shall be complete with edge cover profile, special panels, carrier splice, etc. The carrier shall be suspended from roof by MS flats, angles or 4g or heavier galvanized tie wire hangers having special height adjustment clips made from spring steel at maximum spacing of 1.2 m c/c both ways as per manufacturer's specification. False ceiling with Mineral Fiber Tiles False ceiling shall consist of regular or tapered edge lightweight mineral fiber tiles of size of 600 x 600 or 600 x 1200 or as per architecture design with minimum tile thickness of 15 mm. Exposed surface shall be semi perforated (fine fissured) with nominal depth of perforation as 4 mm. The material shall be humid resistance up to 95% RH with fire performance of class 0/class 1 (as per BS 476) and shall not sag for 10 years under 95% RH.		

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	Metal suspension system shall conform to ASTM C-635 and shall be hot dipped M.S. galvanized (grade 180 as per IS: 277). Nominal size of T-section shall be 24 x 38 mm for main runners and 24 x 30 mm or 24 x 25 mm cross runners. 24 mm wide exposed flange surfaces shall be permanently colour coated. Suspension system shall be as per manufacturer's specification. Gypsum plasterboard, used for false ceiling, shall be minimum 12mm thick conforming to IS: 2095. (b) Suitable cutouts shall be provided in false ceiling to facilitate fixing of lighting fixtures, AC grills, smoke detectors, etc. Additional hangers and height adjustment clips shall be provided for return air grills, light fixtures, A.C. ducts etc. Illumination and A.C. ventilation grills in these areas shall match with the overall aesthetics. (c) Toilets, Pantry, Rest Rooms shall have false ceiling to reduce the high ceiling heights. (d) False ceiling used shall have good impact resistance, durability, high humidity resistance, fire performance shall be in accordance to British Standards BS: 476 as well as aesthetic. (e) Glass wool insulation shall be laid on top of false ceiling panels in Main Control room, Administrative areas where good acoustic is required. (f) Suitable M.S. channel (Minimum MC75 with maximum spacing of 1.2 m C/C both ways) grid shall be provided above the false ceiling level for movement of personnel and to facilitate maintenance of lighting fixtures, AC ducts etc.	
2.22	<u>UNDER DECK INSULATION</u> 50 mm thick under deck insulation with best quality mineral wool insulation of density 40 – 45 kg/cum and conforming to IS: 8183 with aluminium foil facing shall be provided in all air-conditioning rooms, AHU room and at locations where system requirement is there (slab and beam bottom and beam	

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sides). 2.23 <u>ROOF</u> (a) Roof of pump houses and other buildings shall be cast-in-situ RCC slab. (b) For efficient disposal of rainwater, the run off gradient for the roof shall not be less than 1:100 and the roof shall be provided with RCC/MS plate water gutter, wherever required. Gutter shall be made water tight using suitable watertight treatment. This gradient can be provided either in structure or subsequently by screed concrete 1:2:4 (using 12.5 mm coarse aggregate) and/or cement mortar (1:4). However, minimum 25 mm thick cement mortar (1:4) shall be provided on top to achieve smooth surface. (c) Fillets at junction of roof and vertical walls shall be provided with cast-in-situ cement concrete (1:1.5:3) nominal mix followed by 12mm thick 1:4 cement sand plaster. (d) Roof of all buildings shall be provided with access/approach through staircase or cage ladder. Roof where equipment is mounted shall be provided with access through staircase. (e) Pathways for handling of materials and movement of personnel's shall be provided with 22mm thick chequered cement concrete tiles as per IS: 13801 for a width of 1000mm.		
2.24 <u>ROOF WATER PROOFING</u> The RCC roof shall be provided with pre-fabricated APP (atactic polypropylene) modified waterproofing membrane with non woven polyester reinforcement treatment of 4 mm thickness consisting 160 gsm polyester core coated on both sides with APP modified bitumen and finally finished with thermo fusible film. The treatment shall be laid over a coat of bituminous primer @ 0.27 L/Sqm (IS: 3384). 18 mm thick cement sand mortar (1:4) with chicken wire mesh interposed shall be laid over waterproofing treatment. The roof shall be finished with 22 mm thick cement concrete tiles. Water proofing treatment shall be laid over 75 mm thick foam concrete. 12 mm thick uniform		

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or varying 1:4 cement sand plaster shall be laid on top of foam concrete cast-in-situ after it is fully cured and dried for providing smooth surface for laying of water proofing treatment.

The finishing course shall be fully secured and shall have an even density. There shall not be any bubble formation or crushed or squeezed insulation on under bed. The contractor shall give guarantee in writing for all works executed under this specification supplemented by a separate and unilateral guarantee from the specified agency for the roof water proofing treatment work. The guarantee shall be for materials and workmanship for ten (10) years. The mode of execution of the guarantee shall have to be acceptable to the Owner.

2.25 ROOF DRAINAGE

The system shall be provided for removal of rainwater from roof surface without over flow to avoid damage to the roof structure of all buildings and shall consist of the following:

- (a) Roof Drain Heads.
- (b) Rain Water Down comers.
- (c) Fixture

Multiple drains (min.2 nos.) shall be provided for all roof areas. The roof drains shall be sized for the roof area run-off for a maximum rainfall per hour at site. Minimum 100 mm diameter pipe shall be provided to drain out 40 Sq.m of roof surface area and minimum 150 mm diameter to drain out 80 Sq.m of roof surface area.

For Building where metal cladding is envisaged medium class galvanized mild steel pipes conforming to IS: 1239/IS: 3589 with welded joints shall be provided to drain off rainwater from the roof. For rest of the buildings cast-iron pipes with lead caulked joints conforming to IS: 1230 shall be used. These shall be suitably concealed with masonry work, cement concrete / or sheeting work to match with the exterior finish. The number and size of down comers shall be governed by IS: 1742 and IS: 2527. Roof drain level of all RCC framed buildings having cast-in-situ RCC roof shall be provided with Rain water

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gutter and/or 45 x 45 cm size Khurras having minimum thickness of 30 mm with 1:2:4 concrete over PVC sheet of 1 m x 1 m x 400 micron and finished with 12 mm thick cement sand plaster 1:3. All the pipes shall be provided with suitable fittings and fixtures. Gratings shall be of stainless steel. Any roof more than 8.0 meters above grade shall have access from within the building for cleaning of roof drains. Roof drains will conduct water to storm sewers. Rainwater down comers will generally run outside buildings and conducted away from the building to a watercourse through surface drains. 2.26 <u>PARAPETS</u> Parapets shall be provided to all RCC roofs. Parapet wall shall be 600 mm high for inaccessible roofs and 1000 mm high for accessible roofs. Minimum 110mm thick R.C. concrete parapet will be provided unless otherwise mentioned. Polished Kota stone coping 150mm wide shall be provided to all parapets. In case of parapet wall with brick work, minimum 230mm wall thickness shall be provided. 2.27 <u>PAINTING</u> (a) Exterior Masonry Surface : Buildings shall be finished with water proof cement paint over plaster. Granular textured paint/Synthetic plaster composed of synthetic fibre and petroleum based chemical may also be combined along with cement paint to form suitable pattern on building façade Aluminium composite panels (ACP) may be used to accentuate certain portion of the façade or certain element of the façade as the case may be. (b) Exterior Steel Work : Anti-corrosive synthetic enamel paint over anti corrosive primer. (c) All Woodwork : Synthetic paint over a coat of primer.		

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	(d) All Internal Steel Work : Synthetic enamel over a coat of primer (e) Interior Office Spaces, Control Rooms, All A.C. Areas : Acrylic emulsion paint over 2 mm thick plaster of paris punning or white cement putty punning. (f) Other Areas : Acrylic distemper over plastered surface as indicated in finish schedule in this document. (g) Fire Door : Post Office red shade shall be provided.	
2.28	<u>MISCELLANEOUS WORK</u> (a) Counter tops in kitchen Washbasin, pantry & similar areas : Polished granite (b) Pavements, walkways, etc : 50 mm thick anti-skid interlocking concrete pavers (c) M.S. grill : Generally anodized aluminium grill shall be provided. But in specific cases, M.S. grills shall be used as per approved design for security purpose made of 25 mm X 6mm M.S. flats/12mm – 20mm M.S. square bar of approved design shall be provided to suit security requirements. (d) R.C.C. stair railing : For R.C.C stair, hand railing with 20 mm square M.S. bar balustrades with suitable M.S. flats & anodized aluminium/CP Teakwood handrails shall be provided. Stainless steel pipe railing in specific areas shall be used.	

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(e) For RCC main stair and landing of powerhouse building, RCC stair of Technical/service building shall be of white marble with all edges and nosing moulded. (f) Anti - termite treatment shall be done with insecticide emulsion at the rate of 5 liters/m² as per IS: 6313 (Part – II) 1981 for all structures. (g) Suitable arrangement of floor drain with trap shall be provided in floor where spillage of water may occur. (h) RCC staircase shall be provided in main entrance of Turbine building, Facility building and other important buildings. (i) Covered car parking shed with minimum 25mm thick colored interlocking cement concrete tile flooring over reinforced concrete hard standing and . two- wheelers & cycle parking shed shall be provided as per requirement at the desired location of the owner. Structure shall be RCC framed structure with RCC roofing The structure shall be aesthetically harmonious. (j) Access floor where required shall be provided with removable flooring system consisting of fire resistant particle board 600x600x35 mm thick with .05mm thick aluminium foil lining at bottom and with 2 mm thick anti-static PVC topping. The system shall be supported on proprietary removable metal supporting system. Depth of access floor shall be minimum 600 mm. (k) Doors, windows and rolling shutter in all buildings shall have sun-shed either recessed in the wall or projected out. Projection of sun-shed shall be 750 mm for door and 450 mm for windows. Where doors and windows are side by side, 750 wide continuous sun-shed shall be provided. For recessed type shed minimum 450mm offset shall be provided. (l) North Light provisions on the powerhouse shall be made of Polycarbonate sheet of M/s GE fixed to structural framework as per approved design. Arrangement shall have to be provided to prevent ingress of rainwater, if any.		

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(m) Lifts shall be provided in (i) Service Buildings up to roof level. (ii) Power house in de-aerator bay up to de-aerator floor level. Lifts shall not be considered as fire exits. (n) Ramps (i) Ramps shall be provided in front of all ground floor rolling shutters. (ii) Generally 1:8 slope shall be given to ramp, 1:6 slope being maximum allowable. (iii) Ramps shall have neat cement finish with checkered pattern for anti-skid. (o) Parapets shall be provided to all RCC roofs. Parapet wall shall be 600 mm high for inaccessible roofs and 1000 mm high for accessible roofs. 100 mm thick concrete parapet will be provided unless otherwise mentioned. Polished Kota stone coping 150mm wide shall be provided to all parapets. (p) All painting on masonry or concrete surface shall preferably be applied by roller. If applied by brush then it shall be finished off with roller. Minimum two finishing coats of paint shall be applied over a coat of primer. All paints shall be of approved make including chemical resistant paint. (q) External masonry surfaces of all buildings shall have decorative water proof cement paint over a coat of primer as per IS: 5410. (r) Acrylic plastic emulsion paint shall be provided over plaster of Paris finish for control room, control equipment room, computer room, UPS room and air-conditioned areas including entrance lobby.		

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All other areas shall be painted with Oil Bound Distemper (available for internal use) and white wash. Internal surface of walls of rooms for pumps, machineries and maintenance shall be painted with washable painting of dark shade up to a height of 1.5 m above floor level. (s) Acrylic emulsion paint shall be as per IS: 5411 (Part-I), Acrylic washable distemper shall be as per IS: 428, white wash/colour wash shall conform to IS: 627. (t) Battery room and all other areas subject to chemical corrosion shall be painted with acid/alkali resistant epoxy paint over a suitable primer from top of dado. (u) All ceiling shall be painted with oil bound distemper over ceiling plaster. (v) All internal steel doors, ventilators, louvers, rolling shutters shall have two coats of synthetic enamel paint over a coat of red oxide/zinc chromate primer conforming to IS: 2074. (w) Fire resistant transparent paint as per IS: 162 shall be provided on all woodwork over French polish or flat oil paint. French polish shall conform to IS: 348. Flat oil paint shall conform to IS: 137. (x) All fire exits shall be painted in post office red/signal red colour shade, which shall not be used anywhere else except to indicate emergency or safety measures. (y) Oil resistant paint shall be provided in oil equipment room, oil canal and fuel oil pump house etc. (z) Fire-proof putty in cable penetration on walls of cable spreader rooms shall be provided. (aa) Steel work, which is encased in concrete or galvanized, will not be painted. All other steel work will be given a coat of shop paint, applied thoroughly and evenly to dry surfaces which have been cleaned, as per		

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IS: 1477 (Part I & II). After completion of the pre-cleaning, steel work will be given a coat of inorganic zinc primer composed of 85% zinc in dry film, 60 – 75 micron DFT. The final topcoat for interior metal surfaces shall be of polyamide epoxy composed of 77% solids by volume and of 125 – 140 DFT. The final topcoat for exterior metal surfaces shall be Aliphatic Polyurethane composed of 56% solids by volume and of 40 – 50 DFT. (bb) For painting on concrete, masonry and plastered surface IS: 2395 shall be followed. For painting on woodwork IS: 2338 shall be followed. For painting on steel work and ferrous metals, BS: 5493 and IS: 1477 shall be followed. The type of surface preparation, thickness and type of primer, intermediate and finishing paint shall be according to the painting system adopted. Bitumen primer used in acid/alkali resistant treatment shall conform to IS: 158. (cc) All plastered areas above false ceiling shall be provided with two or more coats of white wash. (dd) Resin bonded granular textured finish, for external applications shall consist of crushed stone/quartz chips of 2.5 mm size and of approved colour/shade and bonded with synthetic resins, Adhesives and additives, all together in a single pack mix. It shall be applied externally, on cured and dried plastered surfaces, with a dry film thickness of min. 2.0 mm. The final finish shall have UV-Resistant, fungus/bacterial resistant properties. Grooves shall be provided as per drawing and the same shall be filled with polysulphide sealant of matching colour/shade. 2.29 <u>WATER SUPPLY</u> Two numbers of roof water tanks (one for storing service water and another for potable water) of adequate capacities depending on the number of users and 8 hours storage capacity shall be provided for each building and pump		

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house. Polyethylene water storage tanks conforming to IS: 12701 shall be used. The tanks shall be complete with all fittings including lid, float valve, stop cock, vent pipe, etc. Potable Water System for various buildings shall be connected to the drinking water and service water systems. System will satisfy state and local plumbing codes. Galvanized MS pipe of medium class conforming to IS: 1239 shall be used for internal piping works for service water and potable water supply. The pipes shall be concealed, and painted with anti-corrosive bituminous paint (as per IS: 158) wherever required. 2.30 <u>TOILETS</u> Toilets shall be provided near work areas, but isolated from main areas. Unless otherwise shown in drawings or specified, the dimension of the toilet blocks shall be decided by the number of sanitary fixtures, which shall be based on number of users in accordance with IS: 1172. Attached toilets shall be provided for all senior executive rooms and conference rooms. All other buildings shall have minimum one toilet block each. Toilets shall be provided with all necessary approved Indian Standard fittings. The finished floor of toilet shall have a drop of 12 mm from general finished floor level and shall have sufficient slope towards trap. Sufficient natural light and ventilation shall be provided as per requirement. Toilet down pipes and vent pipes shall be enclosed with minimum 900 wide ventilation duct upto roof level, considering aesthetics of the building. Unless specified each toilet shall be provided with minimum one W.C. (water closet), two urinal, one washbasin, towel rail, mirror and liquid soap dispenser, glass shelves etc. Western/Indian closets shall be provided as specified in the drawing. Bathroom also will be provided in DM plant toilet. Sunken slab to be provided in toilet area in above floors and suitable waterproofing will be done before and after laying sanitary piping. Sewage disposal shall be through centralized STP. Janitor's closet shall be provided for toilets in all major buildings.		

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(a) Raised type W. C. : 2 No. (b) Squatting type W. C. : 2 No. (c) Urinals : 2 Nos. (d) Wash Basin : 2 Nos. (e) Shower : 1 Nos. (f) Bathroom Mirror, 610 mm X 453mm : 2 Nos. (g) Glass Shelves, 610 mm X 127 mm : 2 Nos. (h) Towel Rail 450 mm Long : 2 Nos. (i) Liquid Soap Holder : 2 Nos. (j) Toilet Roll Holder : 4 No. (k) Hand Dryer : 1 No. (l) Janitor : 1 No (m) Drinking Fountain : 2 No. (n) Laying of 150 mm diameter Extra heavy cast iron soil lines : One Lot		
Potable water shall be supplied to basins, water closets, urinals, sinks, water coolers, showers and other plumbing fixtures. Soil and waste piping shall drain through traps to the yard sanitary sewer system.		
2.32	<u>SEWERAGE SYSTEM</u> Extra heavy Cast Iron pipes shall be used for sanitary work below ground as per IS: 1536. Heavy duty Cast iron pipes shall be used for sanitary work above ground level. Inspection chambers and gully trap chambers shall be in solid fly ash brick construction and manhole spacing shall not exceed 20 m.	

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System: The system shall be designed on the principle of "TWO PIPE SYSTEM" having two separate vertical pipes namely Main Soil Pipe (MSP) and Main waste Pipe (MWP) receiving waste from number of Branch Soil Pipe (BSP) and Branch Waste Pipes (BWP). A BSP either shall have only one W.C. to be connected to MSP or it shall receive discharge from number of urinals to be connected to MSP. A BWP shall receive waste from washbasins, baths, sinks, cooler areas, etc. Floor traps shall be provided to receive waste from waste pipes of various fixtures (except from W.C. which shall be directly connected to MSP) and at locations where wastewater is to be drained out. A MSP shall be directly connected to first manhole of an outside sewer. A MWP shall be discharged into first manhole through a gully trap. All vertical stacks and ventilating pipes shall be carried to a height of at least 1.5 meters above parapet and shall be provided with cowl to top. Sizing: Minimum size of BSP receiving discharge from W.C. shall be 100 mm up to MSP/first manhole. Minimum size of BWP shall be 80 mm. Minimum size after gully trap up to first manhole shall be 100 mm. Gradients: The gradient of a horizontal branch shall normally be 1 in 40 but in no case it shall be flatter than 1 in 50 and steeper than 1 in 10. Non-silting and non-scouring velocity shall be maintained. Disposal:		

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- 2.33 Treated sewage can be used for horticulture. Treated solid wastes can be used as manure. The enclosed annexure of this section gives specific details of finish items required for various buildings. For detailed specification of such items, Volume VI/B may be referred.
- 2.34 During execution of the contract, the contractor shall take approval from the owner of all building materials and finish items (e.g. floor tiles, doors, and windows, paints etc.) to be used for the contract by submitting samples and/or product literature as appropriate
- 2.35 DRAINING OUT WATER FROM FLOORS
- For all buildings, suitable arrangement for draining out water collected from equipment, blow downs, leakages, floor washings, fire fighting etc. shall be provided for each floor, complete up to sewers.
- 2.36 PLINTH PROTECTION
- All buildings shall be provided with 1000 mm wide and 100 mm thick PCC of grade M-20 for plinth protection all-round. The plinth protection shall be laid over well-compacted soil and base formed with stone/gravel of rubble for a thickness of 150 mm.
- 2.37 PAVING
- (a) RCC paving minimum 150 mm thick of M20, over an under bed as specified herein shall be provided for areas mentioned below. RCC paving shall be designed, as rigid reinforced concrete pavement for the crane/vehicular/ equipment movement loads which the paving has to bear. The under bed for paving shall consist of preparation and consolidation of sub grade to the required level, laying of stone soling of 230 mm compacted thickness with 63 mm and down aggregate with interstices filled with selected sand followed by 75 mm thick 1:4:8 PCC (1 part cement, 4 parts sand and 8 parts stone aggregate) with 40 mm nominal size aggregate. Paving areas shall be provided with the metallic hardener floor finish as specified elsewhere in the specification. However vehicular passage shall be provided with non-metallic hard granular finish in place of metallic hardener topping. Non-metallic hard granules shall be spread over the green concrete

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	paving slab at the rate of not less than 5 kg/ sq.m. Paving shall be provided for ground floor of all buildings. (b) PCC paving of grade M-20, 100 mm thick laid over 75 mm thick bed of dry brick aggregate shall be provided for following areas: (i) 2.0 m wide pathway all along pipe/ cable corridor and (ii) 2.0 m wide pathway all around each cooling tower and 2.0 m wide ways inter connecting all cooling towers with each other. 2.38 <u>CAR/TWO -WHEELER SHED</u> (a) Covered car parking shed with minimum 25mm thick colored interlocking cement concrete tile flooring over reinforced concrete hard standing and two- wheelers & cycle parking shed shall be provided as per requirement at the desired location of the owner. Structure shall be RCC framed structure with RCC roofing—The structure shall be aesthetically harmonious. 2.39 <u>STATUTORY RULES</u> (b) Bidder/Contractor shall comply with all applicable statutory rules pertaining to Factories Act as applicable for the State, Rules of Tariff Advisory Committee (TAC) & Water Act for pollution control etc. (c) Provision of safety, health and welfare according to Factories Act shall be complied with. These shall include provision of continuous walkway, minimum 500 mm wide, along the crane girder at crane girder level on both sides, comfortable approach to EOT crane cabin, fire escape, locker room for workmen, pantry, toilets, rest rooms etc. (d) Provision for fire proof doors, number of staircases, fire separation walls, encasing of structural members (in fire prone areas) etc. shall be made according to the recommendation of Tariff Advisory Committee. (e) Statutory clearance and norms of State Pollution Control Board shall be followed as per Water Act for effluent quality from plant.	

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2.40 <u>LANDSCAPING</u> Refer Annexure – I for Landscaping design criteria. 2.41 <u>POTABLE WATER SYSTEM AND PLUMBING</u> 2.41.1 This system for various buildings shall be connected to the drinking water and service water systems, the schemes for which are indicated elsewhere in this specification. 2.41.2 Water outlets shall be provided for an instantaneous flow rate of approximately 7 Cu.M/Hr. (25 GPM) 2.41.3 System will satisfy state and local plumbing codes. 2.42 <u>SEALANT</u> Silicon sealant or polyurethane sealant shall be used in all expansion joints exposed to weather. All joints around exterior doors, windows, and expansion joints, etc. shall be sealed for proper water-tightness 2.43 <u>CHAIN LINK FENCING</u> 3.0 M high fencing over 250 thick 200 high toe wall with M.S. angle post embedded in cement concrete block and 2.4 M high PVC coated G.I. chain link fencing of minimum 8 gauge (including PVC coating) with barbed wire for remaining height shall be provided for areas as per safety requirement. 2.44 <u>BOUNDARY WALL</u> Boundary wall shall conform to the requirements for vital industrial undertakings. It will be 3.0-meter high masonry wall over which 600 mm high barbed wire fitted and fixed to embedded bifurcated steel angles shall be provided. Layers of G.I. barbed wire will be four nos. for each bifurcation along with double concertina spiral fencing as per bid drawing 300/ 350 mm thick laterite stone block wall laid in 1: 4 cement sand mortar shall be used in boundary wall. The masonry wall shall be painted with cement- based paint over external plaster and steel angles shall be painted		

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with synthetic enamel paint over zinc chromate primer.

3.0 IS CODES & STANDARDS

Following Indian Codes and Standards shall generally be used for design of architectural works. All applicable I.S. codes shall be used. In all cases, the latest revisions with amendments, if any shall be followed (as on date on LOI)

3.1 MASONRY AND ALLIED WORKS

- (a) IS: 1609 : Code of Practice for Laying Damp-proof Treatment using Bitumen Felts.
- (b) IS: 2212 : Code of Practice for Brickwork.
- (c) IS: 2250 : Code of Practice for Preparation and Use of Masonry Mortar.
- (d) IS: 5134 : Bitumen Impregnated Paper and Board.
- (e) IS: 1542 : Specification for Sand for Plaster.
- (f) IS: 1661 : Code of Practice for Cement and Cement-lime Plaster Finish on Walls and Ceiling
- (g) IS: 2394 : Code of Practice for Application of Lime Plaster Finish.
- (h) IS: 4101 : Code of Practice for External Facings and Veneers.
- (i) IS: 2645 : Water Proofing Materials.
- (j) IS: 712 : Building Limes.
- (k) IS: 1077 : Common Burnt Clay Building Bricks.
- (l) IS: 1127 : Recommendations For Dimensions And Workmanship Of Natural Building Stones For Masonry Work.
- (m) IS: 1528 : Method Of Sampling And Physical Tests For Refractory Materials.

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(n) IS: 1597 : Code Of Practice For Construction Of Stone Masonry (All Parts). (o) IS: 2116 : Sand For Masonry Mortars. (p) IS: 2185 : Concrete Masonry Units (All Parts – Hollow And Solid Concrete Blocks). (q) IS: 2572 : Code Of Practice For Construction Of Hollow Concrete Block Masonry. (r) IS: 2691 : Burnt Clay Facing Bricks. (s) IS: 3414 : Code Of Practice For Design And Installation Of Joints In Buildings. (t) IS: 3495 : Methods Of Tests Of Burnt Clay Building Bricks. (u) IS: 4441 : Code Of Practice For Use Of Silicate Type Chemical Resistant Mortars. (v) IS: 4860 : Acid Resistant Bricks. (w) IS:12894 : Fly Ash Lime Bricks.		
3.2	<u>WOODWORK</u>	
(a) IS: 4021 : Timber Door, Window and Ventilator Frames. (b) IS: 1003 : Timber Paneled and Glazed Shutters. (c) IS: 2191 : Wooden Flush Door Shutter (Cellular and Hollow Core Type). (d) IS: 2202 : Wooden Flush Door Shutter (Solid Core Type). (e) IS: 848 : Synthetic Resin Adhesives for Plywood. (f) IS: 399 : Classification Of Commercial Timbers And Their Zonal Distribution.		

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(g) IS: 883 : Code Of Practice For Design Of Structural Timber In Building.		
3.3	<u>SHEETING WORK IN ROOF AND SIDING</u>	
(a) IS:14246 : Continuously pre-painted galvanized steel sheets & coils. (b) IS: 2527 : Code of Practice for Fixing Rain Water Gutters and Down Pipes for Roof Drainage. (c) IS: 513 : Specification for cold rolled carbon steel sheets & strips (d) IS: 1079 : Specification for hot rolled carbon steel sheets & strips (e) IS: 277 : Specification for Galvanized Steel Sheets (Plain and Corrugated)		
3.4	<u>MISCELLANEOUS METALS</u>	
(a) IS: 226 : Structural Steel (Standard Quality) (b) IS: 800 : Code of Practice for Use of Structural Steel in General Building Construction. (c) IS: 816 : Use of Metal Arc Welding for General Construction in Mild Steel. (d) IS: 2812 : Arc Welding of Aluminium and Alloys. (e) IS: 3150 : Hexagonal Wire Netting. (f) IS: 4948 : Welded Steel Wire Fabric for General Use.		
3.5	<u>PAINTING, POLISHING AND WHITE WASHING</u>	
(a) IS: 348 : Specification For French Polish. (b) IS: 428 : Specification For Distemper Oil Emulsion Colour as Required.		

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(c) IS: 1477 : Code of Practice For Painting (I & II) of Ferrous Metal in Buildings. (d) IS: 2338 : Code of Practice For Finishing (I & II) of Wood and Wood Based Materials. (e) IS: 2395 : Code of Practice For Painting Concrete, Masonry and Plaster Surface. (f) IS: 2932 : Specification For Enamel, Synthetic, Exterior, Type – I. (g) IS: 5410 : Specification For Cement Paint, Colour as Required. (h) IS: 6278 : Code of Practice For White Washing and Colour Washing. (i) IS: 2645 : Integral Cement Waterproofing Compounds. (j) IS: 427 : Specification For Distemper, Dry Colour As Required. (k) IS: 2339 : Specification For Aluminium Paints For General Purposes In Dual Containers. (l) IS: 2933 : Specification For Enamel, Exterior a) Undercoating, b) Finishing.		
3.6	<u>METAL DOORS, WINDOWS, VENTILATORS AND LOUVERS</u> (a) IS: 1038 : Steel Doors, Windows and Ventilators. (b) IS: 1361 : Steel Windows For Industrial Buildings. (c) IS: 1948 : Aluminium Doors, Windows and Ventilators (d) IS: 4351 : Steel Door. (e) IS: 1949 : Aluminium Windows For Industrial Building. (f) IS: 3103 : Code Of Practice For Industrial Ventilation. (g) IS: 3614 : Fire Check Doors.	

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3.7 <u>GLASS AND GLAZING</u> (a) IS: 1081 : Code of Practice For Fixing and Glazing of Metal (Steel and Aluminium) (b) IS: 3548 : Code of Practice for Glazing in Building. (c) IS: 1083 : Code of Practice For Fixing and Glazing Metal Doors, Windows and Ventilators. (d) IS: 2835 : Flat Transparent Sheet Glass. 3.8 <u>FLOOR FINISH AND ALLIED WORKS</u> (a) IS: 777 : Glazed Earthenware Tiles. (b) IS: 1197 : Code of Practice For Laying of Rubber Floors. (c) IS: 1237 : Cement Concrete Flooring Tiles. (d) IS: 1443 : Code of Practice For Laying and Finishing of Cement Concrete Flooring Tiles. (e) IS: 4457 : Specification for ceramic unglazed vitreous acid resisting tile. (f) IS: 5518 : Code of Practice For Laying of Flexible PVC Sheet and Tile Flooring. (g) IS: 13712 : Ceramic Tiles-Definitions, Classifications Characteristics and Marking. (h) IS: 2114 : Code of Practice For Laying In-Situ Terrazzo Floor. (i) IS: 3461 : PVC Asbestos Floor Tiles. (j) IS: 809 : Rubber Flooring Materials For General Purposes. (k) IS: 1195 : Bitumen Mastic For Flooring.		

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(l) IS: 1196 : Code Of Practice For Laying Bitumen Mastic Flooring. (m) IS: 1198 : Code Of Practice For Laying, Fixing and Maintenance Of Linoleum Floors. (n) IS: 2571 : Code Of Practice For Laying In-Situ Cement Concrete Flooring. (o) IS: 5491 : Code Of Practice For Laying In-Situ Granolithic concrete Floor Topping. (p) IS: 5766 : Code Of Practice For Laying Burnt Clay Brick Flooring.		
3.9	<u>SUSPENDED CEILING</u>	
	(a) IS: 2441 : Code of Practice For Fixing Ceiling Coverings.	
3.10	<u>ROLLING SHUTTERS AND GRILLS</u>	
	(a) IS: 6248 : Metal Rolling Shutters and Rolling Grills.	
3.11	<u>ROOF WATER PROOFING, INSULATION AND ALLIED WORKS</u>	
	(a) IS: 73 : Paving Bitumen.	
	(b) IS: 702 : Industrial Bitumen.	
	(c) IS: 1203 : Method of Testing Tar And Bitumen.	
	(d) IS: 1322 : Bitumen Felts For Water Proofing and Damp Proofing.	
	(e) IS: 1346 : Code of Practice For Water Proofing of Roofs with Bitumen Felts.	
	(f) IS: 1609 : Code of Practice For laying Damp Proof Treatment Using Bituminous Felts.	

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(g) IS: 3036 : Code of Practice For Laying Lime Concrete For a Waterproofed Roof Finish. (h) IS: 3037 : Bitumen Mastic For Use In Waterproofing Of Roofs. (i) IS: 3067 : Code of Practice For General Design, Details And Preparatory Work For Damp Proofing And Waterproofing Of buildings. (j) IS: 3384 : Bitumen Primer For Use In Water Proofing And Damp Proofing. (k) IS: 4365 : Code of Practice For Application Of Bitumen Mastic For Waterproofing of Roofs.		
3.12	<u>LIFTS, ELEVATORS AND ESCALATORS</u> (a) IS: 14665 : Electric Traction Lifts. (b) IS: 14671 : Inspection Manual. (c) IS: 2147 : Degrees of Protection Provided By Enclosures For Low Voltage Switchgear And Control Gear. (d) IS: 2332 : Nomenclature of Floors And Stories. (e) IS: 4591 : Code of Practice For Installation And Maintenance of Escalators.	
3.13	<u>WATER SUPPLY, DRAINAGE AND SEWERAGE</u> (a) IS: 404 : Lead Pipes. (b) IS: 458 : Pre-cast Concrete Pipes (With and Without Reinforcement). (c) IS: 651 : Salt Glazed Stoneware Pipes And Fittings. (d) IS: 771 : Glazed Fire-clay Sanitary Appliances (All Parts).	

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(e) IS: 774 : Flushing Cisterns For Water Closets And Urinals (Other Than Plastic Cisterns). (f) IS: 783 : Code of Practice For Laying Of Concrete Pipes. (g) IS: 1172 : Code of Basic Requirements For Water Supply, Drainage And Sanitation. (h) IS: 1626 : Asbestos Cement Building Pipes And Pipe Fittings, Gutters And Gutter Fittings And Roofing. (i) IS: 1742 : Code of Practice For Building Drainage. (j) IS: 2964 : Code of Practice For Selection, Installation And Maintenance of Sanitary Appliances. (k) IS: 2065 : Code of Practice For Water Supply In Buildings. (l) IS: 2470 : Code of Practice For Installation Of Septic Tanks (All Parts). (m) IS: 3114 : Code of Practice For Laying of Cast iron Pipes. (n) IS: 4127 : Code of Practice For Laying Of Glazed Stoneware Pipes. (o) IS: 12251 : Code of Practice For Drainage of Building Basement. (p) IS: 1200 : Method Of Measurement: Laying of Water And Sewer (Part XVI) Lines Including Appurtenant items. (q) IS: 1536 : Centrifugally Cast (Spun) Iron Pressure Pipes For Water, Gas And Sewage. (r) IS: 1537 : Vertically Cast Iron Pressure Pipe For Water, Gas And Sewage. (s) IS: 3486 : Cast Iron Spigot And Socket Drain Pipes. (t) IS: 5329 : Code of Practice For Sanitary Pipe Work Above Ground For Buildings.			

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(u) IS: 3076 : Low Density Polyethylene Pipes For Potable Water Supplies. (v) IS: 1538 : Cast Iron Fittings For Pressure Pipes For Water, Gas And Sewage. (w) IS: 1230 : Cast Iron Rainwater Pipes And Fittings. (x) IS: 1729 : Sand Cast Iron Spigot And Socket Soil, Waste And Ventilating Pipes, Fittings and Accessories. (y) IS: 784 : Pre-stressed Concrete Pipes. (z) IS: 1726 : Cast Iron Manhole Covers And Frames. (aa) IS: 5961 : Cast Iron Grating For Drainage Purposes. (bb) IS: 5219 : Cast Copper Alloys Traps: "P" and „S" Traps. (Part-I) (cc) IS: 772 : General Requirements For enameled Cast Iron Sanitary Appliances. (dd) IS: 775 : Cast Iron Brackets And Supports For Wash Basins And Sinks. (ee) IS: 777 : Glazed Earthenware Wall Tiles. (ff) IS: 2548 : Plastic Water Closet Seats And Covers (all parts). (gg) IS: 2527 : Code of Practice For Fixing Rainwater Gutters And Down-pipes For Roof Drainage. (hh) IS: 1239 : Specification For Mild Steel Tubes And Mild Steel (Part II) Tubular And Other Wrought Steel Pipe Fittings. (10mm to 15 mm Nominal Diameter). (ii) IS: 3589 : Specification for electrically welded steel pipes for water, gas and sewage (220mm to 2000mm nominal diameter).		

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4.0 ARCHITECTURAL SPECIFICATION OF CONTROL ROOM & ANNEXURE ROOM

The control room is located at Operating Floor level of power house building. It is the nerve centre of the plant having state of the art facilities and requires a highly sophisticated hi-tech expression and ambience.

The room will be fully air-conditioned and have access from T G hall side through Air locks to reduce the noise level as well as heat load. Each Air-lock space shall have two numbers of double leaf glazed aluminium doors. The wall facing the turbine hall shall be fully glazed aluminium partition wall with hermetically sealed insulating glass panels. **Control room shall have an internal acoustic partition wall** and shall be integrated with 2 nos. of digital display boards at two different locations and have monolithic fabric finishes with high acoustical properties. It will have fully vitrified tiled floor, linear metal ceiling with A.C and lighting fixtures and wall with acrylic emulsion paint or Aluminium Composite Panel interior cladding. The control room shall have very high quality furniture of approved make similar to Godrej /Feather light. The control desk of laminated and moulded finish of approved colour and texture, appropriate to accommodate/ house control panels, monitors shall be equipped with all functional requirements. Operator's chairs shall be swivel type on casters and have cushioned seat and back of approved material and colour. Necessary arrangement for sealing expansion joints on floor, wall and ceiling has to be ensured. Brief technical specifications of different items to be used for the control room are as follows.

(a) Flooring

Non-skid, fully vitrified, 10 mm thick non-porous, homogenous, abrasion resistant, floor tiles of minimum size 600 mm x 600 mm x 10 mm of approved colour and shall be laid over concrete floor with laying compound strictly as per manufacturer's specification. Total thickness of the flooring shall be 40mm thick including the thickness of the tiles, under bed.

(b) Skirting

Minimum 150 mm high fully vitrified, 10 mm thick non-porous,

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	homogenous, abrasion resistant cover base of matching colour, internal and external corner strip and fixed to the wall strictly as per manufacturer's specification. (c) Wall finish Brick masonry walls, columns, or any other element within the room as the case may be shall be clad with polyester coated 3mm thick Aluminium Composite Panels (Aluminium thickness minimum 0.2mm) of approved make upto the false ceiling level. The colour and design composition of ACP cladding to be submitted for approval of the authority before erection. (d) False ceiling Lineal precoated aluminum alloy ceiling stove enameled on both sides with suspension system as per manufacturer's details. The false ceiling work shall take care of all illumination, fire detection & fighting, HVAC and all other service requirement. False ceiling shall be provided with 25 mm thick insulation of resin bonded mineral wool conforming to IS: 8183. Wherever under-deck insulation is required the insulation shall be 50 mm thick resin bonded rigid mineral wool/ polystyrene block with protective aluminium foil lining. (e) Air lock doors Double acting glazed aluminium door with minimum 15 micron colour anodized finish shall be used having glazing thickness 6mm of clear float glass of approved brand. The doors shall be complete with weather seal, gaskets, floor spring, doorstopper, door locks, push/pull bars of similar finish and all necessary hardware. (f) Glazed partition wall The glazed partition wall shall be made of aluminium sections having same finish that of aluminium doors with double-glazed insulating glass panels. This partition height shall be from top of floor finish to the bottom of the false ceiling. Insulating glass shall consist of 2 nos. 6 mm thick clear float glass separated by an air gap of 12mm thick,	

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hermetically sealed, moisture resistant and of approved manufacturer. The partitions shall be weather proof complete with gaskets, clips, hardware, etc (g) Internal partition wall of control room The internal partition wall facing operating desk shall consist of two numbers of digital display boards at two different locations, integrated with wall panels of Anutone Acoustic Ltd. or similar approved, laid flush with the display board and two nos. of matching doors on either sides for access to the rear side for maintenance. This special purpose partition shall be as manufactured by Anutone Acoustic Ltd. or similar and shall have rigid frame work consisting of G.I. Studs of adequate size@ 600mm c/c and floor, ceiling and intermediate channels to provide a strong wall system capable of supporting wall hung C.C.T.V. at designated locations. The framing system shall be integrated with independent floor supported structural framework of digital display board so as to cover the entire exposed surface around the board with partition panels. The front side of the frame shall have Excelsior Acoustical Panels – Elega finish – 2400/1200 x 600 x 19 mm thick FABRICO SoundSoak – Plane Texture of approved colour. The rear side of partition shall have Excelsior Acoustical Panels – Elega finish – specially Sound Smart – Burl of size 2400/1200 x 600 x19 mm thick smooth finished with gypsum plaster and finished with acrylic emulsion paint. The entire wall shall have Class I fire rating as per BS code. The partition shall not transmit any load to false ceiling. The entire partition wall shall have concealed framing system and have monolithic fabric finish of approved colour or composition of two different colours as per approved design to entire exposed surfaces including door panels on control room side. 4.1 <u>BRIEF DESCRIPTION OF TECHNICAL/SERVICE BUILDING</u> The Technical Building is a 5-storied building (size 48M x 15M) including ground floor Building is located adjacent to the Power House Building as		

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shown in the Plot Plan. An all weather covered access corridor to be provided with powerhouse building at operating floor level, if the Technical Building is detached one from power house building. The building size shall be suitably decided during detail engineering stage. It will house the facilities as listed below. Building should have 2 (two) nos. of passenger elevator (13 passenger) and 2 (two) staircases, with provision of future extension of floors, to be placed suitably. **Overhead water RCC tank of 10,000-litre capacity should be provided at roof of the building.**

It is an important part of operation and maintenance of the plant having state of the art facilities and requires a highly sophisticated hi-tech expression and ambience.

Facilities in different floors shall be as under:

Sr. No.	Level	Area Description
(a)	Ground floor	Entrance lobby, Reception Lounge (double height), First Aid room, Telephone exchange, Civil Maintenance office & Store, Boiler Maintenance Store and staff room, Turbine Maintenance Store and staff room, Lift, Staircases, Toilet etc.
(b)	First floor.	Boiler Maintenance J.E./A.E. room, Boiler Maintenance Dy. E.E. cabins room and E.E. room, Turbine Maintenance Dy.E.E. cabins room and E.E. room, Boiler Maintenance library/record room, Turbine Maintenance library/record room, safety office, pantry.
(c)	Second floor	Electrical Maintenance store and staff room, Electrical Maintenance lab room, Electrical Maintenance J.E./A.E. room, Electrical Maintenance Dy.E.E. cabins room and E.E. room, Electrical Maintenance library/record room, POG store room, POG E.E. cabin, E.E. Efficiency cabin, Computer and Planning section, pantry.

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(d) Third floor I & C store and staff room, I & C lab room, I & C J.E./A.E room, I & C Dy.E.E. cabins room and E.E. room, Testing store and staff room, Testing J.E./A.E room, Testing Dy.E.E. cabins room and E.E. room, I & C library/record room, Simulator Room, Training Hall, pantry, testing library/Record room etc. (e) Fourth floor S.E. three cabins, Dy.C.E. two rooms, C.E. one room with attached toilet, Technical Section, VIP lounge, Conference room, Video Conference room, Pantry etc. (f) Roof Lift M/C room, Water tanks, Cooling towers for HVAC, etc The Building shall be centrally air-conditioned. Drinking Water Cooler, Water filter shall be provided on all floors. Wash room shall be provided on all floors. Separate ladies toilet shall be provided on all floors. All finishing items, Layout, and other requirements should be of owner's choice. However modern design approach of an office building like- open & flexible (workstation based) layout, usage of natural light, solar control, energy efficient, etc shall be considered by the bidder. Since this is one of the most prestigious buildings, aesthetically this should achieve landmark quality. Specially designed long and spacious RCC porch shall be given in front of the main entrance for receiving cars of VIP's. Special attention to be given in front of service building in landscaping the area and developing garden with flowering plants and fountains etc Shaded car parking facility shall be provided as per requirement of the owner. Bidder shall have to furnish all relevant drawings and details including finishing in their offer. Brief technical specifications of different items to be used for the area as follows:		

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(a) Flooring Generally floor finish shall be Non-skid, fully vitrified, 10 mm thick non- porous, homogenous, abrasion resistant, floor tiles, of minimum size minimum 600 mm x 600 mm of approved colour & design, and shall be laid over concrete floor with laying compound strictly as per manufacturer's specification. Total thickness of the flooring shall be 40 mm thick including the thickness of the tiles, under bed. (i) For Entry cum reception lounge, VIP lounge, Main meeting/ conference room:- Suitable and approved combination shed of marble slab and strips shall be used. Floor pattern shall be approved by the owner before erection. (ii) For staircase and Corridors: Steps – risers & tread, stair skirting, corridor floor should be combination of Aranga white marble and Abu green marble. Wall cladding of Elevator Lobby shall be of polished granite slab of light grey shed. (iii) For Toilet Minimum 10 mm thick non-skid vitrified tile, of minimum size 400 mm x 400 mm (overall 40 mm thick) with glazed ceramic tile of same make dado topped with 50 mm wide matching moulded ceramic trims. Dado shall be 100 mm higher than lintel level starting from finish floor level. For other areas like AHU room, Generator room, Electrical room, Etc: 40 mm thick heavy duty cement concrete floor with metallic hardener and matching skirting. (b) Wall finish Two coats of Acrylic Emulsion paint of approved colour shall be applied over a coat of approved primer on the masonry surface		

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prepared with POP (Plaster of Paris)/White Putty (Birla White) for all area except areas like AHU room, Generator room, Electrical room, Etc which shall be of plastered surface with Acrylic Distemper paint. Front wall for elevator shaft shall have polished granite slab wall cladding (min 12 mm thick). Painting to exterior surfaces of wall shall be of cement bound paint like weather coat (Asian Paints). To accentuate the building façade a suitable combination of Aluminium composite panel (ACP)/textured paint like RENOVO may be used. (c) False ceiling It will be applicable for all areas excluding non A/C areas like AHU room, Generator room, Electrical room, Etc, pantry and toilet. It shall be of aluminium linear acoustic false ceiling with glass wool insulation on top having approved colour with stove enamel finish, integrated with light fixtures, HVAC grills and other ceiling mounted accessories, complete in all respect with metal suspension system, trims, profiles etc. For pantry and toilet false ceiling shall be perforated aluminium stove enamel finished panels of size 600x600mm. (d) Doors Double acting glazed aluminium door with minimum 15 micron colour anodized finish shall be used having glazing thickness 8mm of clear/tinted float glass of approved brand. The doors shall be complete with weather seal, gaskets, floor spring, doorstopper, door locks, push/pull bars of similar finish and all necessary hardware. Glazed partition may be etched with suitable and approved designed. Wooden doors shall be of factory made solid core wooden flush door with C.P. teak veneered surfaces in wooden frame with wooden architrave. Toilet & pantry doors shall be wooden panel door. Doors for areas like AHU room, Generator room, Electrical room, Etc shall be hollow metal flush door.		

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(e) Glazed Panels The glazed panels shall be made of aluminium sections having same finish that of aluminum doors with double-glazed insulating glass panels. This partition height shall be from top of floor finish to the bottom of the false ceiling and maximum available width. Insulating glass shall consist of 2 nos. 6 mm thick clear float glass separated by an air gap of 12mm thick, hermetically sealed, moisture resistant and of approved manufacturer. The partitions shall be weather proof complete with gaskets, clips, hardware, etc. Glazed partition may be etched with suitable and approved designed. (f) Windows, Glazed Curtain wall All windows of A/C areas shall be s with heat reflecting glass/double insulated glass. Other windows shall be 15micron thick color anodized aluminium glazed window with minimum 4mm thick clear float glass. Glazed curtain wall shall be Unitised structural glazing system comprising of 30 micron colour anodized aluminium extrusions with double insulated heat reflecting glass. The system shall be able to withstand wind pressure as per relevant data given elsewhere in this specification at all heights. (g) Utilities All utility lines like water supply line, Electrical wiring, telephone line etc. shall be concealed type. Fittings and fixtures for toilets should be of best quality and to be got approved by Owner prior to installation. Roof treatment, sanitary & sewerage system, roof drainage etc. shall be as per detail spec given in V-VI/A and VI/B. (h) Any other items of work not specifically mentioned here shall be as per the guidelines indicated in Volume- VI/ A and VI/B.		

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5.0	<u>DESIGN DATA FOR ARCHITECTURAL WORKS</u>	
5.1	<u>POWER HOUSE AND OTHER BUILDINGS</u>	
5.1.1	Brick works internal : 230 mm thick, brick wall with 1:6 Cement: Sand and external mortar. Grade of brick shall be of Class designation - 5 as per relevant IS Codes.	
5.1.2	Half brick thick wall : 1:4 cement sand mortar with 2 nos. 6 mm diameter M.S. rod in every fourth layer.	
5.1.3	One-third brick thick wall : 1:3 cement sand mortar with 2 nos. 6 mm diameter M.S. rod at every alternate layer.	
5.1.4	Damp proof course : 1:1.5:3 Concrete with a minimum of 2% admixture of water proofing compound.	
5.1.5	Plaster :	
	Exterior & rough side : 18 mm thick with 1:6 cement- sand of interior brick wall mortar in two layers except where special finish provided.	
	Interior : 12 mm thick with 1:6 cement-sand mortar	
	Ceiling : 6 mm thick with 1:4 cement-sand mortar	
5.1.6	Plaster of Paris Punning : 2 mm thick punning to be provided to all areas receiving acrylic distemper paint emulsion or acrylic distemper paint.	
5.1.7	Cladding for power house	
5.1.7.1	Wall cladding shall be provided as detailed in Cl. 4.0 of Vol.-VI/A Sec-IV.	
5.1.7.2	Metal cladding shall be as follows:	
	(a) Metal Cladding:	

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Permanent colour coated Insulated metal cladding system Permanent colour coated sandwiched (insulated) M.S./High tensile steel metal cladding of approved colour combination shall be provided for main plant building and any other building with metal cladding where thermal insulation is required. Permanent colour coated (non-insulated) M.S./High tensile steel metal cladding of approved colour combination shall be provided for boiler roof/canopy, CHP areas and cladding over parapet walls of buildings where metal cladding is specified. Troughed galvanized M.S. sheet having 0.6 mm minimum thickness with minimum rate of galvanization of 275 gm./sq.m. Or high tensile steel sheet having minimum yield strength of 350 MPa of 0.5 mm minimum thickness and coated with zinc aluminium alloy (zincalume) at the rate of 150 gms./ sq.m shall be used on external face (outer face) of cladding system. The outer side (exposed face) of the sheet shall be permanently colour coated with silicon modified polyester coating of Dry Film Thickness (DFT) 20 microns (minimum) over primer of approved colour shade. Inner face of the sheet shall be provided with suitable pre-coating of minimum 7 microns, of off-white colour. Galvanized M.S. Sheets of minimum 0.6 mm thickness with minimum rate of galvanization of 275 gms/sq.m. or high tensile steel, having minimum yield strength of 350 MPa of 0.5mm minimum thickness, coated with zinc aluminium alloy at the rate of 150 gm/sq.m shall be used as inner liner (internal face) of cladding system. The exposed face shall be permanently colour coated with silicon modified polyester paint of DFT 20 microns (minimum) over primer. Inner face of sheet shall be provided with suitable pre-coating of minimum 7 microns. Z spacers if required shall be made out of at least 2 mm thick galvanized steel sheet of grade 275 as per IS: 277. The sheets shall be fixed by means of concealed fixing system or any other compatible method approved by the Engineer. The fasteners		

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shall be of high quality corrosion resistant grade of self-tapping / self-drilling type provided with suitable cap. The insulation shall be of Glass wool, having a density of 32 kg/cu.m. for glass wool, 48 kg/cu.m. for rock wool or 40-45 kg/cu.m (b) Permanent colour coated (non-insulated) metal cladding system Troughed galvanized M.S. sheets having 0.6 mm minimum thickness with minimum rate of galvanization of 275 gms./sq.m. (or High tensile steel sheet coated with zinc aluminium alloy @ 150 gms./sq.m. of 0.5 mm minimum thickness and having minimum yield strength of 350MPa) shall be used for the cladding system. The outer side (exposed face) shall be permanently colour coated with Silicon modified polyester paint of minimum DFT 20 microns over primer, of approved colour/shade and the inner side (internal face) shall be coated with same paint of minimum DFT 20 microns over primer of off-white shade. These shall be fixed with concealed fixing system or any other compatible method approved by the Engineer. The sheets shall meet the general requirement of IS: 14246 and shall conform to class 3 for the durability. (c) Flashings, caps, trim closures etc. for jambs, lintels, softies, and cornices All flashings, trim closures, caps etc. required for the metal cladding system shall be made out of plain sheets having same material and any weather/moisture sealants with appropriate material and coating specification as mentioned above for the outer face of the sandwiched metal cladding. Overlap shall be min. 100 mm or as specified by manufacturer. (d) Factory assembled double skin insulated metal cladding system Factory assembled double skin insulated metal cladding made up of 0.50mm TCT colour coated profiled galvalume steel sheets shall be provided for cladding. The outer skin profile depth is 28 mm and the inner skin shall be slightly ribbed steel sheet. The core in between the outer profiled sheet and the inner profiled sheet shall be		

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polyurethane foam in 30 mm thickness having a density of 40 – 45 kg/cum. The foam shall be filled in between the outer and inner sheet at factory using highly dedicated foaming machine. The fasteners to be used for these factory made panels shall be of adequate sizes and shall be of self-drilling and self-tapping type, compatible to be used with galvalume steel sheets. 5.1.8 False Ceiling Aluminium pre-painted false ceiling, either lineal panel system or aluminium tile/plank system. In other air-conditioned areas, 12.5 mm Gypsum board/ Mineral fiberboard ceiling with aluminum grid will be used. This shall be in line with Cl. 2.7 above. 5.1.9 Floor finish (a) Generally, finish to utility areas shall be 40 mm thick heavy-duty patent stone with metallic hardener on concrete slab. (b) For T.G. Hall (operating floor), MCC room, offices etc. self leveling epoxy flooring finish will be as follows The epoxy systems On the prepared substrate, one coat of a solvent free, resin based dispersion, Primer shall be applied. Density of the primer is around 1kg/lit and the mixing ratio of two components, Comp. A and B: 1:2.5 by weight. Over the primed surface, epoxy modified cementations self leveling floor topping shall be laid maintaining the thickness of 2mm. the mixing ratio of three component Comp. A: Comp. B: Comp. C: 1:2.5:17 by weight, compressive strength at 30°C approx. 45N/mm² after 28days, the mortar density is around 2.2 kg/lit. Priming would be repeated again (same as No. 1). Finally, after drying of the primer, a multi component self smoothening decorative floor topping based on special epoxy system		

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shall be laid maintaining the thickness of 2mm. The compressive strength of shall be greater than 60N/mm² at 30°C after 14 days, tensile bond strength greater than 2.5N/mm² at 30°C after 14 days. The mixed density is 1.7kg/lit at 30°C. The system shall be allowed for curing for 3 days. Application Applicator shall apply each product in the specified system strictly as per the written method statement by the manufacturer at the following minimum consumption rates Primer @ 200gm/sq m depending on the substrate. First layer of epoxy flooring @ 4.4kg/ sq m depending on the substrate for approx. 2mm thickness. Primer @ 100gm/sq m for the second coat. Final decorative epoxy topping @ 3.6Kg/ sq m depending on the substrate for approx. 2mm thickness. (c) For battery room, battery charger room, chemical laboratories, chlorination room etc., the areas handling corrosive liquids, overall 40 mm thick Acid and Alkali resistant tiles flooring with 20mm thick tiles with silica based epoxy mortar shall be used. Acid and Alkali resistant tiles of 20 mm thickness with silica based epoxy mortar up to 2.1M height from finished floor level shall be used as dado. Acid and Alkali resistant paint shall be applied up to the ceiling level above Acid and Alkali resistant tiles dado. Ceiling shall also be painted with Acid & Alkali resistant paint. (d) All areas of toilet, including W.C and urinal shall have vitrified ceramic tiles floor. Dado shall be of glazed tiles of minimum 5/6 mm thickness up to 100 mm higher than lintel level starting from finish floor level.		

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(e) Wherever access flooring is required this shall consisting of fire resistant phenyl formaldehyde bonded particle board panels (600 x 600 x 35 mm) with 2 mm thick flexible antistatic PVC topping and 0.5mm thick aluminium foil lining at bottom and PVC strip edging on sides of each panel mounted on steel pedestals of adjustable height and supporting steel grid system provided under space, or overall 40 mm thick antistatic PVC flooring having 3mm thick antistatic PVC tiles laid over adhesive as per recommendation of the manufacturer. (f) Floor/staircase and the areas prone to slippage due to oil spillage etc. shall be provided with non-skid floor finish. (g) 750 mm wide, minimum, R.C. paving as plinth protection, shall be provided around all buildings with surface drain of required size. (h) Risers and treads of concrete staircase of powerhouse shall be of white marble slab and in all other stairs, same shall be of Kotah stone finish. 20/25 mm thick, Kotah stone finish excepting main stair riser and treads shall be of marble. All areas shall have 150mm high skirting unless indicated otherwise in the specification.		
5.1.10 Doors and Windows (a) Doors in plant and utility areas shall be double plated (18G) hollow flush door with pressed steel frame as per IS: 4351. The door shutters shall be 45mm thick with two outer sheets of 18G rigidly connected with continuous vertical 20G stiffeners @ 150mm c/c. Side, Top & Bottom edge of shutter shall be reinforced by continuous pressed steel. The doors shall be sound deadened by filling the inside void with mineral wool. (b) Fire rated doors shall be double cover plated type with mineral wool insulations and with panic device shall be provided on division walls of cable spreader rooms and at all fire exit points as per recommendation of Loss Prevention Association of India/Tariff Advisory Committee. These shall be as per IS: 3614. Fire resistance grade of the doors shall be as per LPA/TAC requirements. However, minimum fire resistance grade shall be for two (2) 2 hours.		

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	(c) Main Entrance of Control Room, Control Equipment Room shall be provided with air-locked lobby with provision of double doors of aluminium framework with glazing with double swing type. Doors of control room, control equipment room, computer room, etc. shall be full glazed pre-coated minimum 3mm thick aluminium i.e. colored anodized aluminium. Full glazed aluminium partition with airlock shall be provided along (B) row of Turbine hall operating floor where clear view is desired. Glazing between air-conditioned areas shall be single glass whereas that between air-conditioned and non-air-conditioned area shall be with hermetically sealed insulating glass. (d) Doors of W.C. and shower shall be wooden panel door. (e) All windows and ventilators shall be glazed aluminum windows conforming to IS: 1949. & IS: 1948 (f) Alternatively pre-coated (polyester painted) steel windows and ventilators may be used for auxiliary plant buildings. (g) Alternatively, steel reinforced UPVC windows may be used for Service building if agreed by the owner. 5.1.11 Rolling Shutters Rolling shutters as per IS: 6248 with suitable operating arrangement (manual, mechanical and/or electric) according to size shall be provided in buildings to facilitate handling and transportation of equipment. The curtains of rolling shutter will be of interlocking scrolls made of hot rolled double dipped galvanized steel lath section of 18swg tested mild steel strips at 75mm rolling centres, locked with galvanized malleable iron clips. The bottom lath will be coupled to a locked plated fabricated from 3mm thick galvanized steel plate and security riveted with stiffening angles. 5.1.12 Glazing: (a) Glazing for windows in general shall be minimum 4 mm clear float glass and as mentioned elsewhere in this document.	

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(b) Glazing in Control room between A/C & non-A/C area shall be with double glazed insulating glass consisting of 2 nos. 6 mm clear toughened float glass with 12 mm air gap in between, hermetically sealed. (c) Minimum 6.0 mm thick toughened float glass shall be provided in doors, partitions, etc. (d) 24mm thick insulated double glazing having 6 mm thick tinted heat-reflecting type outer float glass and 6 mm thick plain inner float glass with 12 mm air gap & hermetically sealed shall be mounted on 15 micron coloured anodized aluminium frame suitable for structural glazing system 5.1.13 Painting (a) External masonry surfaces of Power House buildings shall have combination of cement paint with granular textured finish/synthetic plaster, 'Renovo' and for other buildings, cement paint over plastered surface. (b) Acrylic plastic emulsion paint shall be provided in control room, control equipment room, computer room, UPS room, all office areas and all air-conditioned areas including entrance lobby. (c) All other areas shall be provided with acrylic distemper. (d) Internal surface of walls in rooms for pumps, machineries and maintenance shall be painted with washable synthetic enamel paint of dark shade up to a height of 1.5 m above floor level. (e) Battery room and all other areas coming in contact with acid/alkali or other corrosive liquid shall be painted with acid/alkali resistant paint. Acid and Alkali resistant paint shall be applied up to the ceiling level above Acid and Alkali resistant tiles dado as specified elsewhere in this section. Ceiling shall also be painted with Acid& Alkali resistant paint.		

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(f) All structural steel members including doors, windows, ventilators, louvers, rolling shutters and all other exposed steel work shall have two or more coats of synthetic enamel paint over zinc chromate primer conforming to IS-2074 and shall have minimum 110 micron DFT. (g) All woodwork shall be painted with two coats of synthetic enamel paint over a coat of approved primer. DFT shall conform to IS specification. (h) All fire exits shall be painted in Post Office red. (i) Epoxy paint shall be provided in oil equipment room, oil canal, fuel oil pump house, etc. (j) Fire-proof putty in cable penetration on walls of cable spreader rooms shall be provided 5.1.14 Aluminium Composite Panels: (a) Material: Total thickness of the panel – 4mm Thickness of the aluminium skin – 0.5mm Tensile strength of aluminium skin – 120N/mm² minimum Density of PE core – 920 – 980 Kg/m³ (Non toxic grade Polyethylene) Coating – PVDF Adhesive film – DUPONT, USA Adhesive film – DUPONT, USA 24μ - 30μ in PVDF including primer. 15μ - 18μ in polyester coating.		

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Coating thickness (back foil) – 4μ - 7μ polyester coating. Coating thickness (front foil) (b) Color – as indicated in the drawing. (c) Fixing arrangement – aluminium composite sheets shall be folded inwardly on four edges (without cutting the outer skin) to form Aluminium Composite Panels (ACP) and shall be riveted to the aluminium extruded section like angle or channel. There shall be at least one rivet at the both ends of the folded edge and other rivets shall be 200mm c/c per panel edge/ fold. Aluminium angles shall form a frame around the panel and shall be fixed to the steel sub-frame by self tapping screws with EPDM shim to prevent by- metallic reaction. The gap/groove between two adjacent panels shall be filled with Silicon sealant of approved make (GE or similar make) to prevent water seepage. (d) The supply fabrication and erection of ACP is inclusive of steel sub-base framework if necessary as per site condition. The contractor shall take site measurement and produce working drawings for approval of engineer before erection of ACP. 5.1.15 Poly Carbonate Sheet: (a) 4mm thick Compact Polycarbonate sheet, transparent or smoke tinted, of Lexan Polycarbonate or similar approved. (b) Framing shall be specially designed aluminium sections, colour anodized, with EPDM Gasket as per system provider's details. Framing shall be fixed to the steel structure as per site measurement, drawings and instruction of Engineer- in -charge. (c) Sealing of joints shall be done with Silicon sealant. Shape of the roofing shall be as per drawing and approved by the owner.		

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System provider shall prepare and submit the detailed working drawing for approval of engineer before erection. 5.1.16 Stairs: (a) All stairs shall have not more than 13 risers in one flight but in case of fire escape stairs, 15 risers may be allowed instead of 13 risers. Height of risers and width of treads shall be 180 mm (maximum) and 250 mm (minimum) respectively for fire escape stairs and 166mm (maximum) & 250mm (minimum) for general staircases. Minimum width of stairs shall be 1000mm for fire escape stairs and 1200 mm for general stairs. In general, rises shall be 150 mm. (b) Aluminium angle nosing shall be provided for edge protection of RCC stairs. Moulded marble nosing shall be provided for the main stairs finished with marble slab/Kota slab finishes. (c) 40ø NB stainless steel pipe handrail for Stair in T.G. Hall area and 32ø NB medium class G.I pipe Handrail for stairs in other areas, minimum 1.0 metre high, shall be provided around all floor/roof openings, projections/balconies, walkways platforms, concrete and steel stairs. 1200mm high railing may be provided for external fire escape stairs. Handrail shall be two rail systems with the top rail 1000mm/1200mm above the walkway/platform/floor surface and the intermediate rail 500mm below the top rail. Guardrail post spacing will be proportional to the length of the protected horizontal opening but will not exceed 1500mm c/c to posts. 5.1.17 Draining out water from floors In all buildings, suitable floor drainage system to drain out water collected from equipment, blow downs, leakages, floor washings, fire fighting etc. shall be provided in each floor. 5.1.18 Minimum 3.0 meter high fencing above toe wall shall be provided around switch yard, trans-former yard, building transformer area, fuel oil area, Dry ash storage silo area & other areas where fencing is necessary due to statutory requirements. Fencing shall comprise 2.4 meter high PVC coated galvanized chain link fencing of minimum 8 gauge (including PVC coating)		

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of mesh size 75 mm and galvanized concertina for switchyard /transformer yard. Galvanized barbed height of 0.6 meters shall be provided above the chain link fence. The diameter of steel wire for chain link fencing excluding PVC coating shall not be less than 12 gauge. Steel entry gate matching construction shall be provided for all fenced areas. Top of toe wall shall be minimum 200 mm above the formation level. 5.1.19 Water Supply and sanitation : (a) RCC roof water tank of adequate capacity depending on the number of users for 8 hours storage shall be provided for each building. (b) Galvanized MS Pipe of medium class shall be used for internal piping work for potable water supply. (c) Extra heavy cast iron pipes with lead joints shall be used for sanitary work below ground. (d) Heavy cast iron pipes with lead joints shall be used for sanitary work above ground level. (e) Each toilet shall contain following best quality fittings /porcelain fixtures in adequate numbers as per National Building Code. In toilets primarily meant for workers an additional squatting type WC shall be provided. Minimum one exclusive toilet facilities for handicapped shall be provided in each floor. Water closet – Indian & European type. Large flat back urinal with porcelain divider. Shower set. Wash basin – Counter-top wash basin to be provided in office areas selectively as per Owner's desire. Sink–Stainless steel sink with integrated drain-board to be provided in janitor's closets, kitchen, pantry areas of "FRANKE" or similar approved make.		

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Metal storage cabinets, under- counter as well as overhead, shall be provided in janitor's room, kitchen, pantry and similar areas as per requirement of Owner. Minimum 600 mm long porcelain tray. Minimum 500 mm long stainless steel towel rail. Stainless steel liquid soap holder. Recessed porcelain soap tray in shower area. Stainless steel toilet paper roll holder. Robe hooks 450 x 750 mm high square edge 6 mm thick float glass mirror of adequate width to match toilet layout and interior décor. Septic tanks with up-flow filter including all accessories and extra heavy cast iron soil lines shall be provided. Effluent from septic tank shall pass through chlorination chamber to bring down BOD level to acceptable limit before discharging to nearest drain. Drinking fountains in adequate numbers. The exact number of fittings and fixtures, brand, colour etc. shall, however be finalized during detail engineering stage and same shall be of Owner's choice and Approval. Note: Toilets in Power House Operating Floor shall have coloured fixtures including counter-top washbasins with wide mirror, European type water closet with flush valve, sensor operated urinal, exclusive shower set etc. Other toilets in general shall have white porcelain fixtures, low down cisterns, sensor operated urinals etc. Toilets for handicapped		

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persons shall have adequate grab bars, barrier-free access and appropriate fittings and fixtures.

5.1.20 Statutory rules

- (a) Vendor shall comply with all applicable statutory rules pertaining to Factories Act as applicable for the State, Rules of Tariff Advisory Committee (TAC), and Water Act for pollution control etc.
- (b) Provision of safety, health and welfare according to Factories Act shall be complied with. These shall include provision of continuous walkway, minimum 500 mm wide, along the crane girder at crane girder level on both sides, comfortable approach to EOT crane cabin, fire escape, locker room for workmen, pantry, toilets, rest rooms etc.
- (c) Provision for fireproof doors, number of staircases, fire separation walls, encasing of structural members (in fire prone areas) etc. shall be made according to the recommendation of Loss Prevention Association of India/Tariff Advisory Committee.

6.0 INTERIOR FINISH SCHEDULE FOR BUILDINGS

	BUILDING / AREA	FLOORING/ SKIRTING/ DADO	WALL	CEILING
(a)	Operating Floor			
	T.G. Hall Area, Switchgear Room, MCC Room, Control Equipment Room.	Flooring shall be finished with Self leveling Epoxy flooring. Passages shall have 10 mm thick non-skid fully vitrified tiles of minimum size 600 mm x 600 mm (overall 40 mm thick) laid in pattern	Acrylic emulsion paint over POP on masonry surfaces, polished granite slab minimum 12mm thick wall cladding on (B) row wall (outer) upto false ceiling level. There shall be minimum joints between	T.G. Hall - synthetic enamel paint over zinc chromate primer to metal deck and all metal walls Acrylic emulsion paint on exposed

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	BUILDING / AREA	FLOORING/ SKIRTING/ DADO	WALL	CEILING
		with different colour of tiles	granite slabs. The quality including colour texture etc. of granite shall be approved by the owner. Above false ceiling of control room & Annexure room exposed plastered masonry surfaces	plastered ceiling (without false ceiling). Aluminum lineal pattern false ceiling.
(b)	Control Rooms, Computer Rooms, etc	For detail refer to clause no. 4.00	For detail refer to clause no. 4.00	For detail refer to clause no. 4.00
(c)	All office areas, Conference Room and other important areas	10 mm thick non-skid fully vitrified tiles of minimum size 600 mm x 600 mm (overall 40 mm thick) laid in pattern with different colour of tiles.	Acrylic emulsion paint over POP	Acoustic mineral fiber board ceiling on aluminum grid system. Acrylic emulsion paint over POP in areas without false ceiling
(d)	Access floor where required	Minimum 600 mm high false floor with adjustable metal supporting system and fire resistant floor panels finished with antistatic vinyl flooring and matching		

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	BUILDING / AREA	FLOORING/ SKIRTING/ DADO	WALL	CEILING
		skirting.		
(e)	Stairs & Lobby	Kota stone slab in general	Acrylic distemper	Acrylic distemper
	(i) Main Stair & Landing	Aranga White marble slab 25 mm thick (min.) with larger possible size to be approved by the owner.	Acrylic emulsion paint over POP	Acrylic emulsion paint over POP.
	(ii) Lift lobby	----- Do -----	Granite slab cladding Same as Sl No.-1	Aluminium lineal pattern false ceiling.
(f)	Battery Room & Battery Charger Room, UPS Room	Minimum 20 mm thick acid and alkali resistant tiles set in and jointed with epoxy mortar (overall 40 mm thick) along with 2100 mm high dado of same tile	Chemical resistant paint	Chemical resistant Paint
(g)	Chemical Feed Station	Minimum 20 mm thick acid and alkali resistant tile set in and jointed with epoxy mortar (overall 40 mm thick) along with 2100 mm high dado of same tile	Chemical resistant paint.	Chemical resistant paint.
(h)	AHU Rooms,	40 mm thick heavy-	Acrylic distemper	Acrylic

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	BUILDING / AREA	FLOORING/ SKIRTING/ DADO	WALL	CEILING
	Air Washer Rooms, Cable Spreader Rooms & all other service areas	duty cement concrete floor with metallic hardener		distemper
(i)	Toilet and other wet areas	Minimum10 mm thick non-skid vitrified tile, of minimum size 400 mm x 400 mm (overall 40 mm thick) with glazed ceramic tile of same make dado topped with 50 mm wide matching moulded ceramic trims. Dado height shall be100 mm higher than lintel level starting from finish floor level	Acrylic emulsion paint over POP	Acrylic emulsion paint over POP. Aluminum false ceilingwhere required.
(j)	Oil Spillage area	Non-skid self leveling epoxy over IPS (overall 40 mm thick)	Epoxy paint	Epoxy paint.
(k)	All other general areas except operating floor	Overall 40 mm thick heavy-duty concrete floor with metallic hardener	Acrylic distemper	Acrylic distemper
(l)	CW/ACW Pump House & Electrical	40 mm thick heavy duty cement concrete floor with metallic	Acrylic distemper	Acrylic distemper

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	BUILDING / AREA	FLOORING/ SKIRTING/ DADO	WALL	CEILING
	Building	hardener and matching skirting		
(m)	Fuel Oil Pressuring Pump House	Self-levelling epoxy floor paint	Acrylic distemper paint	Acrylic distemper paint
(n)	ESP &VFD Control Building	10 mm thick non-skid fully vitrified tiles of make of minimum size 600 mm x 600 mm (overall 40 mm thick) laid in pattern for Control room. Other areas 40mm thick heavy duty IPS flooring with metallic hardener.	Acrylic emulsion paint over POP for control room. Other areas acrylic distemper paint.	Pre-coated aluminium linear ceiling in air conditioned areas Acrylic distemper paint in other areas
(o)	Coal Mill Building	-Do-	Single skin metal sheet	Exposed painted Cladding Structure
(p)	Condensate Transfer	40 mm thick heavy duty cement Pump concrete floor with metallic	Acrylic distemper paint	Acrylic distemper paint
(q)	Unloading Bay and all abrasion prone working areas.	40 mm thick IPS flooring with Ironite topping. Skirting: 125 mm high machine	Oil bound distemper over 12 mm thick internal plaster	Oil bound distemper over 6mm thick ceiling plaster

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	BUILDING / AREA	FLOORING/ SKIRTING/ DADO	WALL	CEILING
		pressed plain cement tiles		
(r)	Pump Houses (In all pump houses except fuel oil pump house)	40 mm thick IPS flooring with Ironite topping Skirting: 125 mm high machine pressed plain cement tiles	Oil bound distemper over 12 mm thick internal plaster	Oil bound distemper over 6mm thick ceiling plaster
(s)	Fuel Oil Pump Hall (In oil spillage areas)	40 mm thick IPS flooring with Ironite topping in chequered finish Skirting: 125 mm high machine pressed plain cement tiles	Oil resistant paint over 12 mm thick internal plaster	Oil bound distemper over 6mm thick ceiling plaster
(t)	D. M. Plant areas and all Chemical dozing and handling areas.	Acid/Alkali resistant tiles Skirting: 1500 mm high acid / alkali resistant tile dado	Acid/Alkali resistant paint over 12 mm thick internal plaster above dado	Oil bound distemper over 6 mm thick ceiling plaster.
(u)	Cable Spreader room (all)	40 mm thick IPS flooring with Ironite topping Skirting:	Colour wash over 12 mm thick internal plaster	Oil bound distemper over 6mm thick ceiling plaster

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	BUILDING / AREA	FLOORING/ SKIRTING/ DADO	WALL	CEILING	
		125 mm high machine pressed plain cement tiles			
(v)	MCC & Switchgear room (all)	40 mm thick IPS flooring with Ironite topping Skirting: 125 mm high white cement base marble mosaic tiles	Acrylic Emulsion paint over internal plaster	Oil bound distemper over ceiling plaster	
(w)	Electrical Equipment room and Supply Ventilation equipment room (all)	40 mm thick IPS flooring with Ironite topping Skirting: 125 mm high machine pressed plain cement tiles	Oil bound distemper over 12 mm thick internal plaster	Oil bound distemper over 6mm thick ceiling plaster	
(x)	Laboratory (all)	Matt finish ceramic tile flooring Skirting: 2100 mm high glazed ceramic tiles dado	Acrylic emulsion paint over internal plaster above dado	Aluminium False ceiling of 'Luxalon of 84C' type	
(y)	Control Rooms (all)	2 mm thick antistatic PVC tiles finish over 40mm thick IPS flooring Skirting:	Acrylic emulsion painting over plaster of Paris finish	Aluminium False ceiling of 'Luxalon of 84C' type	

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	BUILDING / AREA	FLOORING/ SKIRTING/ DADO	WALL	CEILING
		125 mm high 2mm thick PVC tiles		
(z)	Office, Operator's room (all)	2 mm thick antistatic PVC tiles over 40 mm thick IPS flooring or vitrified tiles flooring Skirting: 125 mm high 2mm thick PVC tiles or vitrified tiles.	Acrylic emulsion painting over plaster of Paris finish	Aluminium False ceiling of Luxalon of 84C type
(aa)	Staircase (all)	40 mm thick white cement base cast- in-situ marble mosaic with molded nosing in tread Skirting: 125 mm high cast- in-situ white cement base marble mosaic finish	Oil bound distemper	Oil bound distemper on soffit of waist slab and stair room slab.
(bb)	Staircase to control rooms (all)	Polished Kota stone with molded nosing in tread Skirting: 125 mm high polished Kota stone	Oil bound distemper	Oil bound distemper on soffit of waist slab and stair room slab.
(cc)	Lobby & Passages (all)	40 mm thick white cement base marble mosaic tiles flooring except in passages.	Oil bound distemper	Oil bound distemper over 6mm thick ceiling plaster

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	BUILDING / AREA	FLOORING/ SKIRTING/ DADO	WALL	CEILING
		Passages to match adjacent flooring. Skirting: 125 mm high white cement base marble mosaic tiles		
(dd)	Toilets (all)	Matt finish ceramic tile flooring Skirting: 2.1m high glazed ceramic tiles dado	Oil bound distemper above dado	Oil bound distemper over 6mm thick ceiling plaster
(ee)	Crusher House	40 mm thick IPS flooring with Ironite topping Skirting: 125 mm high machine pressed plain cement tiles	Pre coated metal sheet cladding	Oil bound distemper over 6mm thick ceiling plaster under RCC slab or painted exposed metal deck.
(ff)	Lube Oil Storage Shed and storage yard	40 mm thick IPS flooring with Ironite topping in chequered finish Skirting: 125 mm high machine pressed plain cement tiles Storage yard: 150 mm thick gravel filling	Oil resistant paint over 12 mm thick internal plaster	Exposed Painted structure.

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	BUILDING / AREA	FLOORING/ SKIRTING/ DADO	WALL	CEILING
		over 230 mm rubble soling		
(gg)	Inflammable Shed	40 mm thick IPS flooring with Ironite topping in chequered finish Skirting: 125 mm high machine pressed plain cement tiles	Oil resistant paint over 12 mm thick internal plaster	Exposed Painted structure.
(hh)	Canteen building (Dining Hall)	Ceramic tiles 2100 mm high glazed ceramic tiles dado	Oil bound distemper over 12 mm thick internal plaster	Oil bound distemper over 6mm thick ceiling plaster
(ii)	Canteen building (Kitchen, Wash & pantry)	Matt finish ceramic tile flooring Skirting: 2100 mm high glazed ceramic tiles dado	Oil bound distemper over 12 mm thick internal plaster	Oil bound distemper over 6mm thick ceiling plaster
(jj)	Office	Overall 40mm thick Vitrified tile flooring with 10mm thick vitrified tiles laid in pattern in two shades. Skirting: 125 mm high vitrified tiles skirting	Acrylic emulsion painting over plaster of Paris finish	Aluminium False ceiling of 'Luxalon of 84C' type

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	BUILDING / AREA	FLOORING/ SKIRTING/ DADO	WALL	CEILING
(kk)	Fire station Building – Fire Tender Parking area (provision of 3 nos. of fire tenders).	40 mm thick IPS flooring with hardener Skirting: 125 mm high machine pressed. plain cement tiles	-	Cement paint over 6mm thick ceiling plaster
(ll)	Fire Station Building – Offices, Lobby, Control room, Rest room,	Overall 40mm thick Vitrified tile flooring with 10mm thick vitrified tiles laid in pattern in two shades. Skirting: 125 mm high vitrified tiles skirting.	Acrylic emulsion painting over plaster of Paris finish	Aluminium False ceiling of „Luxalon of 84C’ type or Acrylic emulsion painting over plaster of Paris finish
(mm)	Fire Station Building – Toilets	Matt finish ceramic tile flooring Skirting: 2100 mm high glazed ceramic tiles dado	Oil bound distemper over 12 mm thick internal plaster	Oil bound distemper over 6mm thick ceiling plaster
(nn)	Gate Office	Overall 40mm thk Kota stone flooring Skirting: 150mm high kota stone skirting	Oil bound distemper over POP	Oil bound distemper over POP
(oo)	Security & Time Office	Overall 40mm thick Vitrified tile flooring	Oil bound distemper over POP	Oil bound distemper over

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	BUILDING / AREA	FLOORING/ SKIRTING/ DADO	WALL	CEILING
		with 10mm thick vitrified tiles laid in pattern in two shades. Skirting: 125 mm high vitrified tiles skirting.		POP
(pp)	Lobby (all)	Marble mosaic tiles in white cement base Skirting: 125 mm high marble mosaic tiles in white cement base	Oil bound distemper over 12mm thick internal plaster	Oil bound distemper over 6mm thick ceiling plaster
(qq)	Staircase (all)	40 mm thick white cement base cast- in-situ marble mosaic with molded nosing in tread Skirting: 125 mm high cast- in-situ white cement base marble mosaic finish	Oil bound distemper	Oil bound distemper on soffit of waist slab and stair room slab.
(rr)	Toilets (all)	Matt finish ceramic tile flooring Skirting: 2100 mm high glazed dado ceramic tiles	Oil bound distemper above dado	Oil bound distemper over 6mm thick ceiling plaster
(ss)	External wall	Waterproof cement based paint over 20 mm thick external		

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	BUILDING / AREA	FLOORING/ SKIRTING/ DADO	WALL	CEILING
		plasters over brickwork		
(tt)	Roof treatment	As per clause no 2.24, section IV of Architectural specification		

6.1 DOORS / WINDOWS SCHEDULES

Sr. No.	Name of Room	Door	Window
(a)	Pump halls & D. M. Plant	40 mm thick Hollow Metal Pressed Steel Door	Aluminium Powder coated windows - Openable windows at working level & fixed windows at high level.
(b)	Unloading Bays	Steel Rolling Shutter	Aluminium Powder coated windows - Openable windows at working level & fixed windows at high level.
(c)	Cable spreader rooms, MCC & Switchgear rooms	2 hours fire rated steel door	Aluminium powder-coated fixed windows
(d)	Electrical equipment, Supply & Ventilation rooms	40 mm thick Hollow Metal Pressed Steel Door with vision panel	Aluminium powder coated openable windows
(e)	Control rooms	Aluminium Powder coated fully glazed air lock door	Aluminium Powder coated windows with double glazing with 12mm air gap

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Sr. No.	Name of Room	Door	Window
(f)	Office rooms & operator's rooms	Aluminium Powder coated fully glazed door	Aluminium Powder coated openable windows at working level
(g)	Toilets	FRP door shutter with aluminium door frames	Aluminium frame glass louver windows
(h)	Lube oil storage shed & Inflammable Store	40 mm thick Hollow Metal Pressed Steel Door	-MS Openable windows at working level & MS top hung ventilator at high level.
(i)	External doors	40 mm thick Hollow Metal Pressed Steel Door	
(j)	Canteen Building (Dining hall)	Aluminium fully glazed doors	Aluminium powder coated windows - Openable windows at working level & fixed windows at high level.
(k)	Canteen building (Kitchen, Wash, pantry)	FRP door shutter with aluminium frame	Aluminium powder coated windows
(l)	Electrical equipment room, Supply & Ventilation room	40 mm thick Hollow Metal Pressed Steel Door with vision panel	Aluminium powder coated openable windows
(m)	Office room	Aluminium fully	Aluminium powder

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Sr. No.	Name of Room	Door	Window
		glaze door	coated windows
(n)	Security & Time Office	Aluminium fully glazed door	Aluminium powder coated windows
(o)	Fire Station building	40 mm thick Hollow Metal Pressed Steel Door	Aluminium powder coated operable & fixed windows
(p)	Control Room	Aluminium powder coated fully glazed door	Aluminium powder coated windows
(q)	Toilets	FRP door shutter with aluminium powder coated door frames	Aluminium powder coated frame glass louver windows / ventilators.
(r)	Gate Office	Aluminium powder coated fully glazed door	Aluminium powder coated openable windows
(s)	Coal sampling and processing room	40 mm thick Hollow Metal Pressed Steel Door	Steel framed glazed window and ventilator

7.0 MINIMUM SIZES OF NON-PLANT BUILDINGS

Sr. No.	Name of Building	Nature of Construction	No. Of Stories	Approximate Plan Area	Remarks
(a)	Fire Station Building	RCC Framed Structure, Brick Cladding and RCC	Ground floor + one	25.0m X 10.0m + 18.0m x 10.0m for fire tender parking.	

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Sr. No.	Name of Building	Nature of Construction	No. Of Stories	Approximate Plan Area	Remarks
		roof			
(b)	Canteen Building	RCC Framed Structure, Brick Cladding and RCC roof	Ground floor	25m X 15m	
(c)	Gate Office	RCC Framed Structure, Brick Cladding and RCC roof	Ground floor	8m X 12m	
(d)	Security & Time Office	RCC Framed Structure, Brick Cladding and RCC roof	Ground floor	25m X 10m	
(e)	Work shop	RCC columns, Brick cladding, Structural steel Truss & Colour coated roof sheets	Ground floor	65m X 30m	
(f)	Lube oil storage shed with storage yard	RCC columns, Brick	Ground floor	30m X 15m	

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Sr. No.	Name of Building	Nature of Construction	No. Of Stories	Approximate Plan Area	Remarks
		cladding, Structural steel Truss & Colour coated roof sheets and storage area with barbed wire fencing			
(g)	Gas cylinder storage building	RCC framed structure with RCC roof & brick claddings	Ground floor	15 X 20m	
(h)	FOPH foam shed	Structural steel frame work with brick cladding	Ground floor	10m X 13m	
(i)	Stores	Structural steel frame work with brick cladding	Ground floor	75m X 30m	No. of sheds to be decided during detailed engineering.
(j)	Security office for store area	RCC framed structure with RCC roof and brick cladding	Ground floor	10m X 5m	
(k)	Security Cabin	RCC framed	Ground floor	10m X 5m	

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Sr. No.	Name of Building	Nature of Construction	No. Of Stories	Approximate Plan Area	Remarks
		structure with RCC roof and brick cladding			
(l)	Car & scooter Parking	RCC framed structure with RCC roof	Ground floor	30m X 50m	
(m)	Coal sampling and processing room	RCC framed structure with RCC roof and brick cladding	Ground floor	15 m x 25 m	
LIST OF APPROVED VENDOR: REFER MASTER SPECIFICATION VOLUME-II, SECTION 11					

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ANNEXURE-I

TECHNICAL SPECIFICATION FOR LANDSCAPE DESIGN

1.0 INTRODUCTION

Industries located on any site, by virtue of the nature of their operation, changes the existing pattern and circumstances of the site and the areas surrounding it. The impact ranges from general pollution i.e. air, water and noise pollution, alteration and destruction of views, traffic congestion etc.

Landscape planning for this project attempts to identify the various environmental and aesthetic issues related to this and proposes corrective and preventive measures that may be adopted to reduce the negative impacts.

This document sets out the framework and lines of action by which the landscape has to be adjusted in accordance with ecological principles to meet the needs of changed circumstances.

2.0 OBJECTIVES

One of the most common problems in the landscape treatment of industrial sites is the protection of the public from undesirable views and from noise, dust and similar nuisances. The movement of dust will depend on the season of the year and time of the day, wind speed and direction, turbulence of air, soil moisture and soil temperature, air temperature and humidity.

(a) Environmental amelioration

Thus the main challenge of landscape design lies in negating the adverse environmental effects – both off-site as well as on-site i.e.

(i) Control pollution and filter dust

(ii) Provide shade and improve microclimate

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(b) Site conservation is another major issue associated with landscape design for an industry: soil and water conservation, infrastructure stabilization, pollution control, and wastewater treatment. (c) The other but not lesser objectives are: (i) To create an aesthetically pleasing environment through careful use of hard and soft landscape elements (ii) To enhance the natural and existing characteristics of the land. (iii) To design a functionally appropriate landscape that do not disturb the industrial operations 3.0 <u>LANDSCAPE DESIGN VISION</u> The site has been divided into a few typical zones on the basis of their situational similarities, for the purpose of achieving similar design responses, which are further classified into separate functional zones of specific requirements. These are: (a) Intensive Landscaping Zones (i) Administrative zone (ii) Gate Complex Area (iii) Canteen, Service Building & Similar Building Areas. (b) General Landscaping Zones (i) Open Store yard (ii) Cooling Tower Area (iii) Other incidental areas		

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(c) Linear Landscaping Zones (i) Water Reservoir Embankment (ii) Railway Track Embankment (iii) Green Belt along Boundary (iv) Internal vegetative screen (d) At Micro Level (i) Along Boundary wall (ii) Along internal roads (iii) Along external Approach road		
3.1	<u>PROPOSED GUIDELINES</u>	
The following guidelines have been formulated after close study and analysis of the site plan vis-à-vis it's technical, aesthetic, environmental and security requirements.		
3.1.1	Administrative zone	
This area is to be intensively landscaped with lawn, grass mounds, fountains, flowerbeds, pathways and stone paved areas with appropriate landscape illumination.		
3.1.2	Gate Complex Area	
For security reasons, the design shall be such that trees or other vegetations do not block the eyelevel and obstruct visibility. Also, as per technical requirements, 17.5 M space on both sides of Switchyard area is to be kept free from tall plantations. Therefore, maximum height of plants should be kept within 1.0 m.		

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It is preferable to limit landscaping to grass and groundcovers of both foliage and flowering type. Palms may be added to scale down the large expanse of the space. Suitable paving material and pattern may be adopted for smooth flow of movement. 3.1.3 Canteen, Service building & similar building areas: This area is likely to receive a number of visitors, and hence, demands to have aesthetically pleasing surroundings. However, since these two buildings form part of the Plant core area, planting need to be limited to grass, ground cover and small shrubs, which can be maintained as hedges and soft edgings. Appropriate hardscape shall also be a part of landscaping. 3.1.4 Open store yard: This zone should be so treated that alteration and modification do not involve too much resource and is not difficult to reclaim the land when required. Simplified landscaping with grass and ground covers, hedges and plant edgings along roadside should be appropriate. Part of the stretch may also be developed as Plant Nursery to meet the site requirements in long-term. 3.1.5 Cooling Tower Area Air and ground in the adjoining area of the cooling towers is likely to have high humidity. Accordingly, appropriate plants are to be selected for plantation in this area. 3.1.6 Other incidental areas : The rest of the open spaces with no special aesthetic requirements shall be put under grass cover with vegetative borders, edgings and hedges of flowering/ foliage shrubs. Much of the problems associated with industries result from these large un-built ground spaces, which are required as “elbow-rooms”. Proper		

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3.1.7 maintenance of these areas is central to check deterioration of the Plant's overall ambience. 3.1.7 Railway Track Embankment: Technical requirements and environmental factors are the main Concern. Evergreen trees with small canopy and dense foliage are to be planted along the railway trackside to arrest coal flying from empty wagons, subject to the space available. The sloped embankment shall be planted with grass. 3.1.8 Water reservoir edge: Similar to above, the embankment shall be covered with grass. 3.1.9 Green Belt along Boundary A 50.0 m wide green belt or dense afforestation along periphery to be created to protect surrounding areas from air pollution, specially coal and fly ash dust particles. 3.1.10 Internal Vegetative Screen A similar buffer is required to screen the core Plant area from air borne coal dust. A vegetative barrier comprising of tall evergreen dense foliage trees would make suitable protection against the dust pollution. 3.1.11 Boundary plantation: Security is the main concern here. Flowering Shrubs and other plants with spikes and thorns may be suitable for this stretch as this would act as natural barriers against trespassing or unauthorized attempts to enter the Plant area. However, these plants are to be maintained below the boundary wall height to allow unobstructed view all around. 3.1.12 Internal Roads The internal roads, wherever possible, may be planted with fast growing and flowering/non-flowering trees of small crown spread. Areas with overhead and underground service lines shall be devoid of trees to prevent		

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root and branching system interfering with these. Those areas shall have planting limited to shrubs and ground covers (in the form of hedges, borders and edgings) only 3.1.13 External Approach Road The approach road of the Plant may also be considered for landscaping with low and dwarf flowering shrubs and grass along the outer periphery of the boundary wall and tall columnar trees on the opposite side. 4.0 DESIRABLE TREE CHARACTERISTICS: (a) Trees shall be so selected that they have the following attributes, apart from being ecologically appropriate: (i) Help in retention of soil (ii) Create less and controlled leaf-litter – evergreen tree species preferred (iii) Large canopy with high crown height to provide shade as well as to allow easy movement of trucks etc. (iv) Trees with high dust-filtering capacity to control air pollution (v) Hardy and resistant to strong gusty winds (vi) Maintenance free and those disliked by cattle (vii) Deep root system, so that chances of surface damage of road due to shallow and surfacial roots are eliminated (viii) Aesthetically pleasing, with attributes like colour and fragrance (ix) Fast growing species are preferred Note: A Detailed out 'Broad Guidelines For Plant Selection' and 'Planting Rationale' leading to selection of plant species are given in the following pages.		

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4.1 BROAD GUIDELINES FOR PLANT SELECTION

	Zone	Situations/ Activity Areas	TREES									Shrub	Grass/ Ground cover	Specimen plants	Others (Creeper, Palm etc.)
			Fast growing	Flowering/ Non- flowering	Foliage Density	Fragrance	Exotic/ Indigenous	Evergreen/ Deciduous	Crown Spread (M)	Crown Height (M)	Tree Height (M)				
4.1.1	Intensive Landscaping Zones														
	(a)	Administrative	Preferred	Both	Mixed	Preferred	Both	Both	Varies 6.0- 10.0	Varies / 2.0 m clear	Varies 6.0- 15.0	✓	✓	✓	Version - http://www.simpopdf.com
	(b)	Gate Complex	Preferred	Both	Mixed	Preferred	Both	Evergreen	-Do-	3.0 m clear	-Do-	✓	✓	✓	
	(c)	Canteen, Service Building & other similar bldg. areas	NA	NA	NA	NA	NA	NA	NA	NA	NA	✓	✓	✓	
4.1.2	General Landscaping Zones														

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	Zone	Situations/ Activity Areas	TREES									Shrub	Grass/ Ground cover	Specimen plants	
			Fast growing	Flowering/ Non-flowering	Foliage Density	Fragrance	Exotic/ Indigenous	Evergreen/ Deciduous	Crown Spread (M)	Crown Height (M)	Tree Height (M)				
	(a)	Open Store Yard	NA	NA	NA	NA	NA	NA	NA	NA	NA	✓	✓	PLANT NURSERY	
	(b)	Cooling Tower Area	May/ May not	Both	Mixed	May/ May not	Indigenous	Evergreen	Varies 6.0- 10.0	Varies / 3.0 m clear	Varies 6.0- 15.0	✓	✓	May / May not	May / May not
	(c)	Other Areas	Preferred	Non-flowering	Dense	Preferred	Indigenous	Evergreen	2.5 – 3.0	1.5 Clear	Upto 4.5	✓	✓	May / May not	May / May not

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	Zone	Situations/ Activity Areas	TREES									Shrub	Grass/ Ground cover	Specimen plants	Others (Palms etc.)
			Fast growing	Flowering/ Non-flowering	Foliage Density	Fragrance	Exotic/ Indigenous	Evergreen/ Deciduous	Crown Spread (M)	Crown Height (M)	Tree Height (M)				
4.1.3	Linear Landscaping Zones														
	(a)	Water Reservoir Embankment	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	✓	NA	NA
	(b)	Railway Track Embankment	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	✓	NA	NA

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	Zone	Situations/ Activity Areas	TREES									Shrub	Grass/ Ground cover	Specimen plants	Others (Creepers, Palms etc.)
			Fast growing	Flowering/ Non-flowering	Foliage Density	Fragrance	Exotic/ Indigenous	Evergreen/ Deciduous	Crown Spread (M)	Crown Height (M)	Tree Height (M)				
	(c)	(i) Green Belt along Boundary	Must	Non-flowering	Very Dense	May/ May not	Indigenous	Evergreen	Varies 6.0-8.0	Varies / 3.0 m clear	Varies 12.0-18.0			N A	NA
		(ii) Internal Vegetative Screen	Must	Non-flowering	Very Dense	May/ May not	Indigenous	Evergreen	Varies 4.0-6.0	Varies / 3.0 m clear	Varies 6.0-15.0			N A	May be combined with Ficus, Trellis
4.1.4	AT MICRO-SCALE														

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	Zone	Situations/ Activity Areas	TREES									Shrub	Grass/ Ground cover	Specimen plants	Others (Palm etc.)
			Fast growing	Flowering/ Non-flowering	Foliage Density	Fragrance	Exotic/ Indigenous	Evergreen/ Deciduous	Crown Spread (M)	Crown Height (M)	Tree Height (M)				
	(a)	Along Boundary Wall	NA	NA	NA	NA	NA	NA	NA	NA	NA	✓	✓	May / May not	NA
	(b)	Along Internal roads	Must	Non-flowering	Dense	May/ May not	Indigenous	Evergreen	2.5 – 3.0	1.5 Clear	Upto 4.5	✓	✓	May / May not	May / May not
	(c)	Along External Approach Road	Must	Non-Flowering	Very Dense	May/ May not	Indigenous	Evergreen	-Do-	-Do-	-Do-	✓	✓	No	No

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4.2 PLANTING RATIONALE FOR SELECTION OF TREE SPECIES

Sr. No.	Zone	Situations/ Activity Areas	Functional Needs	Required Qualities Of Plant Materials
4.2.1	CANTEEN, SERVICE BUILDING AND SIMILAR BUILDING AREAS			
	(a)	Front	Allow visibility to and from building while creating a vista effect, may be interspersed with medium height Canopy trees to provide shade.	Trees with prominent trunk, upright & with minimum leaf litter. Evergreen flowering trees may be added in between to provide shade.
	(b)	Back and sides	Trees providing shade.	Tall spreading winter deciduous flowering trees to allow sun in winter while providing shade in summer. Crown height preferably more to allow easy passage of service/ utility vehicles.
	(c)	Parking areas: (i) Car Parking (ii) Two-wheeler Parking	Trees providing shade	Spreading type winter deciduous trees to allow sun in winter while providing shade in summer.

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Sr. No.	Zone	Situations/ Activity Areas	Functional Needs	Required Qualities Of Plant Materials
	(d)	Around the building	Trees providing shade and casting deep shadow. on the building walls specially on the south and western sides to minimise heat gain	Columnar medium height trees with good Aesthetic qualities like colourful and fragrant flower/ foliage.
	(e)	Pedestrian Pathways	Trees and plants providing richness in experiencing the spaces	Mixed variety of trees (both evergreen and deciduous) with good aesthetic qualities like colourful and fragrant flower/foliage to offer seasonal variation and dynamism in landscape.
4.2.2	MASS PLANTATION/ AFFORESTATION & PERIPHERAL GREEN BELT			
	(a)		Fast growing trees to arrest pollution and act as a green belt. Minimum Leaf litter and ability to control pollution are the prerequisites.	Heterogeneous group of trees: A combination of evergreen and deciduous species- Flower and fruit bearing trees may also be considered. Indigenous species preferred. Evergreen trees with fairly large and rough textured foliage to arrest fine air pollutants. Rows of hedges of different heights and with a suitable colour scheme to be used along roadsides.

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Sr. No.	Zone	Situations/ Activity Areas	Functional Needs	Required Qualities Of Plant Materials	
4.2.3	SPECIAL LANDSCAPED AREAS				
	(a)		Aesthetics is the main concern here. Environmental factors like shade and Pollution control will follow as secondary requirements.	Evergreen ornamental flowering trees are preferred. Specimen plants and colourful attractive ground covers are must. Accent plants to be used to accentuate the entry points. Exotic species will bring in exciting look.	
4.2.4	OPEN STORE YARD				
	(a)	Entire Area	This area shall be so planted that replacement and transplantation is easy and cost effective.	Grass is the best option. However, a part of this area should be used to develop in-house plant nursery.	
	(b)	Silo-Ash area	Screening	Double row of tall columnar evergreen foliage trees.	
	(c)	Switch Yard Area	Increased greenery along external periphery	Thorny shrubs that form good hedge or edgings are preferred.	
4.2.5	COOLING TOWER AREA				
	(a)	Adjoining areas	This area being slushy, plants that can thrive in soil conditions with high moisture level are preferred.	Plants naturally growing near water margins and which are efficient for wastewater treatment.	

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Sr. No.	Zone	Situations/ Activity Areas	Functional Needs	Required Qualities Of Plant Materials
	(b)	Pavement sides	May be accentuated with low hedges and ground covers.	
	(c)	All left-over open ground spaces	Required for movement of man and equipment	Plants allowing free movement
4.2.6	WATER RESERVOIR			
	(a)	Sloped Banks	Water body to be kept litter free.	Non-leafy vegetation to be planted that can Stabilize the slope as well as provide a green look.
	(b)	Water body	Water body to be protected from coal dust from sided wagons	Dense foliage small canopy trees with non-Spreading root system that can form a solid vegetative screen.
4.2.7	RAILWAY EMBANKMENT	Sloped Areas	Slope stabilization	Ground covers to prevent soil erosion
4.2.8	BOUNDARY WALL SIDE	Between internal road and boundary	Leave 10.0 m of clear zone for security reasons. However, Smaller plant species that do not block eye level and discourage movement may be considered.	No trees to be provided. Other plant materials shall include shrubs and climbers pruned to boundary wall height. These shall preferably be spiky and thorny. Flowering evergreen species to be given priority. Wall hugging creepers may be used to add more green.

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Sr. No.	Zone	Situations/ Activity Areas	Functional Needs	Required Qualities Of Plant Materials
4.2.9	INTERNAL ROADS			
	(a)		Areas with overhead and underground service lines shall be devoid of trees to prevent root and branching system with these	Fast growing and flowering / non-flowering trees of small crown spread. Some areas shall have planting limited to shrubs and ground covers only.
	(b)		The stretch along overhead transmission lines from switchyard shall have to be free from tall trees; rest of the stretch may have taller spreading type trees. However, care has to be taken to avoid the 10.0 m clear zone from tall tree plantation.	Small trees or tall shrubs with large foliage to ensure manageable leaf litter. Evergreen flowering species to be given preference. Indigenous species preferred.
	(c)		Evergreen trees with spreading canopies casting shade on the road may be considered if the stretch is aligned with the sun-path.	Indigenous species preferred.
4.2.10	EXTERNAL ROAD	2.0 M wide strip along Road	Environmental considerations are the main concerns.	Small canopy evergreen trees preferred so that Truck movement along road remains undisturbed. Also hardy maintenance free species are must.

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SECTION- 5

BROAD GAUGE RAILWAY SIDING WORKS:-

**CIVIL, P-WAY WORKS, OVERHEAD EQUIPMENTS,
SIGNALLING AND TELECOMMUNICATION**

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1.0 <u>SCOPE OF WORK</u> 1.1 The contractor shall execute all the works for and on behalf of MSPGCL. 1.2 <u>SYSTEM STUDUY:-</u> The contractor shall work out details of the system for Railway Siding works required for successful and timely completion of project. For all necessary information required for establishing the system for providing B.G. Railway siding for 1x660 MW Bhusawal Thermal Power Project, it would be a responsibility of contractor for liaison with railway authority and concerned departments. 1.3 <u>BASIC & DETAILS ENGINEERING:-</u> Contractor will carry out the final location survey based on the General Arrangement Drawings, pegging out the alignments, soil investigation, preparation of construction programme in consultation & coordination with Railway Department & MSPGCL & executing contract, design & drawing, supply of materials, execution of civil & P-way, construction, erection, commissioning of rail track including construction of bridges, ROB, Foot over bridge, unloading platform, oil handling system, overhead electrification, signalling, TG line, furnishing all the required work in drawing and other connected works required for railway siding for the propose of coal, oil, ash, transportation etc. required for the running of power plant. Scope shall be inclusive of coordination with Railway Department & preparation of design & drawings for construction of all buildings Such as TNC building, Central panel building etc station works such as cabins, relay rack, battery rooms, DG room, signalling and telecommunication room, drain works, cross drainage works goomties etc. along with electrification works and with all materials, equipments machineries etc. The works not elaborated specifically but are essential for supply installation testing and commissioning and BG railway lines are deemed to have been included in the work and the same shall be as per prevailing standard engineering practices of Railways.		

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Rail structures shall generally include Ballast, Prestressed concrete sleepers & 60kg rails normally IU or 1st quality as per railway requirements. The rail structure shall be provided on compacted murum formation. as per RDSO guide lines/Railway norms. The rail top at proposed wagon tipplers and take off point of existing siding should match in such a way that gradient also shall be within permissible limit as per RDSO guide lines/Railway norms. The scope also includes for crossing of tracks, suitable ROB, sub passes for roads wherever required. No where level crossing across the siding shall be allowed. Necessary provision of cross drainage and RCC drains with RCC cover if necessary, in continuation to existing railway siding drains or as per topography of existing land catchments area should be provided to allow the passing of run off across the Railway Siding All along the siding necessary siding protection against scouring cut off toe drain, slope protection as required and approved by railway should be provided. Contractor shall submit design/drawings and obtain necessary various approvals from Railways, other central/state government Departments/agencies/local bodies well in advance. The copy of various approvals/drawings should be submitted to MSPGCL. 1.4 <u>PROJECT AND EXECUTION AND SUPERVISION OF WORKS:-</u> It shall be the responsibility of contractor to ensure the completion of all the activities in proper sequence from the concerned agencies. The contractor shall constantly maintain necessary liaison with concerned Railway Authority. They will attend meeting with Railways for arriving at resolution in issues related to Railway works. The contractor shall check out the activity precisely with time frame to be adhered for completion of work & also obtain timely clearances and approvals from Railways and other out side departments/agencies. The contractor shall exercise proper control on quality of the works and so as to maintain the quality of the works as per relevant IS code/ standards /railway norms as applicable.		

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1.5	<u>INSPECTION AND CERTIFICATION OF THE SIDINGS:-</u> On completion of the project, as well as during course of execution of works as and when required contractor shall arrange inspection of Railway authorities with railway equipment if required and obtain fitness certificate before commissioning of part or whole of the siding work. The fees for Railway authorities and charges of railway equipments & manpower for checking the track/OHE line/S&T work shall be borne by the contractor. The contractor shall ensure that the commercial notification for use of the siding are issued by the Railway Department in time so as to achieve mile stone activities.	
1.6	<u>POST COMMISSIONING SUPERVISION:-</u> System shall be maintained after commissioning for the period of 12 months by the contractor. However contractor shall render their services during the guarantee period of 12 months. Further contractor shall be responsible for any deficiency in the supervision as per Railway standard till completion of guarantee period of 12 months after successful completion of the work.	
1.7	<u>TENTATIVE LENGTH:-</u> Tentative length of various rail lines shall be as below. (a) Tippler line 1 and 2 ----- 4.0 Km) (b) Engine line 1 and 2 ----- 2.0 Km) (c) Stator and Transformer line ----- 2.5 Km) The above total rail line 8.5 Km are indicative only. The contractor shall finalize the same during detail Engineering as per actual.	
2.0	<u>FOUNDATION EXCAVATION & CONCRETING</u> These specifications supplement the Technical Specifications provided GCC & Specifications of latest Edition	

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2.1	<u>FOUNDATION EXCAVATION</u>	
2.1.1	The excavation in foundation shall include all shoring and other protective work that may be required for ensuring safety during excavation.	
2.1.2	Sand filling in foundation shall be done in the foundation laid on Black Cotton soil or the weak soil, if so desired by the Engineer – in – Charge. If the foundation is laid on good soil, this will not be operated.	
2.2	<u>CONCRETE WORK</u>	
2.2.1	Stone aggregate used for concrete shall be hard stone as per the specification applicable to the Schedule and the same shall have to be got approved by the Engineer-in-Charge. Coarse sand shall also be according to the specification laid down the concerned Schedule for concrete of various type like M15, M20, M25 etc . For these mixes unless otherwise specified stone of 20 mm size shall be used. For fine concrete 1: 2: 4 in RCC or in plain concrete stone aggregate shall be 20 mm size or below.	
2.2.2	Contractor should ensure that quarries selected by him are such, as are approved by State Government for quarry, and that ballast and sand obtained from these are according to the specification followed in concerned Zonal Railway.	
2.2.3	For cement concrete in super-structure, the Contractor should use Steel Shuttering generally suitable to provide batter and offsets. The steel plate should have smooth surface and should be free from bulging during concreting. The entire shuttering should be watertight as far as possible. If however, the contractor wants to use wooden shuttering, he will have to use new planks and scantling etc for fabrication of such shuttering so as to ensure smooth and leak proof surface.	
2.2.4	(a) Concrete in foundation and super-structure shall have to be vibrated. For super- structure, if required by the Engineer-in-Charge, surface vibrator may also have to be used. (b) The concrete shall be mixed properly in mechanical mixer and shall be of plastic consistency. The proper consistency shall be determined by the Engineer-in-Charge by slump test, which shall be carried out	

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	by the Contractor at his own cost. The concreting shall be commenced only after the Engineer-in-Charge has inspected the shuttering and placement of reinforcement and passed the same. Cost of moulds, labour, tools and plants etc for the slump test and cube test of concrete shall be borne by the Contractor including the cement, which is to be supplied by the Contractor.	
2.2.5	While casting concrete, provision shall be made for providing weep holes with PVC pipes.	
2.2.6	Plain/Reinforced Cement Concrete Works The IS Code of Practice for the structural use of reinforced concrete shall form part of these specifications and this Code and the standard practice in reinforced concrete construction that has been evolved by the adoption of this Code shall be followed. (Refer volume VI-B' section 3)	
2.2.7	Aggregates River sand/coarse sand of approved quality shall be used as fine aggregate for cement concrete, reinforced cement concrete of any other type. Sand shall be clean and absolutely free from dirt and any other objectionable admixture. No deleterious materials shall be permitted. Sample of sand to be used shall be approved by Engineer-in-Charge or his authorised representative. (Refer volume VI-B'section3)	
2.2.8	Coarse Aggregate	
2.2.8.1	The coarse aggregate, which may be either stone ballast as directed, should be well graded and preferably machine broken, and should conform to relevant specification and should be obtained from approved quarries. The Stone should not be soft, thin, elongated, laminated or weathered. The aggregate should be free from dust. Cleaning and washing, if necessary, should be carried out as per direction of the Engineer-in-Charge or his authorised representative.	
2.2.8.2	The mention of sources, as indicated above, does not, however, absolve the Contractor(s) of his/their liability to ensure that the coarse sand, stone chips	

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and ballast as may be required for the work are strictly in accordance with standard specification. In case these materials cannot be had, according to specification, from these sources, the Contractor may bring the materials from any other source by obtaining prior permission of the Engineer – in – Charge provided the materials are according to standard specification. 2.2.8.3 In addition to the routine test, special tests on materials will be carried out whenever required by the Engineer., if the results are as per standard laid down, failing which the cost of these tests will be borne by the Contractor. Necessary facilities in the form of moulds, cones, scales, materials, labour for casting, curing, specimen and such other facilities as prerequisite to any standard concrete tests will in any case be afforded by the Contractor free of cost. (refer volume VI-B'section3) 2.2.9 Form Work And Shuttering 2.2.9.1 The formwork shall be water tight to the best possible and sound material. It shall be sufficiently strong and rigid to resist force caused by vibration and incidental loads associated with it. 2.2.9.2 The shuttering shall be so designed that the shuttering on the sides of beams, columns and the walls may be removed first, leaving the shuttering under the soffits of beams and slabs and their supports to remain the position. If wooden forms are used, they shall be invariably oiled with non-staining material oil. Preferably steel plate; plywood shuttering should be used for exposed concrete surface. 2.2.9.3 If at any stage of the work, during or after placing the concrete in the structure, the work is found defective, such concrete shall be removed and work be done with fresh concrete and adequate rigid forms at the cost of the Contractor. 2.2.9.4 The centering shall be supported by double wedge in order to facilitate casting and removal of the shuttering without jerking. Centering and shuttering shall be carefully eased in order to prevent the load being instantly transferred to concrete. The period that shall lapse after the last pour concrete for easing the removal of centering and shuttering shall be fixed by the Engineer – in – Charge.		

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2.2.9.5	Shuttering shall be either of wooden planks of 35 mm minimum thickness with or without steel sheet lining or of steel plates stiffened by steel angles and where wooded planks without steel sheet are used, the edge of the planks and the top surface will be plain to ensure butting of the planks and a water tight surface to prevent leakage of cement slurry. During casting concrete, the shuttering shall be supported on wooden battens and beams and props of vertical ballies properly cross braced together so as to make the form work rigid. In place of ballies props, props of brick pillar of adequate section built in mud mortar may be used.	
2.2.9.6	The formwork shall conform to the shape lines and dimension shown in the plan. It shall be sufficiently rigid and strong to maintain correct shape of the members during disposition of concrete and shall be able to resist forces caused by vibration of concrete and incidental loads associated with the men working over it. The shuttering shall have smooth and even surface and its joints shall not permit leakage of cement slurry.	
2.2.9.7	If at any stage of work during or after placing concrete in the structure, the form work sags or bulges out beyond the required shapes of the structure, the concrete shall be removed and the work redone with the fresh concrete and adequately rigid form work at the cost of the Contractor (details of shuttering centering shall be subject to the approval of Engineer – in – Charge. The complete form work shall be inspected and approved by the Engineer – in –Charge, before the reinforcement bars are placed in position).	
2.2.9.8	Instead of wooden ballies, steel props scolders or in the form of pipes may be used by the contractor with the approval of Engineer-in-Charge. The Contractor will, however, submit the detailed design for these.	
2.2.10	Reinforcement	
2.2.10.1	Reinforcement shall be of the Tor Steel or equivalent (cold twisted deformed bars as per IS: 1786) as directed by the Engineer as per approved drawings. No extra payment shall be made in case other form of steel is used in lieu of mild steel due to non-availability of mild steel.	
2.2.10.2	It shall be the responsibility of the Contractor to clean the reinforcement with dry gunny bag, if they are coated with light rust impurities.	

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2.2.10.3	The rate for reinforced cement concrete includes straightening and uncoiling of rolls of reinforcement. No extra payment for straightening and / or uncoiling of reinforcement rolls shall be payable .	
2.2.10.4	Binding wire of approved quality shall be arranged by the Contractor himself and the rates quoted for respective item should include cost of binding wire and the process of binding etc.	
2.2.10.5	Welding of reinforcement will not be permitted except in special circumstances under the written approval of the Engineer.	
2.2.11	Unless authorised by Engineer-in-Charge, the Contractor shall not dig pits, within or Client's land for extracting shingle or sand or murum, which must be arranged by the Contractor(s) himself/themselves at his/their own cost.	
2.2.12	All works shall be done strictly in accordance with the approved drawings and no departure shall be made by the Contractor without the order of the Engineer (given to him) in writing.	
2.2.13	RCC pipes for culverts/bridges should conform relevant specifications. These should be tested and certified by approved testing agencies/ laboratories and certificate to this effect should be produced by the Contractor if asked for approval of material by Engineer – in – Charge. Nothing extra will be paid for testing and certification by testing agency/ laboratory.	
2.2.14	Paint : Standard brands of paints and primers as per relevant ISI code and as approved by the Engineer-in-Charge shall be used for painting steel work. The rate cover the cost for all labour and materials, cleaning materials, ladder, scaffolding, tools, plants and equipment's including brushes of approved pattern at Contractor's expenses.	
2.2.15	General	
2.2.15.1	The materials to be supplied by the Contractor shall comply with ISI Specifications.	

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2.2.15.2	Samples of the materials that the Contractor intends to supply shall be got approved in advance from the Engineer before commencing the supply of the same.	
2.2.15.3	The land where materials are to be stacked shall be made fit for stacking of materials by the Contractor at his own cost and nothing extra will be paid for this purpose.	
2.2.15.4	The Contractor will also himself / themselves arrange and pay towards the cost of land for such working facilities as he / they need (i.e. land for labour camps, Contractor's office, access road to site (s) of work etc.)	
2.2.15.5	In case any materials is rejected at the site due to its not conforming to the specifications, the Contractor shall arrange to remove all such materials from site at his own cost within 7 days of the receipt of notice to do so. In case of default, removal from site shall be done by MSPGCL at the risk and cost of the Contractor.	
2.2.16	If any work (whether temporary or permanent) or other materials, the value of which has been included in any of account bill(s) is destroyed or damaged or has/have for any other reasons be replaced or restored by the Contractor(s), the value of the work or other materials so destroyed may be recovered by MSPGCL from any payment due to the Contractors provided always that no omission to deduct any amount from money due to the Contractor and not payment by the MSPGCL after aforesaid amount become due shall in any way prejudice or effect the right of MSPGCL to make such deductions at any later date.	
3.0	<u>LAYING OF PERMANENT WAY</u>	
3.1	<u>TRACK STRUCTURE</u>	
3.1.1	Components	
	The track shall consist of the following elements:	
3.1.1.1	Main Rails 60 kg/T-12, 90 UTS flat bottom (1st quality or IU rail as applicable).	

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3.1.1.2	Secondary rails such as check rails etc shall be of 52 Kg T-12, 90 UTS flat bottom	
3.1.1.3	Rails fastenings – Fish Plates 60/52 kg with bolts and nuts.	
3.1.1.4	Mono block pre-stressed concrete sleepers for plain tracks, level crossings, bridges.	
3.1.1.5	Guard rails on bridge, check rail on level crossings.	
3.1.1.6	Fittings for sleepers – grooved rubber sole plates, elastic rail clips, GFN Liners, metal liners.	
3.1.1.7	Stone Ballast 65mm size.	
3.1.1.8	Fouling mark.	
3.1.1.9	Gradient Posts.	
3.1.2	The track shall be laid with 1540Nos/km monoblock PSC sleepers. The track ballast cushion shall consist of hard stone ballast of 65mm size to a depth minimum 250 mm or as per Railway Standard Specifications.	
3.1.3	Points & crossings – 1 in 8.5 BG turnouts with curved switches and CMS crossings laid on PSC sleepers with built up crossings.	
	1 in 8.5 Diamond crossings with double slip on 60 kg steel sleepers and 60 kg rails.	
	1 in 8.5 Scissor cross over with 4725 mm track center on 60 kg steel sleepers and 60 kg rails.	
3.1.4	Glued Joints.	
3.1.5	Guard Rail on bridges span over 3.00m.	
3.1.6	Check rail at level crossing.	

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3.2 <u>TRACK LAYOUT STANDARDS</u> 3.2.1 Prescribed Tolerances The following track standards have been prescribed for track laying. <table><tr><td>(a)</td><td>Gauge</td><td>Sleeper to sleeper variation</td><td>± 2 mm</td></tr><tr><td>(b)</td><td>Expansion gap</td><td>Over average gap worked out by recording 20 successive gaps</td><td>± 2 mm</td></tr><tr><td>(c)</td><td>Joints</td><td>(i) Low joints not permitted</td><td>--</td></tr><tr><td></td><td></td><td>(ii) High joints not more than</td><td>± 2 mm</td></tr><tr><td></td><td></td><td>(iii) Squareness of joints on straight</td><td>± 10 mm</td></tr><tr><td>(d)</td><td>Spacing of sleepers</td><td>With respect to theoretical spacing</td><td>± 20 mm</td></tr><tr><td>(e)</td><td>Cross level</td><td>To be recorded on every 4th sleeper</td><td>± 3 mm</td></tr><tr><td>(f)</td><td>Alignment</td><td>(i) On straight on 10 Metre chord and</td><td>± 2 mm</td></tr><tr><td></td><td></td><td>(ii) On curves of radius more than 600 m on 20 m chord.</td><td></td></tr><tr><td></td><td></td><td>(iii) Variation over theoretical versines on curves of radius less than 600 mm on 20 m chord</td><td>± 5 mm</td></tr><tr><td></td><td></td><td>(iv) Variation over theoretical versines</td><td>± 10 mm</td></tr><tr><td>(g)</td><td>Longitudinal level</td><td>Variation in longitudinal level with reference to approved longitudinal sections.</td><td>50 mm</td></tr></table>			(a)	Gauge	Sleeper to sleeper variation	± 2 mm	(b)	Expansion gap	Over average gap worked out by recording 20 successive gaps	± 2 mm	(c)	Joints	(i) Low joints not permitted	--			(ii) High joints not more than	± 2 mm			(iii) Squareness of joints on straight	± 10 mm	(d)	Spacing of sleepers	With respect to theoretical spacing	± 20 mm	(e)	Cross level	To be recorded on every 4 th sleeper	± 3 mm	(f)	Alignment	(i) On straight on 10 Metre chord and	± 2 mm			(ii) On curves of radius more than 600 m on 20 m chord.				(iii) Variation over theoretical versines on curves of radius less than 600 mm on 20 m chord	± 5 mm			(iv) Variation over theoretical versines	± 10 mm	(g)	Longitudinal level	Variation in longitudinal level with reference to approved longitudinal sections.	50 mm
(a)	Gauge	Sleeper to sleeper variation	± 2 mm																																															
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3.2.2 Service Tolerances

(a)	On straight and on curved track other than transitions.	2mm/m 3.5mm/m
(b)	On transitions	1mm/m 2.1mm/m

(a)	On straight	5mm/m	10mm/m
(b)	On curves	5mm/m	7mm/m

3.3 LINKING

- 3.3.2 The contractor shall lead and spread the rails in pairs along the new alignment on the cess. Kinks from each rail, if any, shall be removed with the help of Jim Crow, etc.

- 3.3.3 The sleepers shall be lead out and laid to the required number for each rail length at the required spacing (65 cm c/c normally) to facilitate linking of track.

- 3.3.4 Rails shall be placed on sleepers and connected by means of a pair of fish plates at each joints with two bolts initially.

(a)	Plumbago (Dry Graphite)	-	5 kgs.
(b)	Kerosene Oil (2 nd quality)	-	3.5 ltrs for 100 joints
(c)	Black or reclaimed oil	-	2.75 ltrs

- 3.4.1 Gauge – On straight and curves upto 4^0 (440m radius), the gauge shall be maintained exact (1673 mm) and on curves sharper than 4^0 , it shall be kept slack by 6mm (1679 mm).

(a)	On straight track	-	3 mm to +6 mm
(b)	On curves upto 4°	-	3 mm to +13 mm
(c)	On curves sharper than 4°	-	0.0 and upto +19 mm

		Tolerance Generally	Tolerance on isolated location
(a)	On long term basis	6 mm	10 mm
(b)	As an intermediate measure	10 mm	15 mm

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3.4.3	Cross Levels This is measured in terms of relative difference in the level of two rail tops measured at the same point. Cross level difference also includes the variation in super elevations. Not specified on consideration that small but constant cross level differences do not matter much.																													
3.4.4	Twist Twist is the rate of change of cross levels between two points. It is measured in terms of changes in cross levels per unit length over a fixed base of 3.5m.																													
3.4.5	Expansion gaps at joints to be provided as mentioned below. Maximum permissible variation in expansion gaps is as given in para- 2 above.																													
3.4.6	Recommended expansion gaps for 12m / 13m rails. <table><tr><td></td><td>Rail Temp. range of Laying the rails</td><td>Initial laying (mm)</td><td>During service(mm)</td></tr><tr><td>(a)</td><td>0⁰ C to 10⁰ C</td><td>10</td><td>8 to 12</td></tr><tr><td>(b)</td><td>10⁰ C to 12⁰ C</td><td>08</td><td>6 to 10</td></tr><tr><td>(c)</td><td>25⁰ C to 40⁰ C</td><td>06</td><td>4 to 8</td></tr><tr><td>(d)</td><td>40⁰ C to 55⁰ C</td><td>04</td><td>2 to 6</td></tr><tr><td>(e)</td><td>55⁰ C to 70⁰ C</td><td>02</td><td>0 to 4</td></tr><tr><td>(f)</td><td>Above 70⁰ C</td><td>0</td><td>0</td></tr></table>			Rail Temp. range of Laying the rails	Initial laying (mm)	During service(mm)	(a)	0 ⁰ C to 10 ⁰ C	10	8 to 12	(b)	10 ⁰ C to 12 ⁰ C	08	6 to 10	(c)	25 ⁰ C to 40 ⁰ C	06	4 to 8	(d)	40 ⁰ C to 55 ⁰ C	04	2 to 6	(e)	55 ⁰ C to 70 ⁰ C	02	0 to 4	(f)	Above 70 ⁰ C	0	0
	Rail Temp. range of Laying the rails	Initial laying (mm)	During service(mm)																											
(a)	0 ⁰ C to 10 ⁰ C	10	8 to 12																											
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(e)	55 ⁰ C to 70 ⁰ C	02	0 to 4																											
(f)	Above 70 ⁰ C	0	0																											
	After welding the short rails into 3 rails short welded panel of 39 m lengths the expansion gaps at the joints will be provided as below with respect to mean annual rail temperature (tm) as for temperature zones III & IV prescribed on Indian Railways.																													

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Temperature Range	Tm-17.5 C to Tm-12.6 C	Tm-17.5 C to Tm-12.6 C	Tm-17.5 C to Tm-12.6 C	Tm-17.5 C to Tm-12.6 C	Tm-17.5 C to Tm-12.6 C	Tm-17.5 C to Tm-12.6 C	
Trail laying	12mm	10mm	8mm	6mm	4mm	2mm	
Expansion gaps During service	(11 to 14)	(9 to 8)	(7 to 11)	(5 to 9)	(3 to 7)	(1 to 5)	
3.4.7	Paint marks shall be made on the rails showing the spacing of sleepers as directed by Engineer-in-charge. Necessary paint shall be arranged by the contractor.						
3.4.8	Full quantity of small fittings shall be fitted completely after slewing the track to correct alignment and as directed by Engineer-in-charge. The track so linked shall be aligned to correct position and remaining two bolts shall be fitted and tightened in the fish joints. Cutting, straightening of rails and drilling/chamfering of holes (machine made) in rails wherever required, ensuring correct sleeper spacing, laying of sleepers to correct gauge, alignment, longitudinal and cross levels and fastening of fish bolts, fish plates, fixing of rubber pads, fixing of liners & ERC etc., straightening by Jim Crowing if necessary, paint marking of sleeper spacing on gauge face of the rails, painting and lettering of month and year of laying, greasing/oiling of fish plates and fish bolts shall be in the scope of contractor. (IS-408-1981) Provision of correct expansion gaps according to temperature, etc., including loading, leading and unloading at the site of work with one initial packing shall be done by contractor. The spacing of the sleepers shall be suitably adjusted as directed by Engineer-in-charge at joint. Glued joint & insulated joints, check rail, guard rail etc., shall have to be laid as required according to plan.						
3.5	<u>BALLASTING AND INITIAL PACKING</u> After assembling and laying the track, additional ballast shall be put in and track lifted and packed to make the cushion of 250mm under the sleeper. Lifting and lowering of the track shall be done to the required level.						

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Defects in cross levels and longitudinal levels shall be rectified and through packing done from one end to the other. 3.5.1 Final Adjustment and Packing After the track is tested by Locomotive/Wagon by Engineer-in-charge, lift the track and pack wherever sags are formed. Any sleepers which have shifted from correct spacing or gone out of square, shall be replaced and squared after loosening the fastenings. Thereafter the fastenings shall be tightened again and final packing given. The joint and shoulder sleepers shall be repacked. The ballast section shall be dressed neatly and boxed including light rollers (minimum 2 passes of stone ballast) as per Railway specification for preparation of ballast bed if required thickness 250mm and subsequent supplementation of ballast after linking/packing of track as per approved profile for single line/double line, straight track, curves including ballast in shoulder and cribs as per Railway Specification. 4.0 <u>EARTHWORK, BLANKETING, TURFING, CONCRETE AND OTHER CIVIL WORKS</u> 4.1 <u>SITE CLEARANCE</u> SCOPE This item covers the following operations in the area lying between the toes of banks/tops of cuttings along the alignment and sidings. All necessary labour, materials, equipments, tools and plants, transportation and stacking etc. required are included in the rates. Site clearance Removal of obstructions Stacking and disposal of salvaged materials Preparation of base Cutting of sugarcane and all trees coming in the alignment. (Refer Volume VI-B section 1 and 2)		

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4.2	<u>EARTHWORK IN FILLING</u>	
4.2.1	Bank shall be made to the neat profile. Earthwork in embankment shall be carried out in layers, one layer at a time. No layer shall exceed 30 cm in thickness after compaction. Shrinkage allowance for each layer is to be provided as determined by compaction trials and as approved by the Engineer so as to get the desired thickness of 25 cm.	
4.3	<u>FILL MATERIALS:</u>	
4.3.1	If sufficient material excavated from the adjacent cuttings is available the same shall be used for earthwork in filling in formation. In case the excavated material is not of the required quality the same shall be disposed off as directed. The contractor shall obtain fill material from his own source own cost and the same shall be pre-selected after soil investigations.	
4.4	<u>CONSTRUCTION OF EMBANKMENT</u>	
4.4.1	To achieve a stable formation for embankment, soil investigations and testing are to be done by contractor as per railway norms.	
4.4.2	Determination of maximum dry density in different types of soil to achieve moisture content, density and rolling relationship as per railway specifications.	
4.4.3	The earthwork shall be compacted to the full height by mechanical means at or near the optimum moisture content in layers of 30 cm to achieve the specified density as per latest RDSO/railway specification.	
4.4.4	A "Blanket" of suitable material shall be provided as specified.	
4.4.5	The side slopes shall be as per recommendation in soil investigation report or flatter with or without berms as determined by soil samples and as per profile of embankment approved by railway authority.	
4.4.6	Each layer shall be levelled with motor grader, bulldozer, or similar equipment capable of shifting and forming the layer into a neat and cohesive surface.	

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4.4.7	Each layer must be approved by the Engineer in charge before the next layer is placed.	
4.4.8	if required slopes shall be protected with stone pitching with or without cement grouting, toe wall, retaining wall etc	
4.5	<u>EARTHWORK ON BRIDGE APPROACHES</u>	
4.5.1	Earthwork on bridge approaches shall be done as directed by the Engineer and the top 100 cm of all banks must be of murum or any suitable blanketing materials as directed by the Engineer.	
4.6	<u>SOIL EXPLORATION / TESTING</u>	
	SOIL EXPLORATION: as per requirement for railway siding work including bore logs wherever required, soil testing as mentioned below	
4.6.1	The Contractor shall arrange for testing of the soil to ascertain the suitability of the soil for formation of embankment, to obtain its proctor density characteristics and to obtain strength of the soil in the compacted/un-compacted conditions in the embankment in order to design slopes. The testing of soil shall be done in accordance with Railway specifications.	
4.6.1.1	The Contractor shall also make arrangements for quality control of compaction of the embankment by establishing and manning adequate Field Laboratory (ies).	
4.6.1.2	The Contractor shall establish Field Laboratory (ies) to cover all the above investigations, triaxial and other tests for ascertaining strength characteristics, for which he may arrange any other centralised laboratory (ies) where he will get the tests done. All the tests and laboratory works shall be in the contractors scope	
4.6.2	The Contractor shall submit samples of earth which he proposes to use for formation of the embankment along with relevant tests results to the Engineer before commencing earthwork and shall get the same approved for use. While approving the sample for use, particular size distribution shall not be the only consideration.	

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4.6.3	The Contractor shall take undisturbed samples as per IS – 2132:1986 of the parent soil over which the embankment shall rest and shall conduct suitable Laboratory Test to enable analysis of the stability of the base after construction of the embankment to assess its long term settlement, distance of borrow pits etc. Such tests will normally be required when proposed embankment is more than 6 m high or where the parent base soil is exceptionally weak.	
4.7	<u>DETERMINATION OF MAXIMUM DRY DENSITY</u>	
4.7.1	For Clayey Soils	
	The maximum dry density shall be determined by heavy proctor compaction test in accordance with IS: 2720 (Part – VIII) – 1983. The dry density and moisture content relationship shall be obtained for a number of samples and shall cover moisture content ranging from 2 % less than the optimum moisture content to plastic limit.	
4.7.2	Sandy And Silty Soil With Moderate Cohesion	
4.7.2.1	Where the soil is amenable to compaction and satisfactory results are obtained when compacted by heavy proctor test as per IS: 2720 (Pt – VIII) – 1983, the soil, shall be treated like clayey soil in the manner mentioned above.	
4.7.2.2	Where the soil is amenable to tests by heavy proctor, field trials as per IS: 10379-1982 shall be conducted to achieve moisture content density and rolling relationships. Such moisture contents should cover a range upto high moisture contents so that such relationship is available in quality control of compaction at higher moisture contents as mentioned below.	
4.7.3	Gravelly Soil	
	For Gravel fraction upto 30%, moisture content density relationship shall be obtained by heavy proctor test (IS: 2720-Pt-VIII, 1983) on fraction passing 40 mm IS Sieve IS : 10379-1982.	

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4.7.4	Weathered Soils In certain weathered soils the behaviour to compaction in field differs from Laboratory compaction characteristics and the maximum compaction achievable for such soils in the field shall be determined in accordance with provision of Method 3 of IS: 10379-1982.	
4.7.5	Locally available soil may be selected for use, care being taken to avoid use of organic clays, silts and peat, poorly graded sands and gravel with uniformity coefficient of less than 2 (to safeguard against liquefaction under vibration of moving loads or specially during earth tremors) gravely soils with percentage of gravel size fraction 30 % rock fills and expansive soils. The moisture content of the soil, which the Contractor brings to site for making embankment, should be appropriate for compaction as specified in these specifications.	
4.8	<u>COMPACTION</u>	
4.8.1	Compaction shall be carried out by means of suitable equipment mechanically to achieve the densities prescribed depending upon the type of soil, height of bank etc.	
4.8.2	Compaction equipment shall be specially selected to match the type of soil and got approved in advance by the Engineer for instance, plain rollers should be used for ordinary soil, vibrating rollers for sandy soil, sheep foot rollers for clayey soil, etc.	
4.8.3	Procedure of compaction:	
4.8.3.1	Before work is commenced, the contractor is advised to conduct field compaction trials, for his own guidance so that compaction is efficiently and economically achieved. This trial should also be used to assess the thickness of the loose layer of soil that should be adopted for formation of the bank, as well as to determine the most efficient type of rollers.	

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4.8.3.2 Control Of Moisture Content For Compaction In Field (a) All compaction shall be attempted to be done at moisture content as near as possible to optimum moisture content so as to give maximum dry density under rolling. (b) Where natural moisture content of the earth is less than the optimum moisture content for achieving maximum dry density, water should be sprinkled either in the borrow – pits or over the spread layer in the embankment, as convenient, to obtain the necessary moisture content with a tolerance of 2% and compaction done. (c) Where the natural moisture content is more than the optimum moisture content for maximum dry density, soil should be left for drying for upto 2 days or less so as to reduce the moisture content to the desired level. In case the soil does not lose enough moisture to achieve the optimum moisture content at the end of a period of 2 days, compaction shall be permitted at the available moisture content provided the same is not more than the plastic limit of the soil and also provided that the strength characteristics of compacted soil at available moisture content do not make the slopes of the embankment uneconomical. In such cases, the strength characteristics of compacted soil shall be obtained from appropriate laboratory tests and slope etc. redesigned and adopted. 4.8.4 In filling the approaches of bridges or the spandrels between small arches or culverts, earth filling shall be raised simultaneously with abutments/wing walls and compacted in layers to achieve the standards of compaction specified for the main body of the embankment. The layers in this case shall be 20 cm thick. 4.8.5 The compaction shall be done so as to achieve at least 98 % of the maximum dry density attainable at the corresponding moisture content of the soil, as determined by using heavy proctor test in accordance with IS: 2720 (Pt. VIII) – 1983, followed by field trials as per IS – 10379-1982, depending upon the type of soil. 4.8.6 The moisture content of each layer of soil at the time of compaction should be about 1 percent to 2 percent less than the optimum moisture (OMC)		

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	corresponding to IS: 2720 (Part VII). The soil spread in layers shall be thoroughly compacted over the entire width. Each layer shall be tested in the field for density and got accepted by the Engineer before the next layer is laid.	
4.8.7	The moisture content of the soil in the borrow pits and in the embankment after compaction will be determined as laid down in IS: 2720 (Part – II) 1983, except that the soil may also be dried through application of heat from a portable stove on an open pan.	
4.8.8	The optimum moisture content of the soil shall be determined by proctor compaction test as per IS: 2720 (Pt VII). This test shall be conducted for the soil, which is to be taken from borrow pits and whenever any change in the nature of soil is met with.	
4.8.9	The laboratory dry density of the soil being used in the embankment shall be determined as per IS: 2720 (Pt. VIII) – 1983.	
4.8.10	The control of compaction through number of passes of compacting equipment shall not be accepted as a substitute for moisture content and density determination as specified.	
4.8.11	Care should be taken during the compaction operation to slope the surface of the bank to drain water to minimise the absorption of water and to prevent ponding. The quality of compaction shall be determined by taking mean of the results of density of number of samples collected mostly on either side of the centre line at intervals of 10 m or so with a few taken at random near the two sides, in each layer. The mean value so obtained shall be equal to or exceed the minimum specified density mentioned above. However, in no individual test shall the density be less than the minimum values specified by more than 5% otherwise further compaction shall be done at the appropriate location.	
4.8.12	While compacting it should be ensured that there is a minimum overlap of 150 mm between each run of the roller.	
4.8.13	The Contractor shall be allowed to lay a further layer of soil only after the	

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compaction of particular layer has been found satisfactory and approved by the Engineer. 4.8.14 The top of the formation shall be finished to a slope of 1 in 30 away from the centre of the full width of the embankment (old and new in case of doubling). 4.8.15 In all above cases latest RDSO/Railway specification shall be followed. 4.9 <u>BLANKETING</u> 4.9.1 Blanketing materials to be used on the work will have to be approved by the Engineer before being brought to site. The contractor shall bring the bulk supply of blanketing material according to approved sample and stack the same on the finished formation where the quality shall be checked. After approval of the quality, the Contractor shall be allowed to spread the material and start compaction. The top surface of the formation must not be allowed to be damaged by the Contractor in the process of carting the materials for blanketing. Any damage done to the formation shall be made good with necessary compaction by the Contractor. 4.9.2 The blanketing materials shall be sand, quarry dust, gravel, other non – cohesive material/Murum. It should satisfy the following properties. 4.9.2.1 It should be coarse and granular 4.9.2.2 If it contains plastic fines, the percentage of such fines i.e. particles passing 75 micron sieve should be between 2 to 5%. If the fines are non-plastic, the same shall be between 8 to 12%. 4.9.2.3 Uniformity co-efficient i.e. D_{60} / D_{10} must be preferably above 7 but not less than 4. The co-efficient of curvature i.e. $S_{30} / (D_{60} \times D_{10})$ should be within 1 and 3. 4.9.2.4 In all above cases latest Railways/RDSO specification shall be followed. 4.9.3 The blanketing should generally cover the entire width of formation from shoulder to shoulder.		

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4.9.4 All the blanketing material should be compacted by mechanical means like appropriate type of rollers or plates vibrator of $\frac{3}{4}$ tonne capacity. Compaction should be at optimum moisture content, as determined by conducting heavy proctor test in accordance with IS: 2720 (Pt VIII) 1983 for maximum dry density at OMC + 2 %. The compaction shall be done to attain 98% of the maximum dry density obtainable at moisture content at which compaction heavy proctor test in accordance with IS: 2720 (Pt VIII) - 1983 followed by field trials as per IS: 10379-1982. Mean density of a number of samples will determine the quality of compaction in each layer. In no individual case shall the density be less than the minimum value specified by more than 5%. 4.9.5 The top of blanket shall be finished to a slope of 1:30 away from the centre of formation. Each layer shall be compacted to the desired density over the entire width commencing from both sides. There should be a minimum overlap of 150 mm between each run of the roller. 4.9.6 The Contractor shall establish laboratories at site with such equipment and personnel as adequate for checking the quality of the blanketing material as well as for checking the quality of compaction of the blanket. 4.10 <u>TURFING</u> 4.10.1 The turfing of banks shall not be commenced without the written permission of the Engineer. It will consist of soda/sarkanda not less than 100 m thick and 250mm square well beaten into the bank and the Contractor will be responsible for ensuring that the turf grow properly. In the even of its not doing so, he will re-do at his own expense such parts as have not grown. Before turfing is commenced the side slopes are to be dressed to the specified section. 4.10.2 Before the onset of monsoon suitable measures should be taken for the protection of the bank already formed against erosion of formation deep rain cuts and disturbances to the bank including the side slopes etc. 4.11 <u>EARTH WORK</u> 4.11.1 Area grading in railway siding shall be carried out as per relevant Area grading drawing. However necessary excavation and filling shall be carried		

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out for base formation below rail track, bridges, culverts, toe wall, retaining walls, drains other foundations etc 4.11.2 Clearing the site: 4.11.2.1 The site on which the structure is to be built as shown on the plan and the area required for setting out and other operations shall be cleared of all obstructions, loose stones, materials and rubbish of all kinds, stumps, brush wood, shrubs and other growth, roots being entirely grubbed up, cutting of all trees including sugarcane 4.11.2.2 All holes or hollows, whether originally existing or produced by the removal of loose stones or brush wood, shall be carefully filled up with earth well-rammed and levelled off upto the level of already filled or existing ground as directed. 4.11.3 Excavation: 4.11.3.1 Excavation shall be carried out mechanically or/and manually in accordance with lines, levels, grades, curves as requirement. And Shall include blasting, chiselling shoring, strutting, dewatering, protection and safety measure, disposal of excavated material etc. 4.11.3.2 Bottom of foundations shall be levelled both longitudinally and transversely on stepped, any of the excavation be carried down to a level below the required level, the Contractor shall fill in such extra excavation at his own cost with 1:4:8 ordinary grade concrete well rammed in position until it is brought up to the proper level; filling in with excavated material not being permitted for this purpose. The corners of the excavated pits shall be made true and square and all loose debris shall be removed to the satisfaction of the Engineer. Before any foundation concrete is placed the Engineer shall inspect the foundation trenches. If any, loose patches or pockets come to light on inspection, these shall be dug out as directed and filled and rammed with 1:4:8 ordinary grade concrete. Just before laying the foundation concrete all bottom of trenches shall be lightly watered and thoroughly rammed.		

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4.11.3.3 Blasting: No blasting shall be permitted for excavation of foundation even in rocky formation, unless permitted by the MSPGCL and subject to proper licenses and permission being obtained from the authorities concerned. 4.11.4 Filling: 4.11.4.1 All filling in and around the foundation, plinth and area levelling in and around the site of work shall be done from selected material from the excavation. in layers of 20cm. (compacted thickness) watered and well compacted as per railway norms. 4.11.4.2 Filling shall be done after the concrete or masonry in the foundation has fully set and it shall be done in such a manner as not to cause undue thrust on any part of the structure 4.12 <u>PLAIN & REINFORCED CONCRETE – ORDINARY GRADE & CONTROLLED GRADE</u> 4.12.1 General: 4.12.1.1 This item relates to the supply, preparation, placing and curing all concrete work in plain and reinforced portions of work referred to under respective item in the Schedule of Quantities. All concrete work shall be carried out in conformity with the latest edition of IS: 456. 4.12.1.2 Concrete for the purpose of these specifications is preferably controlled concrete. 4.12.2 All operations relating to mixing, placing and curing shall be subject to the approval of the MSPGCL and the Contractor shall provide unhindered access for this purpose for inspection and selection of samples. Testing shall be done in close liaison with the MSPGCL and method of testing shall generally follow the standard methods described in the relevant Indian Standard Specification		

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4.12.3 Materials: 4.12.3.1 All materials used in the work shall be new and of the qualities and standards specified in relevant IS code/RDSO norms/Railway standards 4.12.3.2 Materials falling to comply with these specifications shall be immediately removed from the works 4.12.4 Water: Water used both for mixing and curing shall be clean and free from injurious amounts of oil, acids, alkalis, salts, sugar or organic materials, or other substances that may be deleterious to concrete or steel. The Ph value of water shall not be less than 6. 4.12.5 Cement: 4.12.5.1 Unless otherwise specified, cement shall be ordinary Portland cement conforming to IS: 8112, of approved make and brand. 4.12.5.2 It shall be stored in a dry place in regular piles not exceeding 10 bags high and in such manner that it is adequately protected from moisture and contamination. 4.12.5.3 Different consignments shall be stacked separately, so that they can be used in the order in which they are received. 4.12.6 Sand: Sand shall be coarse, clean river sand. The sand shall be of siliceous material, sharp, hard, strong or durable and free from clay, dust, dirt, alkali, organic material, deleterious matter, lumps etc., in excess of the limits given in Table-I of IS: 383. Sand shall be well graded and conform to either grading Zone-II or grading Zone-III, defined in Table-II, Clause-IV of IS: 383] Sand shall be washed and dried if so required without extra charges.		

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4.12.7 Coarse aggregate: Coarse aggregate shall be from sources approved by the Architect. It should consist of hard, strong, durable and angular particles and shall generally conform to the requirements of IS: 383. Coarse aggregate shall be well graded and shall be selected from the standard grading given in IS: 383. Maximum size of coarse aggregate for use in reinforced concrete work shall be limited to (20mm or ¾"). For use in massive reinforced concrete members having sufficiently wide spacing of reinforcement use of 40mm (1.1/2") size graded aggregate may be permitted by the MSPGCL Normal aggregate shall have specific gravity (saturated surface-dry basis) not less than 2.6 and shall be determined in accordance with IS: 2386 (Part-III). The coarse aggregate shall be washed if required by MSPGCL and only clean, fresh water shall be used for this purpose. 4.12.8 Admixtures: No admixtures shall be used in the concrete unless approved by the MSPGCL. Approval shall be based on the evidence that with the passage of time neither the compressive strength of concrete is reduced nor are other requisite qualities of concrete and steel impaired by the use of such admixtures. Admixtures containing Calcium Chloride or similar salts shall not be used under any circumstances. 4.12.9 Controlled concrete: 4.12.9.1 All concrete used for structural application shall be controlled grade concrete. The concrete shall be designated by specified characteristic compressive strength of 150mm cube of 28 days in N/sqmm. 4.12.9.2 Mix proportions used for a particular designation of concrete shall be based on the mix design carried out on samples of materials proposed for use in the works. The design mix shall be got approved from MSPGCL well in		

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advance 4.12.9.3 Preliminary tests will have to be made if the source of the materials change or any changes in mix proportions are to be made in the course of construction. 4.12.9.4 Minimum cement content shall be as specified. 4.12.9.5 All controlled grade concrete shall be compacted by mechanical vibration. 4.12.10 Preliminary test: 4.12.10.1 The cube strengths of concrete as observed during the preliminary tests carried out under laboratory condition shall have a minimum value of as mentioned in IS: 456-2000. 4.12.10.2 Test specimens for works cube tests shall be secured, prepared and tested generally in accordance with IS: 516. 4.12.11 Water-cement-ratio and workability: The quantity of mixing water shall be controlled throughout the works. At least one determination of moisture content shall be made every day, preferably just before commencement of the concreting work. 4.12.12 Batching and mixing: All materials shall be batched by weight, except water, which may be measured by volume in graduated containers. Cement shall be weighted separately. The accuracy of all weighing devices shall be maintained within (one) 1% and the devices shall be checked periodically as directed by the MSPGCL. The weigh-batching machine shall be Healthy Gresham or of other approved make. Cumulative batching of materials may be permitted provided the method of measurement gives the above specified accuracy. All machines and methods used for batching shall be subject to the approval of the MSPGCL.		

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4.12.13 Compaction: All concrete shall be thoroughly compacted by means of mechanical vibration. The MSPGCL shall remain the final deciding Authority of the type of Vibrators to be used for any particular case. As far as practicable, only internal vibration shall be used for compacting concrete, unless specified otherwise. Internal vibrators of high frequency type shall generally conform to the requirements of IS: 2505 and shall be preferably of electric or pneumatic power driven type. Use of immersion vibrators for compacting concrete shall generally follow recommendation of IS: 3558. 4.12.14 Curing And Protection The concrete shall be initially protected from damage on account of impact, undue pressure, excessive heat, drying winds and rain, etc., by covering with wet sacking, hessian or similar absorbent materials soon after the initial set. After the final set, the concrete shall be kept continuously and preferably by continuous spraying with water or by ponding. 4.12.15 Failure to meet specification requirement and load testing of concrete structures. 4.12.15.1 Concrete structures constructed under this specification shall meet all applicable requirements as regards appearance, dimension, strength and durability (particularly concrete cover to reinforcement). In the event of the failure of these structures to meet the requirements, the Engineer may reject these structures and order their removal and re-building all at contractor's cost or accept the same subject to satisfactory performance under load test conducted generally as per the requirement of IS-456. The cost of conducting such tests as well as provision of suitable electrometers for measurement of deflection shall be borne entirely by the contractor. 4.12.15.2 As and alternative to load tests, the taking out of coarse from concrete in accordance with IS-1139 and testing the same in accordance with IS-516 and using the test result in conjunction with structural analysis of this structure may also be required by the architect. The cost of taking out coarse samples and testing the same shall be borne by the contractor. The contractor must		

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provide for hammer testing equipment, which shall always be kept at site. 4.13 <u>MASONRY</u> 4.13.1 Stone Masonry 4.13.1.1 Material: Stones used in masonry shall be got approved from Engineer in charges. The stones shall be sound, durable, free from flaws, cracks, injuries, vane sand holes, cavities, patches of soft loose materials and shall be of uniform colour and texture. No stone shall taper to a point. The stone shall be kept free from dirt, oil, grease or any other injuries material, which may attack the stone or mortar or prevent adhesion of mortar. Stones with skins shall not be used. Generally, the stone should not contain crypto crystalline silica, or chert, mica or any other deleterious material like iron oxide, organic impurities etc. and the type shall be as specified. 4.13.1.2 Size Stone Masonry (a) General (i) This specification refers to providing materials and constructing coursed rubble masonry in foundations, plinth and superstructure. Stones (ii) Different categories of stones such as face stone, backing stone, hearting stone, headers, quoins etc. shall be collected in advance to suffice at least for a week's requirements and shall be stacked separately category-wise. (b) Item To Include (i) Un Course rubble masonry laid in cement mortar of specified proportion, built in any position to any height or depth and to lines, levels, curved and batters shown on the plans or as ordered by the MSPGCL including quoins, headers etc., and striking joints and curing.		

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(ii) Erecting and removing all scaffolding, ladders and use of plant required for execution of the item, safety of the labour and inspection of the work including compensation for any injury, damage etc. De-watering to allow construction in the dry and proper setting of masonry. Clearing the site round the masonry. (iii) All labour, use of tools, materials and other items incidental to satisfactory completion of the item.		
5.0	<u>GENERAL P – WAY WORKS</u>	
5.1	All works – linking of Railway tracks, assembly, laying and linking at points and crossings, ballasting, through packing and connected works shall confirm to the various instructions and specifications stipulated in “Indian Railways Permanent Way Manual – 1985” with up-to-date correction slips, IRS drawings, track manual and other relevant Railway Codes/Manuals.	
5.2	The proposed sidings shall be mostly laid with 60/52 Kg rails on PSC sleepers in single rails / 3 rail panels.	
5.3	While ballasting and track linking, care should be taken to prevent any damage to the formation, including blanketing and to prevent blocking of side drains. The contractor should make good such damages.	
5.4	<u>TURN-OUTS:</u> The Turn-outs 1 in 8 ½ and 1 in 12 assembly i.e. switch assembly, lead portion and crossing assembly shall be laid by 60 Kg rails to the Indian Railway Standard PSC sleepers with a ballast cushion.	
5.5	The operation of dumping ballast lifting and packing should continue till such time the track attains final level and shape of ballast section.	
5.6	Rails shall be connected by means of pair of fishplate in the first instance only with two bolts and nuts, one in each rail. The fishing planes of the fishplates and rail are to be greased. Grease shall be supplied by the Contractor. Cutting of rails where necessary, shall be done to suit squaring	

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of joints. 5.7 Paints mark shall be made on the rails showing the spacing of sleepers 5.8 Full quantity of small fittings is to be fitted completely after linking the track to correct alignment. 5.9 The track so linked shall be aligned correctly to the alignment pegs given or as directed by Engineer till it takes correct position and the remaining two bolts to be fixed in fish plated joints. 5.10 During the above process, alignment, adjustment and squaring of sleepers, gauging shall be done by contractor. Cross-level and longitudinal levels should be checked and rectified. 5.11 Greasing of fishplates, fish bolts and nuts with lubricating oil and graphite grease to be supplied by the contractor includes cleaning fishing planes of rail ends with wire brush. 5.12 The works should be executed in a workman like manner to the satisfaction of the Engineer – in – Charge at site. The contractor will be primarily responsible for Safety of traffic that moves on opened up track, notwithstanding the presence of MSPGCL representative at site. 5.13 Good quality track ballast as per specification and of approved quality shall be supplied and stacked on cess of formation or at the toe of bank or on top of cutting or at suitable places. 5.14 The contractor shall transport the ballast it on top of the blanketing surface /formation and spread it in the standard profile. After spreading, the ballast profile should be consolidated. 5.15 The thickness of the finished ballast spread should be as per railway norms, and the layer should be dressed and boxed to proper profile and dimensions 5.16 While spreading the ballast on the finished formation, care shall be taken that the formation/blanketing surfaces is not damaged. In no circumstances, vehicular carts/trucks shall be permitted to ply on the		

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finished blanketing/formation. In case some damage to the surface is done, the Contractor shall repair the damages before spreading the ballast. 5.17 Any sleeper which have shifted from correct spacing or gone out of square shall be moved back and square after loosening the fastenings. The fastenings shall be tightened again after squaring. 5.18 The track shall be slewed to correct alignment by sighting along the railhead of the base rail. It should be ensured that track does not get lifted in the process of slewing. 5.19 The track shall then be given a final packing. For this, sighting shall be done along the base rail and any dip or low joint lifted correctly and packed, attending also to the packing of adjacent sleepers. After the base rail is thus packed for two or three rails length, the cross level should be checked and the opposite rail lifted wherever necessary and sleepers under the rail seat packed. 5.20 The joint and shoulder sleepers shall be repacked and cross level adjusted at the time each through packing of sleepers. 5.21 Oiling and greasing hand-operated points will include adjusting the point rodding and fixing hand lever frame, where found necessary by means of spikes with the sleepers for smooth operation of the point and adjusting the opening between tongue rail and stock rail. For any bent tongue rail, if required, Jim-crowing may have to be done and the gap adjusted as required. Oil and Grease shall be supplied by the Contractor 5.22 All the elastic rail clips should be thoroughly cleaned. Grease should then be applied on Central leg of the ERC and eye of MCS Inserts and then the clip should be driven at the time of assembly. 5.23 At some locations work is required to be carried out under running traffic/block. During the work under running traffic/block, contractor should arrange for protection of track and displaying the signals as per rules of Indian Railways.		

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5.24 <u>CONTRACTOR'S TOOLS AND PLANTS AND CONSUMABLES ETC.</u> All the P. Way tools such as (a) Rail tongs, (b) Crow bars (c) Fishing spanners, (d) Hammers (e) Keying hammers (f) Cotter splitters (g) Shovels (h) Mortar Pans (i) Beaters, (j) Track Lifting Jacks, (k) Gauges, (l) Level Board (m) Spirit levels (n) Cant Board (o) Expansion liners (p) Wooden Squares (q) Steel Tape (r) Wire brushes (s) Cotton Waster (t) Rake Ballast (u) Soap as required for the work shall be arranged by the contractor. 6.0 <u>DEEP SCREENING OF BALLAST</u> 6.1 <u>SCOPE OF WORKS.</u> 6.1.1 Deep screening of ballast shall include the following items of work: - 6.1.1.1 Removing entire stone ballast including muck lying in the track between and under the sleepers and on the shoulders. The depth below the bottom of the sleepers up to which the ballast and the muck should be dug up will be specified by the Engineer-In charge of work. This will normally be 30 cm.		

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6.1.1.2	Screening the ballast with screens of approved design to separate the clean ballast from muck, putting back clean ballast into the track and disposing of the muck as directed by the Engineer-In charge. The muck must be used for cess and slope repairs wherever necessary as directed by the Engineer-In charge but should not be thrown on slopes of cuttings or inside drains and catch water drains. Muck will be defined as particles passing through 30 mm sieve.	
6.1.1.3	Adequate number of wooden blocks of size 45 x 25 x 13 Cm .or as required as per site conditions to support the track for passing trains while the work is in progress shall be provided. These works shall be contemplated on the first day, for the length taken up for screening. No sleepers will be left unsupported at any stage.	
6.1.1.4	Aligning and levelling the track and kutcha packing underneath sleeper with the screened ballast adequately so as to pass trains at 20 Kmph. These works shall be completed on the first day, for the length taken up for screening.	
6.1.2	"Spreading and boxing of ballast" will include the following items of works.	
6.1.2.1	Pulling all the ballast on the formation on to the track and boxing it to approved profiles. Proper template and dog lines should be used. The width at the shoulder should be as directed by the Engineer-In charge which will normally be not less than 3.51m Metres (11'6") not more than 3.81m (12'6") for B.G.	
6.1.2.2	No ballast should be wasted on the slopes of banks or in cuttings. All ballast from the slopes should be picked up & put in the track as directed by the Engineer-In charge.	
6.1.3	Repairs to cess should be carried out with the muck removed after screening. The cess be levelled & dressed to approved profile.	
6.1.4	Speed Restrictions – Speed Restrictions as required for safety of traffic will be arranged by the Engineer-In charge. No work on the track should be commenced until the	

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Permanent Way Inspector of the Railways has imposed the speed restrictions and erected speed indicators. After speed restriction is imposed, the contractor shall progress with the work in a systematic manner, long length of tracks under speed restriction should be avoided. Caution watchman as necessary during day and night should be arranged for by the contractor. 6.1.5 Safety Hazards – 6.1.5.1 The works should be executed in a workman like manner to the satisfaction of the Engineer-Incharge. The Contractor will be primarrily responsible for the safety of traffic that moves on the opened up track, not with standing the presence of Railways supervisory staff at site. 6.1.5.2 In the event of any accident at the work spot, a departmental inquiry will be held by the Railway. If it is established that the accident occurred wholly or partially due to any act amounting to negligence on the part of the contractor shall render himself liable for all damaged and also legal prosecution if loss of life is involved. 6.1.6 Contractors supervisory personnel. 6.1.6.1 The contractor shall employ and post at site a technical supervisor who should adequately qualified and well experienced in execution of permanent way works. The name, particulars of technical qualifications and record of experience of the supervisor employed should be advised to the Engineer-In charge. If in the opinion of the Engineer-In charge the supervisor is not fit to be in charge of the work, he should be forth with replaced. In this matter the opinion of the Engineer-Incharge shall be final and binding on the contractors. 6.1.6.2 No work on the track should be done unless and until the contractor technical supervisor is at site.		

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6.1.7 Progress of work.

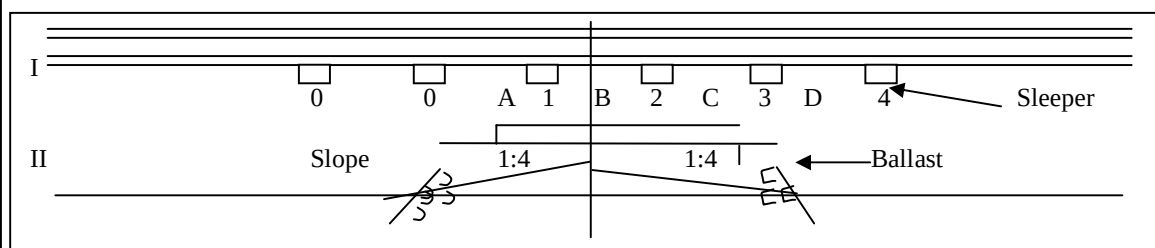
6.1.7.1 The progress of work shall be achieved by the contractor as directed by Engineer-In charge or his representative with sufficient labour in a systematic way, to keep pace with the relaying and to keep the length of speed restriction to the minimum.

6.1.7.2 If the works are stopped or delayed due to shortage of material or some other reason on owners account, the contractor will have no claim for any compensation whatsoever on account of such delay or stoppage of work.

The Contractor may be required to start the work from any location in the section according to the need of Owner and as directed by the Engineer. The Contractor is bound to execute the work accordingly. The stretch where work is to be done & the direction of progress will be given by the Engineer.

6.1.8 Modus operandi for deep screening.

6.1.8.1 Procedure for deep screening ballast and providing proper cushion without a traffic block.



6.1.8.2 Organise the work of ballast screening party in such a way that at the end of each working day, there is no length of unscreening track left between screened length of track. At the same time, it should be ensured that, when ballast is being excavated from underneath the sleeper (as per procedure detailed below) there are at least four sleeper between it and the next sleeper being simultaneously and similarly worked on.

6.1.8.3 Remove ballast from space 'A' & 'B' on either side of 1st sleeper '1' down to final formation level and provide wooden blocks to support the rail for passing trains.

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6.1.8.4 Remove ballast, from 1st sleeper down to final formation level. 6.1.8.5 Screen ballast place it back under 1st sleeper and pack it. 6.1.8.6 Remove wooden blocks from space A. 6.1.8.7 Remove ballast from space 'C' down to formation level and after screening, place in space 'A' up to bottom of sleeper the balance may be taken out side the track and screened. Support the rail in space 'E' with wooden blocks. 6.1.8.8 Remove ballast from under 2nd sleeper '2' down to formation level. 6.1.8.9 Remove ballast from space 'D' down to formation level and after screening place in space 'B' up to bottom of sleeper the balance may be taken outside the track and screening. The wooden blocks should be removed from space 'B' and placed to support the rails in space 'D'. 6.1.8.10 Remove ballast from under sleeper '3' and so on till the whole rail length is provided with screened ballast up to level of bottom of sleepers. 6.1.8.11 Lift track to provide additional cushion where required. 6.1.8.12 Pack the track in the final position and then provide boxing. 7.0 <u>TRACK BALLAST</u> 7.1 <u>SCOPE:</u> These specifications will be applicable for stone ballast to be used for all types of sleepers on normal track, turnouts, tunnels and deck slabs etc., on all routes. 7.2 <u>DETAILED SPECIFICATIONS</u> 7.2.1 General (a) Basic Quality:		

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	Ballast should be hard, durable and as far as possible angular along edges/corners, free from weathered portions of parent rock, organic impurities and inorganic residues. (b) Particle Shape: Ballast should be machine crushed and cubical in shape as far as possible. Individual pieces should not be flaky and should have generally flat faces with not more than two rounded / sub-rounded faces. (c) Physical Properties: Ballast sample should satisfy the following physical properties in accordance with IS:2386 Pt.V-1963 when tested as per the procedure given in Annexure – 1&2 for BG Track. Aggregate Abrasion Value - 30% maximum Aggregate Impact Value - 20% maximum * Relaxable up to 35% & 25% respectively on techno-economic grounds by owner. (d) The shape parameter “Flakiness Index” as determined in accordance with IS: 2386 Pt.I-1963 following procedure given in Annexure-3 should not be more than 50%. The “Water Absorption” tested as per IS: 2396 Pt.III-1963, following procedure given in specification should not be more than 1%.	
7.3	<u>SIZE AND GRADATION</u>	
7.3.1	Ballast should satisfy the following size and gradation :	
	(a) Retained on 65mm sq. mesh sieve - 5%	
	(b) Retained on 40mm sq. mesh sieve - 40% to 60%	

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(c) Retained on 20mm sq. mesh sieve - Not less than 98% for for machine crushed. Not less than 95% for hand broken. 7.3.2 Method of Sieve Analysis (a) The screens for sieving of ballast shall be of square mesh and shall not be less than 100 cm in length, 70 cm in breadth and 10 cm in height on sides. (b) While carrying out sieve analysis, the screen shall not be kept inclined, but held horizontally and shaken vigorously. The pieces of ballast retained on the screen shall not be pushed through the screen openings. (c) The percentage passing through or retained on the sieve shall be determined by weight only. 7.4 <u>SAMPLE AND TESTING</u> 7.4.1 On acceptance of tender, three samples in sealed jars submitted by the successful tenderer will be kept in Owners office will provide visual guidance to check uniformity of supply. However, fulfilment of size, gradation, shape and physical properties shall be criteria for acceptance of supply in the field. Rest of the samples submitted at the time of tender can be disposed off after finalization of the tender. 7.4.2 In order to ensure supply of uniform quality of ballast, the following norms shall be followed in respect of sampling, testing and acceptance. 7.4.2.1 On supply of the first 100 cum, the tests for size, Gradation, Abrasion Value, Impact value, Flakiness Index and Water Absorption shall be carried out. Further supply shall be accepted only after his ballast satisfies the specifications for these tests.		

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7.4.2.2 Subsequent tests shall be carried out as follows:-			
	Supply in Stacks		Supply in Wagons
	For each stack of volume less than 100 cum.	For each stack of volume less than 100 cum.	
Size and gradation test			
Testing Frequency	One for each stack	One for each stack	One for each wagon
Size of sample	** 0.027 cum.	**0.027 cum for every 100 cum. or part thereof.	** 0.027 cum.
Abrasion Value, impact value, Flakiness Index and Water Absorption Test @	One for every 2000 cum		
Testing Frequency			
Size of Sample	45 Kg.		
** This sample should be collected using a wooden box of internal dimensions 0.3 m x 0.3 m x 0.3 m from different parts of the stack. These tests shall be done for the purpose of maintaining quality during supply. In case of the test results not being as per the prescribed specifications at any stage, further supplies shall be suspended till suitable corrective action is taken and supplies ensured as per specifications. The above tests may be carried out more frequently if warranted at the discretion of owner authority.			
7.4.2.3	If the quality of ballast is noted to have changed during supply, as revealed by visual comparison with the approved sample, the tests shall be redone to confirm that it satisfies the properties as per railway norms. The approved		

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sample of the changed supply should be preserved, for future checks in three sealed transparent jars jointly signed by the contractor and owner Authority. 7.5 All tests for Abrasion Value, Impact Value, Flakiness Index and Water Absorption conducted subsequent to award of contract shall be carried out by the contractor. 7.5.1 Aggregate, Abrasion Value The abrasion test for track ballast shall be carried out using Los Angeles machine as per specification based on IS: 2386 part IV - 1963) 7.5.2 Aggregate Impact Values The Impact value test for track ballast shall be carried out using Impact testing machine as per specification based on IS: 2386 part IV - 1963) 7.5.3 Flakiness Index (Based on IS"2386 Part I – 1963) The flakiness index of an aggregate is the percentage by weight of particles in it whose least dimension (thickness) is less than three-fifth of their mean dimension. 8.0 <u>WELDING OF RAILS</u> 8.1 <u>WORK SPECIFICATIONS</u> The work shall be carried out conforming to IRS Specifications. lay down the steps to be taken for production of a satisfactory joint by AT welding. Two types of AT welding processes are followed for welding of Rails namely conventional welding and SKV welding. As a matter of policy SKV welding (short preheat welding) is adopted now on all Indian Railway for Alumino Thermic Welding and the same shall be followed for this project.		

8.2 SELECTION OF RAILS TO BE WELDED

8.2.2 Rails

8.2.2.1 Characteristics of SKV welding for 52 kg rail 90 UTS

(i)	Width	42 – 44 mm	43 – 46 mm	45 – 46 mm
(ii)	Thickness	6 – 9 mm	6 – 9 mm	7 – 9 mm

(a)	Rail gap	:	25 ± 1 mm		
(b)	Pre-heating time	:	4.5 minutes		
(c)	Tapping time	:	20 ± 3 sec		
(d)	Type of mould	:	Pre-fabricated CO ₂ mould		
(e)	Heating technique & device	:	Top heating with Compressed air-petrol		
(f)	Welding technique	:	SKV process		
(g)	Mould waiting time	:	4.5 – 5.5 minutes		
(h)	Chipping device	:	Double cutter weld trimmer		
(i)	Weight of portion	:	13.25 Kg ± 2%		
(j)	Weld metal dimensions :-	:	Web	Foot	Bottom
(i)	Width	:	39-40 mm	44-48 mm	46-50 mm
(ii)	Thickness	:	8 – 9 mm	8 – 10 mm	6 – 9 mm

- 8.3.1 Clause 14 to 16 of IRS/T-19/1984 pertaining to execution, guarantee and acceptance of test shall be strictly followed. However, special attention is invited to Clause 16.2 pertaining to USFD testing of the weld which is read as under :

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All the fusion-welded joints shall be got ultrasonically tested by the contractor as per the directions of the Engineer-in-charge before acceptance as per the procedure for ultrasonic testing of thermit welded rail joints. The testing shall be arranged by the contractor as early as possible but before the welding team leaves the welding site. All the joints which are found to be defective on the report submitted shall be cut and re-welded by the contractor free of cost. Such re-welded joints shall also be tested ultrasonically and if found defective, cut and re-welded free of cost. 8.3.2 The contractor will be responsible for the welded joints remaining satisfactory for the guarantee/maintenance period as provided in the specification and the performance guarantee will be kept open for 2 years. For every joint falling during the guarantee period, 4 times of the cost of welding at the accepted rate of the contract will be recovered from contractor's dues, if the joint is not re-welded by the contractor. 8.4 Thermit portions suitable for the welding technique for the type of rail section and its rail chemistry shall be arranged by the contractor. Only such thermit portions shall be used by the contractor which have been inspected, passed and sealed by RDSO. The Engineer-in-charge or any Supervisor authorized by him can check at any time, the place or storage of welding portions, to satisfy himself that only RDSO certified portions are being used. 8.5 The contractor shall provide to each welding party metallic straight edges of 1 metre and 10cms length and 1 set of feeler gauges in units of 0.1mm to 2mm and all other equipment viz Grinding machine along with grinding stones/files/pre-fab moulds etc., required for completion of work in workman-line manner. 8.6 The contractor carrying out the work shall be the approved one by RDSO for the welding technique and type of rails sections. His staff under the category of supervisor duly certified by the RDSO and the welder duly certified by RDSO only shall be permitted to carry out the work. Provisions of Part C of IRS Specifications T-19-1984 shall be strictly followed. 8.7 The welding work shall be carried out by the self contained units at each location so that all type of works concerning each points i.e. lifting, leveling, aligning, packing, moulding, welding, chipping and final finishing shall be done by contractor.		

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8.8	In case of welding on the cess of track, rails spreading, creating gaps, leveling, alignment etc., shall be done by the contractor. The contractor shall be responsible for ensuring that the rails are brought to correct alignment and level before welding.	
8.9	The contractor shall be responsible for proper filling and grinding of the joints and their finish to the specified tolerances after welding as given below :	
8.9.1	Vertical alignment :	
	Variation not more than + 1.0 mm to – 0.0 mm measured with 1.0m straight edge.	
8.9.2	Lateral alignment :	
	Variation not more than plus or minus 0.5 mm measured with 1.0 m straight edge.	
8.9.3	Head finish one side :	
	Plus or minus 0.3 mm on the gauge face side of the rail head measured with 10.0 cm straight edge.	
8.9.4	Head finishing on the top table surface :	
	+ 0.4 mm to – 0.0 mm measured with 10.0 cm straight edge.	
8.9.5	All weld collars are required to be painted in terms of RDSO letter No.M&C W/I dt:12/8 as under :	
8.9.5.1	Apply one coat of Ready Mixed paints, brushing bituminous, black, lead free, acid, alkali, water and chlorine resistant to IS-9862-81 on the welded area and one foot on either side of the joints.	
8.9.5.2	After 8 hours drying, apply a second coat of the same paint to IS-9862-81.	
8.9.5.3	Painting should be carried out by brush.	

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8.10	The contractor shall ensure to protect the work against wind and weather during the actual execution of the work.	
8.11	The contractor shall arrange the necessary equipments along with qualified staff approved/authorized by RDSO for carrying out requisite tests specified in IRS Specifications.	
8.12	<u>PREPARATION OF RAILS</u>	
8.12.1	Contractor shall remove kinks and twists in the rail particularly within 2 metres of each joint and other works and ensure that necessary defects have been removed before commencing the welding work.	
8.12.2	In case of released serviceable rails, the same shall be free from excessive wear and corrosion. Rails with matching wear shall be welded together. Maximum vertical wear shall not be more than 6 mm and maximum reduction in head with not more than 6 mm in the case of 60/52 kg./m rails. The released rails should have a residual life of about 10 years and ultrasonically tested before welding.	
8.12.3	The rail ends shall be cropped as marked by the Engineer-in-charge to remove any battering or hog effect at the ends before welding.	
8.13	During the course of welding in situ, the contractor shall be responsible for execution of following, but the contractor shall ensure compliance as per Specification before commencing welding work.	
8.13.1	Creation of required amount of gap for welding.	
8.13.2	Shifting of sleeper for inserting wooden blocks/wedges if found necessary for welding.	
8.14	<u>TESTING OF JOINTS</u>	
8.14.1	The USFD testing as per Clause No.16.2 of IRS specification No.T-19/84 is to be arranged by the contractor from the approved/ authorized agency. The testing shall be completed as early as possible and welding team shall not leave the welding site till testing is completed. A test report shall also be submitted for record.	

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8.14.2

Transverse testing of welding test sample

The test weld sample, not less than 1.5m long with thermit weld in the centre shall be placed on cylindrical / semi cylindrical supports having 30-50 diameter on a span of 1.0 m for 60/52 kg/m rail. With a transverse load of 150/75 MT applied gradually at the weld at the centre, a minimum of 20/15 mm deflection must be produced without showing any sign of cracking or failure. This test shall be conducted on 1 out of 1000 welded joints.

8.14.3

Hardness Test

Brinell Hardness Test shall be conducted at the welded joint and at the Heat Affected Zone (**HAZ**). The average hardness number determined shall be as under:

(a)

Weld metal

:

BHN of Parent Metal + 20

(b)

HAZ

:

BHN of Parent Metal + 20

(c)

Rail Metal elsewhere

:

= 230 BHN

8.14.4

Test sample shall be taken after every 50 welded joints. The contractor shall arrange for the transport of these joints at his own cost, getting the sample welds tested and shall also bear the testing cost. In case any test joint/joints fails/fail, the guarantee of two years shall be extended for a further period of one year for the particular km/kms representative joints or which fail / fails.

8.14.5

If during the process of welding certain joints are found defective or do not conform to the required standard and are rejected.

8.15

STEEL CHANNEL SLEEPERS

8.15.1

Fabrication of Steel Channel Sleepers

8.15.1.1

The work includes cutting of steel to size and shape, drilling, assembling, welding, riveting, bolting, milling, grinding, galvanizing and performance of any other activity required in manufacturing of steel channel sleepers

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and supply of fittings and fixtures excluding rubber/elastomeric pads. 8.15.1.2 Steel Channel Sleeper and all steel fittings shall be provided as per RDSO drawing references mentioned in table enclosed. 8.15.1.3 M.S. Packing plate of suitable thickness should be welded only at bottom of flange of individual channel of channel sleeper to maintain rail level. 8.15.1.4 The pad plate should have two strips welded, one at either end to avoid lateral movement of channel sleeper. 8.15.1.5 Galvanizing of entire fabricated channel sleeper along with all M.S. Fittings i.e hook bolts, clips, nut bolts etc shall have to be done by dip galvanizing method as per standard specification of railway. 8.15.1.6 No drilling, cutting, punching or exposing the bare metal etc will be permitted after galvanizing. 8.15.1.7 For payment purpose, actual weight of finished sleeper with all steel fittings will be considered. This should however not vary more than +/- 5% of nominal weight of sleeper shown in/calculated from standard/approved drawings. 8.15.1.8 Fittings have to be supplied at site/.depot as directed by engineer in-charge as per Table below. 8.15.1.9 All nuts should have self locking screw threaded insert (Stainless Steel Helisert). No extra payment shall be made for this. 8.15.2 Elastomeric Pads 8.15.2.1 For plate girder/riveted plate girder/through girder bridges requirement of one sleeper will be (i) Elastomeric Neoprene pads of same design as Grooved rubber pads 10 mm thick 2 Nos (ii) Grooved rubber pads 6 mm thick (for guard rails) 4 Nos, (iii) Elastomeric pads as per Drg No.RDSO/B-1636/1/R2 8.15.2.2 Different type of elastomeric pad is required for welded plate Girder /through girder bridges and under slung bridges. It should be supplied as		

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per type of bridges. 8.15.2.3 The elastomeric neoprene pads of grooved rubber pads design and elastomeric pads shall have to be procured from RDSO approved suppliers with prior approval of Engineer in charge. Contractor shall have to submit copies of challan and bill for such procurement. Elastomeric Neoprene shall have to be used in place of rubber. 8.15.3 Removal of Track for fixing channel sleeper 8.15.3.1 Suitable block will be arranged for execution of these works on running traffic including necessary charges of railway part borne by the contractor. 8.15.3.2 Wooden sleepers/bridge timbers may have different spacing on different bridges. 8.15.3.3 Length of dismantled track will be calculated bridge wise from end of girder on one abutment to end of girder on other abutment. Nothing extra will be paid for closure of the day's work on bridge. 8.15.3.4 Contractor shall be responsible to make suitable arrangement for making up the difference in level of track on wooden sleepers and steel channel sleepers. In case of closure of days work on bridge, suitable ramp shall be provided by contractor to the satisfaction of Engineer in charge. 8.15.3.5 Released material from dismantled track shall have to be transported and neatly stacked as per instruction of Engineer in charge. 8.15.4 Fixing of Steel Channel Sleepers 8.15.4.1 The fixing includes providing channel sleepers with all it's fittings on the flanges of steel girder bridges/rail bearers & linking & fixing running rails and guard rails over steel channel sleepers so fixed with its fittings and fixtures. 8.15.4.2 Suitable block shall be arranged for execution of these works on running traffic including necessary charges of railway part borne by the contractor 8.15.4.3 The running rails and guardrails of any size for the bridges shall be		

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supplied at bridge approaches for fixing over channel sleepers. 8.15.4.4 If the track is fish plated track then rails shall be supplied with necessary holes for making joints and with fish plates, bolt etc complete. However, if the track is welded joint track, contractor has to leave required gap between two rails for welding as per instruction of Engineer in-Charge at the site of work. 8.15.4.5 Fixing of grooved rubber pad and elastomeric pad should be done with contractor's epoxy adhesive approved by Railway. 8.15.4.6 The entire top surface of the girder on which channel sleeper rests shall be painted with one thick coat of red lead (confirming to IS:102). 8.15.4.7 Track geometry shall confirm to parameters of mainline track of Group A route irrespective of classification of route on which bridge is located.		

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<u>TABLE</u> Reference of RDSO Drawing for Normal Channel Sleepers				
Sr. No.	Description of parts	Drawing No.	Specification	Nos. per sleeper
1.	Channel sleepers (duly galvanized)	RDSO/B-1636/2	IS:2062-1975	1
2.	MS canted bearing plate (duly galvanized)	RDSO/T-5155	IRS/T-5 1965	2
3.	MS clip (outer) duly galvanized	RDSO/T-5157/5197	IS-226 1962	2
4.	MS Clip (inner) duly galvanized	RDSO/T-5158	IS-226 1962	2
5.	Annular Cap (duly galvanized)	RDSO/T-5159/5198	IS-226 1962	4
6.	T-Head bolt & nuts with self-locking screw thread insert (stainless steel helisert) (25 mm x 120 mm) duly galvanized.	RDSO/T-5160	IRS/T-10 1968	4
7.	Tapered washer (for guard rails 52 kg) duly galvanized	RDSO-T-5161/5162 (90R)	IS-226 1962	4
8.	Tapered washer (for guard rails at top channel flange) duly galvanized	RDSO/T-5162/5200	IS-226 1962	4
9.	Bolts & nuts (for guard rails) duly galvanized	RDSO/T-5164	IRS/T-10	4

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Sr. No.	Description of parts	Drawing No.	Specification	Nos. per sleeper
10.	Single coil spring washer (4 Nos for rail clip and 4 Nos for guardrail (duly galvanized)	RDSO/T-10773	IS-3063 1972	8
11.	8 mm thick plain washer for inner rail clip (duly galvanized)	Suitable	IS-226 1962	2
12.	Tapered split pin for 22 mm dia hook bolt (duly galvanized)	Suitable	--	8
13.	4 mm dia split pin for 22 mm dia hook bolt (duly galvanized)	Suitable	--	2
14.	Elastomeric Neoprene pads of grooved rubber pad design 10 mm thick for main nail	RDSO/T-5156/5199	IRS for 10 mm thick grooved rubber pad (provisional 1989) Elastomeric Neoprene to be used in place of rubber	2
15.	Grooved rubber pad 6 mm thick for guard rail	RDSO/T-51632	IRS for 6 mm thick grooved rubber sole plate (provisional 1987)	2
16.	Elastomeric pad of size (F-20) x 25 x 330	RDSO/B-1636 / I/R2	IRS specification for 5 th nylon chord reinforced elastomeric pad	2

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Sr. No.	Description of parts	Drawing No.	Specification	Nos. per sleeper
			(provisional 1992)	
17.	Single coil spring washer for 22 mm dia. Hook bolt (duly galvanized)	RDSO/B-1636/I/R2	IS:3063-1972	2
18.	Rubber piece 25 x 12.5 x 5 mm for TEE head bolt.	RDSO/T-5160	IRS-T-37-1982	--
19.	Hook bolt & nuts with self locking screw thread insert (stainless steel helisert) 22 mm dia with single coil spring washer and tapered split pin (duly galvanized)	RDSO/B-1636 /1/R2	--	2
20.	Any other fittings or fixtures required for complete fixing of channel sleepers	--	--	--

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9.0 <u>OVERHEAD EQUIPMENT (OHE) WORKS</u> 9.1 <u>GENERAL</u> 9.1.1 Introduction This part of specification contains general technical and other specifications for design and erection of complete 25KV AC 50 Cycle single phase traction overhead equipment, switching stations, L.T. transformer stations complete with foundations, structures, return conductors and 25KV feeders, if any. This part also gives reference to technical specifications of materials and components and procedure for submission of designs and drawings of basic arrangements, components and fittings designs and other typical designs relating to overhead equipment switching stations. 9.1.2 Scope Of Work Traction overhead equipment in accordance with this specification are detailed in the particular features of the sections to be electrified and their special requirements are indicated. 9.1.3 Wind Pressure For design of layout of overhead equipment maximum span, wind pressure shall be taken as specified. Structures and foundations of overhead equipment, switching stations and L.T. supply transformer stations, shall be designed for the wind pressure 9.1.4 System Particulars The nominal voltage of the overhead equipment will be 25KV AC 50 Cycle, single phase. The supply voltage may, however, rise upto 27.5 KV. One terminal of the 25KV system shall be solidly earthed at the traction sub-station and also connected to the overhead equipment through switchgear provided at the traction sub- station & at the feedings station.		

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9.2 <u>OVERHEAD EQUIPMENT</u> 9.2.1 Track 9.2.1.1 Gauge and track Centre: The track gauge is 1676 mm (5ft 6 inch) in multiple track zones the normal distance <u>between track centres varies between 4270 mm and above.</u> 9.2.1.2 Speed The overhead equipment which shall be of the simple polygonal type and pre-sags should be designed for a maximum speed of 160 Km/h (Approx 100 miles/h) if regulated and for a maximum speed of 80km/h 9approx 50 miles/h) if unregulated unless otherwise specified in part-III for any particular section. 9.2.1.3 Curves The minimum radius permissible is 175mm (573 ft) i.e. a 10 degree curve. Inside station limits, the curvature at a 1 in 8/1-2 turnout is 8 degree i.e. of radius 219 mm (716 ft) 9.2.1.4 Super elevation The maximum super elevation is 165 mm (6.5 inch) one curve; the minimum setting of structures shall be decided on the basis of maximum super elevation. For purposes of design and erection of overhead equipment, the actual super elevation as existing at site or as indicated to the Contractor shall be adopted. 9.2.1.5 Low Joints For low or loosely packed rail joints, a difference of 25 mm (1 inch) in the level of opposite rails may be taken as the basis for estimating the displacement of the pantograph with respect to its normal position.		

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9.2.1.6 Formation Generally sections more than one track have common formation. In certain lengths, however, the formation for different tracks may be separate. 9.2.1.7 Displacement The general design of overhead equipment shall permit a displacement of 100 mm of tracks without difficulty and an adjustment of the overhead equipment on this account shall be of such a nature as could be done conveniently without changing any component of the overhead equipment. 9.2.2 Sectioning 9.2.2.1 Insulated overlap Insulated overlaps are provided for facility of isolation. Some of the overlaps may be provided with manually operated isolator switches. 9.2.2.2 Yard supply The sectioning diagram/s also indicate the tracks in station yards and sidings whose equipment is electrically independent from those of other track. The overhead equipment in yards and sidings may be fed through isolator switch or interrupter. 9.2.2.3 Section Insulators Section insulators shall be provided as indicated in the sectioning diagrams or cross- over between main tracks and to isolate sections of overhead equipment in yards & sidings. Section insulators may also be used to form neutral sections at special locations as indicated in approved drawings. 9.2.3 Overhead Equipment 9.2.3.1 Brief Description		

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Essentially the traction overhead equipment shall consist of a standard catenary wire from which a grooved contact wire is suitably suspended by means of droppers. In order to cater for a speed of 160 km/h, the contact wire is given a pre-sag of about 100 mm for 73 m span and reduced suitably for other spans. 9.2.3.2 Catenary The catenary wire shall be of cadmium copper 19/2.1mm, 65 sq. mm. in size. 9.2.3.3 Contact wire The contact wire shall be grooved and made of hard drawn copper having 107 sq mm cross section. 9.2.3.4 Dropper Droppers shall be made of hard drawn round copper wire, approximately 5 mm dia. Droppers shall be spaced not more than 9 m apart. 9.2.3.5 Encumbrance As a general rule, the nominal “encumbrance” i.e. the centre distance between the catenary and the contact wire at the support shall be 1.40 m. Deviation from this figure will be permitted in special cases (e.g. spans near – bridges, structures with more than one cantilever etc). 9.2.3.6 Jumpers All jumpers connected to OHE conductors shall be used of copper only. The in span jumpers, potential equalizer jumpers at insulated overlaps and neutral section, shall be of 50 Sq. mm. nominal, 19/1.8 mm size. Flexible jumpers shall be used at overlaps, turnouts, crossings etc.		

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9.2.3.7 Anti-theft jumper Anti-theft jumper of 50 sq. mm. nominal, 19/1.8 mm in size shall be used in out of turn wire of conventional OHE and copper cadmium anti creep wire as an anti-theft measure. 9.2.4 Type Of Equipment The overhead equipment used shall be of the regulated type. 9.2.4.1 Regulated In the regulated type of overhead equipment, the tension of both the catenary and the contact wires shall be maintained at a constant value at all temperature/temperatures by means of automatic tensioning devices desired to take up the variation in the length of overhead equipment due to temperature variation. An anti creep shall be provided at a point approximately midway between two tensioning devices and not more than 750 metres from any one of them. Alternatively, the arrangement may consist of anchoring the catenary on either side of the boom of a portal with the contact wire running through and providing a jumper connection. 9.2.5 Plane Of Contact 9.2.5.1 Regulated The regulated overhead equipment shall be so erected that the contact wire has the designed sag. 9.2.5.2 Dropper Dropper charts to be used for standard span of regulated and unregulated overhead equipment would be supplied by the Contractor. Droppers for non- standard span, spans with section insulators and special locations shall be calculated by the contractor.		

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9.2.6 Tensions Regulated In regulated equipment, the tension in the catenary and in the contact wire shall be 1000 kgf in each conductor. 9.2.7 Clearance 9.2.7.1 General The distance between live parts and parts at earth potential (or likely to be earthed) shall be as large as possible. 9.2.7.2 Over bridges and tunnels. The clearance which are to be made available at over bridges, signal, gantries and other over line structures shall be based on the above rules. 9.2.7.3 Platform sheds and structures In the course of checking the overhead equipment pegging plans, the Contractor shall prepare a list of platform sheds and other structures in the vicinity of track to be wired. The clearance to these structures shall be in accordance with Railway norms. If these clearances are not available, the Contractor shall take up necessary modifications. 9.2.8 Height Of Contact Wire 9.2.8.1 Normally, the minimum height of contact wire above rail level shall be 5.50 m at mid span under the worst temperature conditions. This height may be reduced under bridges and in tunnels to the extent permitted by the railway authority. The minimum height shall be 4.80 m. In electric, locomotive sheds and over electric locomotive inspection pits, the minimum height shall be 5.80m. At level crossing, the minimum height shall be 5.50 m. Any infringement restricting minimum height at level crossing shall be removed by contractor.		

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9.2.8.2 Gradient of Contact wire Any change in the height of the contact wire shall be made gradually and the maximum slope shall not normally exceed 3 mm per meter on main lines and 10 mm per meter on sidings. The end spans of any section with a gradient of contact wire shall have a slope not greater than half the main slope. 9.2.9 Termination General 9.2.9.1 Traction overhead lines shall be terminated using components. The termination may be carried forward by one or two spans if anchoring facilities so require. 9.2.9.2 Terminating wires shall be electrically connected to the conductors with which they are likely to approach closely or come in to contact under normal conditions. Supplementary Insulation 9.2.9.3 If a terminating wire passes over a live conductor to which it should not be connected, i.e. in a different elementary section, the portion of the terminating wire close to the live conductor shall be separated by means of insulators. The insulators shall be located in such manner as to clear the swept zone of the pantograph under the worst conditions and as far away as possible from live conductors. 9.2.10 Type Of Structures 9.2.10.1 Cantilever The overhead equipment of main tracks in case of multiple track sections shall be electrically and mechanically independent of one another by provision of independent cantilever masts to the maximum extent possible.		

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9.2.10.2 Portals In cases where the tracks in a multiple track section do not permit location of independent masts and where automatic tensioning of overhead equipment is required, rigid portals may be used. Also in the vicinity of points and crossing, portals may be used, provided it is not possible to have prescribed setting with independent cantilever masts. These structure shall be equipped with standard bracket assemblies for supporting individual equipment of different tracks. Portal structures shall also be employed at anti creep central locations and such portals shall have necessary guy arrangement. 9.2.10.3 Foundation Foundation for all structures shall be designed in an economical manner and as per IS/railway standards. 9.2.11 Cantilever Assembly The bracket assembly carrying overhead equipment shall be of the swiveling type. The assembly shall be such that the tubes adopted will permit easy adjustment of the whole equipment after erection to cater for displacement of the track during maintenance up to the extent of 100 mm on either side. In special locations, pull- off arrangement may be used. 9.2.12 Overlaps Overlaps shall be provided at suitable intervals such that neither the tension length exceeds 1500 m nor the fixed anchor to balance weight anchor exceeds 750 meters. 9.2.12.1 General The contact wires at the overlapping zone shall be parallel to each other in a plane to the track and run separated from each other.		

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9.2.12.2 Insulated In the case of insulated overlaps, the separation between the two contact and the two catenary wires shall be 0.5 m. 9.2.13 Points & Crossing Arrangement of overhead equipment of different type i.e. regulated, unregulated or tramway at points & crossing shall be in accordance with the standard drawings. 9.2.14 Section Insulator 9.2.14.1 Brief Description The section insulators shall provide effective electrical isolation of two elementary electrical sections of overhead equipment and permit smooth passage of the pantograph in either direction at all speeds upto 70 km/h. The section insulators shall be of the single wire type. 9.2.14.2 Size and weight The section insulators assembly shall be such that it should be possible to install the insulator in the overhead equipment. The axial distance between the catenary and the contact wire with section insulator in position is not less than 450 mm. The weight of the complete assembly shall not be more than 45kg (for single wire type excluding the weight to the catenary insulator and that catenary ending lamps). 9.2.15 Bridges & Tunnels 9.2.15.1 Over bridges The complete overhead equipment (i.e. both the catenary and the contact wires) shall normally pass under over-line structures. Additional specified minimum height of contact wire shall be maintained. In special cases, the catenary may be anchored on either side of the over-line structure and the contact wire carried under earth.		

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9.2.15.2 Safety Screens On over bridges, metallic protective screens shall be provided in order prevent any person from coming into contact with the live wires over the equipment. Such screens shall be properly earthed. 9.2.15.3 Height gauges at level crossing Height gauges shall be provided at all level crossing. 9.2.16 Bonding And Earthing Bonding & earthing shall be done in accordance with the code for binding and earthing. 9.2.16.1 Longitudinal and Transverse bonding Longitudinal and transverse bonding of tracks, bonding of structure including traction structure to rails and associated earth shall be provided in accordance with the above code. 9.2.16.2 Traction Structure Bonding Every traction mast or structure shall be bonded to a non- track circuited rail unless it is provided with a continuous earth wires or it is individually earthed by means an earthing station. 9.3 <u>FOUNDATIONS</u> 9.3.1 Scope This part deals with the design of foundations and anchor blocks for traction structures carrying overhead equipment (including those on bridges), structures at switching stations and booster stations and other concrete work. It also deals with specifications for concrete.		

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9.3.2

Design Of Foundation

9.3.2.1

Soil pressure

For design of foundations for traction structures carrying overhead equipment, the Contractor shall determine the type and allowable bearing pressure of soil at suitable intervals and adopt the type and size of foundations, suitable for particular locations with the help of the approved employment schedules. In cases of particularly weak soil, the bearing pressure may have to be determined for each location.

9.3.2.2

Structures carrying overhead equipment

Foundation for traction structures carrying overhead equipment shall be either of the side bearing, side- gravity or new pure gravity type according to their location, formation of the sub- grade and the bearing pressure of the soil. In new filled up soil or cinder formation, pure gravity sand filled core foundations or cantilever type foundation with weight or guyed foundations may be adopted.

9.3.3

Bearing Pressure

9.3.3.1

Guiding Information

The following allowable bearing pressures may generally be expected for kinds of soil. The information is given for general guidance only.

Average good soil in banks and cuttings	: 11,000 Kg/Sqm
Moorum soil in cutting	: 22000 Kg/Sq.mm
New banks and bad soils in banks and cuttings	: 5500 Kg/Sq.mm.

Black cotton soil- pure gravity foundation shall normally be adopted. However, under reamed pile foundations may be adopted in limited locations for rails purpose. In the case of dry black cotton soil, the soil should be subjected to a bearing pressure as close as possible but not exceeding 16500 kg/sq m. the foundation block being not less than 2.8 m. In the case of wet black cotton soil, the soil should be subjected to a bearing pressure as close as possible but not exceeding 8000 kg/sq m.

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9.3.4 Concrete Concrete for foundations shall be nominal mix of grade M 15 obtained by mixing cement, coarse aggregate, fine aggregate and water in accordance with proportions given vide Table 9 of IS : 456 2000 reproduced below. For grouting, mulling, embedding of structures in foundations and for cable trenches at switching stations, nominal mix concrete M20 obtained by mixing materials in proportions as indicated in Table-9 of IS: 456-2000 shall be used. Volume batching may be adopted vide clause 9.3 of IS: 456-2000 reproduced below. IS: 456-2000 TABLE-9: PROPORTIONS FOR NOMINAL MIX CONCRETE (Clause 9.3, 9.3.1) <table><tr><td>Grade of Concrete</td><td>Total quantity of dry Aggregate by mass per 50 kg of cement, to be taken as the sum of the individual masses of the fine and coarse aggregates (kg). Max</td><td>Proportion of fine Aggregate to Coarse aggregate (by Mass)</td><td>Quantity of water per 50 kg of cement, Max.</td></tr><tr><td>(1)</td><td>(2)</td><td>(3)</td><td>(4)</td></tr><tr><td>M-5</td><td>800</td><td rowspan="5">Generally 1:2 but subject to an upper limit of 1:1:5 and a lower limit of 1:2:5</td><td>60</td></tr><tr><td>M-7.5</td><td>625</td><td>45</td></tr><tr><td>M-10</td><td>480</td><td>34</td></tr><tr><td>M-15</td><td>350</td><td>32</td></tr><tr><td>M-20</td><td>250</td><td>30</td></tr></table> Note: The proportions of the fine to coarse aggregates should be adjusted from upper limit to lower limit progressively as the grading of the fine				Grade of Concrete	Total quantity of dry Aggregate by mass per 50 kg of cement, to be taken as the sum of the individual masses of the fine and coarse aggregates (kg). Max	Proportion of fine Aggregate to Coarse aggregate (by Mass)	Quantity of water per 50 kg of cement, Max.	(1)	(2)	(3)	(4)	M-5	800	Generally 1:2 but subject to an upper limit of 1:1:5 and a lower limit of 1:2:5	60	M-7.5	625	45	M-10	480	34	M-15	350	32	M-20	250	30
Grade of Concrete	Total quantity of dry Aggregate by mass per 50 kg of cement, to be taken as the sum of the individual masses of the fine and coarse aggregates (kg). Max	Proportion of fine Aggregate to Coarse aggregate (by Mass)	Quantity of water per 50 kg of cement, Max.																								
(1)	(2)	(3)	(4)																								
M-5	800	Generally 1:2 but subject to an upper limit of 1:1:5 and a lower limit of 1:2:5	60																								
M-7.5	625		45																								
M-10	480		34																								
M-15	350		32																								
M-20	250		30																								

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aggregates become finer and the maximum size of coarse aggregate becomes larger. Graded coarse aggregate shall be used for an average grading of fine aggregate(that is zone II of Table 4 of IS: 383-1970*) , the proportions shall be 1:1.5,1:2 and 1:2.5 for maximum size of aggregate 10 mm , 20 mm and 40 mm respectively. Specification for coarse and fine aggregate from natural sources for concrete (second revision) “In case uniformity in the materials used for concrete making has been established over a period of time, the proportioning may be done by volume batching, provided periodic checks are made on mass/volume relationship of the materials. Where weight batching is not practicable, the quantities of fine and coarse aggregate (not cement) may be determined by volume. If the fine aggregate is moist and volume batching is adopted, allowance shall be made for bulking in accordance with IS: 2386 (Part-III) – 1963’*. ----- “Methods of test for aggregates for concrete part III specific gravity, density, voids, absorption and bulking” ----- The crushing strength of concrete shall not be less than the limits given below :- In judging the acceptability of the materials, quantity of concrete and the method of work, the purchaser will generally observe the provisions of the “ Indian Standard Code of practice for plain and Reinforced Concrete, IS : 456-2000”. 9.3.5 Size And Grading Of Aggregates The graded coarse aggregate 40 mm nominal size (table-2 of IS: 383-1970) shall be used for foundation. A coarse aggregate for grouting muffs and embedding shall be of 20 mm graded nominal size as per table –2 of IS : 383-1970(specification for coarse and fine aggregate from natural sources for concrete). Fine aggregate shall be graded from 10 mm downwards. The maximum size of aggregate for under reamed pile foundation shall be 20 mm graded nominal size.		

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9.3.6	Sand Cored Foundation After erection of masts in sand- cored foundations, the core hole of the foundation blocks shall be filled with dried sand and covered with a layer of bitumen of 80mm thickness below 30 mm from top level of the block. A hemispherical shaped muff shall be provided on such foundations in lieu of standard type.	
9.3.7	Sinking of concretes shells Where the water table is high, one or more sections of reinforced concrete shells may have to be sunk before casting concrete. The size of each shell shall be 1200 mm out side dia x 50mm thick 600mm high reinforced with 6 mm (1/4") dia, rods spaced 150mm apart, both longitudinally and circumferentially, the concrete shall be of grade M15	
9.3.8	Type of foundation in block cotton soil Type of foundation in block soil shall be type BC or NBC or other type as approved by Railway authority	
9.4	<u>STRUCTURES</u>	
9.4.1	Scope This part deals with design for steel structures and steel work for overhead equipment, switching, boosters transformers stations and L.T. supply transformer stations and the specification for steel and pre stressed concrete trail mast.	
9.4.2	Type Structures and gantries may consist of any or more of the following types:- (a) Broad flange beams. (b) Rolled steel joists (I section) (c) Fabricated steel structures (wrapped/bolted)	

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Structure/uprights shall generally be embedded in concrete foundation blocks: in special cases structures may be secured by means of holding down bolts. Limited quality (Appro 700 Nos) of circular span pre stressed concrete mast may also be used as the sole discretion of the purchaser. 9.4.3 Design Steel Structures 9.4.3.1 Designs for steel structures shall, except where otherwise provided, comply with the “Indian standard code of practice for use of structural steel in General Building construction” IS-800-1962. The thickness of smallest steel section used shall be 5 mm for galvanized members 9.4.3.2 All the steel structures and small part steel for carrying overhead equipment are to be fully galvanized after drilling and fabrication as per specification ETI/OHE13(4/84) and no painted structures are to be used. 9.4.4 Cantilever Masts 9.4.4.1 Load For purposes of design the worst possible combination of all loads that may occur shall be considered. The load shall include the following (weight to be assumed for design of structures are shown against important items.) (a) Weight of overhead equipment (1:60 kg/metre for each conventional and 1.32/kg for each composite OHE) (b) Weight of bracket supporting the overhead equipment (60kg/normal bracket) (c) Weight of a man (60 kg) (d) Weight of an earth wire (0.32kg/ metre)		

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(e) Weight of feeder, return conductor or other special equipment wherever they occur. (f) The effect of eccentricity of vertical and horizontal loads on the bracket due to variation in temperature. (g) Wind loads perpendicular and parallel to the track. The wind pressure adopted shall be taken as that indicated. (h) Radial forces on the mast, due to stagger, curvature, anchorage etc. (i) Weight of the mast itself (j) Any other load or loads that may occur due to the special location of the structure. 9.4.4.2 Deflection Notwithstanding the provision contained in IS: 800-1962 regarding permissible deflection, the following shall apply. (a) The deflection at the top of the mast due to permanent loads shall not exceed 8 cm and mast shall be so erected that it becomes reasonable vertical after application of permanent loads. (b) The additional deflection under maximum wind pressure shall not exceed 8cm at the level of the contract wire. 9.4.4.3 Torsion The torsional rotation of the mast due to permanent loads shall not exceed 0.1 radian 9.4.4.4 Typical Design The typical design of a traction mast is included in the set of standard drawings listed. Employment schedules for standard masts for various locations and types are included in the standard drawings listed, to enable selection of suitable types for different locations and local conditions.		

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9.4.5 Anchor Masts 9.4.5.1 Masts at which overhead equipment will be anchored shall also normally be of same type as those other locations. Anchor mast shall normally be provided with suitable guys but struts may be permitted in special cases. 9.4.5.2 Dwarf masts At certain locations where due to local conditions it is not feasible to anchor the guy rod on a foundation block in the ground, dwarf mast shall be used in accordance with approved designs. 9.4.6 Portals 9.4.6.1 General Portal shall be of fabricated steel of standard types to purchaser designs. The most important designs are covered by Drawing listed. 9.4.6.2 Load The loads shall be as detailed in Para 9.4.4as applicable. 9.4.7 Structures On Bridges 9.4.7.1 The structures may be either cantilever masts or portals (hinged or fixed at base) depending on the type and condition of bridge piper capping. As far as possible cantilever masts grouted in foundation blocks on piers will be used. Where this is not possible cantilever masts with holding down- bolts or suitable (hinged or fixed at the base) may be adopted. 9.4.7.2 Designs of structures on bridges to suit different locations and local conditions will be furnished to the contractor by the Purchaser 9.4.8 Special Structures In the case of structures at locations not covered by the employment schedules furnished by the purchaser, the Contractor shall furnish		

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complete design calculation justifying the choice of the type of structures for such locations. 9.4.9 Setting Of Structures 9.4.9.1 The setting of the distance from the central line of the track, on straight or curve to the face of the mast/structure of fitting located on the mast. 9.4.9.2 On straight and outside of curve, the standard setting shall be as per relevant drawing included. Minimum setting of structures shall be 2.5m plus curve allowance as required. Wherever this distance cannot be provided specific approval of purchase shall be obtained before erection, setting of portal upright overlap/ turn-out structures, anchoring structures and other masts carrying more than one OHE will be 3.0 m wherever possible. 9.4.9.3 Extra clearance in curve. The minimum setting of structures on curves shall be determined by adding to the above minimum figures an extra clearance included in the table included in the set of standard listed. Structures with counter weight In cases of structures carrying counter-weights assemblies, the term “setting” shall refer to the minimum distance of the counter-weight from the track centre under the worst conditions of wind. 9.4.9.4 Structures on Platform The setting of structures on platforms shall be not less than 4.75M 9.4.9.5 Structures Near signals In the vicinity of signals, structures shall be located in a manner, which shall ensure good visibility, where necessary, the setting shall be increased as per the relevant drawing included.		

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9.4.9.6 Setting of Structures The value of setting of masts/structures shall be painted on each mast/structure. The figure shall be 25mm in size in white on a red background. In addition the track level shall also be marked on the mast/ structure by a horizontal red painted stroke. 9.4.10 Number Of Structures Carrying Over Head Equipment All structures shall be numbered in according with the numbering given in the approved overhead equipment layout plans. Enameled number plates shall be provided on each mast or structures as per approved designs. 9.5 <u>EQUIPMENT, COMPONENT AND MATERIALS</u> 9.5.1 General This part deals with the details and specification of the equipment's components and materials to be used for traction overhead equipment. 9.5.2 Compliance with Standard Specifications In the technical specifications of equipment's components and materials references are/made to the following standard specifications:- (a) International Electro Technical Commission (abbreviated as IEC) Publication. (b) British Standard (B-S) (c) Indian Standard (I-S) Tenders may, however offer equipment in accordance with the appropriate national standard specifications of the country of manufacture but such offers will be treated as acceptable if the material is better and less costly.		

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9.5.3	Prototype Tests Fittings, Components and materials:- If prototype samples of equipment's components or fittings of any manufacturer have already been approved in connection with the electrification of other section of Indian Railway on the 25KV 50 cycles single phase AC system; prototype samples of such items will be exempted from the tests.	
9.5.4	Inspection and testing These comprise inspection and test conducted at the manufacturer's factory for ensuring quality of manufactured items as part of the <u>Quality Assurance Program.</u>	
9.5.5	Test Certificate These copies of the test certificates for the test carried out at the manufacturer's factory on all equipments shall be furnished within a month after completion of the prototype test. Three copies of the routine test carried out on each equipment shall also be furnished after the equipment is passed for inspection.	
9.5.6	Technical Specification	
9.5.6.1	The following specifications (latest revision) will govern the supply and test of important materials, components and equipment:-	
(a)	Structures steel	IS 226-1975 IS 800-1962 IS 808- 1964 and IS 808 (Pt. - 1-1978) IS 1731- 1971 IS 2004- 1978
(b)	Tensile testing	IS 1607- 1972 for steel products etc
(c)	Dropper wire	IS 282- 1982
(d)	Tin bronze casting	IS 366- 1968

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(e) Aluminium bronze Casting IS 309- 1965 (f) Malleable iron Casting IS 2108 - 1977 Grade (BM 340 / 4600A) (g) Cadmium copper ETI/OHE/50/ (8/83) (h) Contact wire ETI/OHE/ 42/83 (i) Annealed Stranded Copper conductors For jumper wire ETI/OHE/301/with A&C slips No 2 of Feb '85 (j) Structural steel tubes ETI/ OHE/11(9/83) (k) Hot dip galvanization of steel masts (rolled and fabricated) tubes, Fittings used on 25KV AC OHE ETI/ OHE/ 13(4/84) (l) Stainless steel wire Rope ETI/OHE/14(7/83) with A&C slip No 2 Jan '1985 (m) 25KV solid core insulator including those for polluted Zones ETI/OHE/15/ (11/83) (n) 25KV single pole / DP Isolators ETI/OHE/16/ (9/84) (o) Bolts, Nuts & Washers ETI/OHE/ 18(4/84) (p) Aluminum alloy Sections and tubes. ETI/OHE/21(19/74) (q) Section Insulator RE/OHE/27(8/84) (r) Enameled steel parts ETI/OHE/33 (2/73) with A & C slip No 1 of 3/84 (s) Fittings for 25KV 50 Cycle AC ETI/OHE/49(5/84)		

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Traction Equipment 9.5.6.2 Bracket Bracket tubes shall be of seamless cold drawn or electric resistance weld steel with ETI/OHE/11(9/83) with an insulator near the support. The length of the tubes shall be than there will remain a free length of 200mm beyond the catenary suspension bracket to facilitation adjustment during track maintenance. 9.5.6.3 Tubular stay arm Steel tubes adjustable steel rods shall be used for tubular stay arm of all bracket assemblies. 9.5.6.4 Register arm The register arm shall also be electric resistance weld or cold drawn steel tubes of proper dimensions duly formed. This will be suspended by a dropper from the catenary suspension clamp of bracket tube. A hook an eye arrangement shall be used at the bracket end to permit free movement in every direction. 9.5.6.5 Steady arm The steady arm shall normally be fitted in all assemblies or OHE in running and shall be of light alloy BFB sections arranged to work always in tension in accordance with ETI/OHE/2 (9/74). The contact wire shall be fixed by a simple swivel clip without threaded parts. Its length normally of one meter but at tern outs diamond crossing etc, it will be of longer size .Bent steady arm of aluminum alloy tube conforming to spec. ETI/OHE/21(9/74) shall be used for neutral section, over lap and central mast of 4 span overlap. 9.5.7 Dropper General Design 9.5.7.1 The dropper shall generally be designed as shown in standard drawing and made of copper wire about 5mm dia conforming to IS 282 and shall be held by a clip of aluminum bronze as shown in the standard drawings.		

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The distribution of dropper shall be in accordance with standard designs. 9.5.7.2 Loading The droppers shall be able to withstand a vertical load of 200 kg at the point of attachment to the contact wire and the clip shall not slide under a horizontal load of 120 kg. The permissible tolerance in overall length of a dropper will be + 5 mm. 9.5.8 Insulators All insulators except on return conductors and earth wires are of solid core type. 9.5.8.1 Interchange Ability For free inter changeability only the following types of insulators shall be used. While the shapes of the insulators may vary slightly from those in the drawings, the standard dimension of the galvanized malleable cast iron caps shall be adopted. 9.5.8.2 Stay arm Insulator These insulators shall be used in conjunction with the tubular stay arm of all bracket assemblies. 9.5.8.3 Bracket Insulators These shall be used at the base of each bracket assemblies in conjunction with bracket tubes. 9.5.8.4 Ton insulators These shall be used at all places for cut in and terminal insulation including those in return conductors but excluding those in earth wire.		

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9.5.8.5 Post Insulators These shall be used at all places for supporting isolator mechanism bus bars, Jumper's etc of 25KV. 11KV post insulators are used at all places for supporting busbars, jumpers etc in conjunction with return conductors/ return feeders. 9.5.9 Ending Fittings And Splices 9.5.9.1 Terminal or end fittings and splices on copper conductors shall be of the cone type clamping on both the inner and outer strands of conductors except for contact wire- ending clamps, which may be of wedge type. The arrangement shall be easy to install and also be such as would apply the clamping pressure gradually without shock (see specification No. RE/OHE /10/ (3/66) 9.5.9.2 Loading All the parts shall be capable of withstanding, without damage, a load greater than the ultimate strength of the wires to which they are fitted. In the case of threads on damage shall occur when they are subjected to a load- equal to the two third of the ultimate strength of the wires. 9.5.9.3 Restricted use of the splices The use of splices shall generally be avoided and their use shall be restricted to the minimum necessary. Over main tracks, there shall be no splice in the contact wire on first erection. Elsewhere not more than one splice be used in any tension length(i.e. anchor to anchor) for which prior approval shall be taken from the Purchaser. Additional splices may, however, be provided to enable retention of conductors which are found defective during and/or after erection. Splices may also be permitted for repair of damage due to thefts or railway accident. 9.5.9.4 Strength of Assembled Fittings. The strength of fittings assembled with appropriate conductors or wires shall be not less than that of the conductor or wire itself.		

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9.5.9.5 Additional Cadmium copper stranded wire of 65 sq mm nominal section of 37/2.1 mm (as used in head span construction) may be used as additional terminating wire for extending single and double conductors respectively if terminal at the nearest Structure is not feasible. 9.5.10 Electrical Connections For Ohe 9.5.10.1 Parallel clamps shall make all electrical connections between conductors. The general arrangements of connections are shown in the standard drawings. 9.5.10.2 Copper jumpers shall be any of the following:- (a) Large jumpers of annealed copper in accordance with the specification ETI/ OHE/3(1/83) with A&C slip No 2 of Feb'82. (b) Small jumpers of annealed copper in accordance with the specification IS 434 Pt -I 9.5.10.3 Busbars Busbars or rigid jumpers in copper where used shall be of 18 mm copper in accordance with RE/ 30/OHE/5 9.5.10.4 Feeders Feeders shall be of all aluminum conductors 19/3.99 mm (Spider) 9.5.11 Terminal Connectors For Equipments 9.5.11.1 The regulating equipment should have a minimum adjustment range of 950mm stainless steel wire rope in accordance with ETI/OHE/14 shall be used in these equipment 's and these shall be sufficiently flexible for the purpose.		

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9.5.11.2 Counter Weight Counter weights and arrangements used shall be such that these could be accommodated within 330 mm (13 in) measured transverse to the track under the worst condition of wind. The vertical upward movement shall be limited with a fixed top. 9.5.11.3 Reduction Ratio Reduction ratio in the arrangement used shall be five for winch type and three in case of three- pulled type equipment's. 9.6 <u>ERECTION AND INSTALLATION OF EQUIPMENT</u> 9.6.1 Scope This part deals with the methods of erection and installation of traction equipment, including casting of foundations and erection of structures. 9.6.2 Method Of Erection All work shall be done in accordance with method of erection and installation of equipment approved by the purchaser. In the of switching station, booster transformer stations, L.T. supply transformer, Stations, standard methods adopted for erection and installation of electrical equipment shall be adopted. 9.6.3 Sectioning The entire equipment shall be erected in accordance with the finally adopted sectioning diagram and in such a way so as to facilitate sectioning which may be required in future. 9.6.4 Inspection All erection and installation work shall be subject to inspection by the engineer in charge to ensure that the work is done in accordance with the specification, approved designs and drawings and is of the best quality suitable for the purpose.		

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9.6.5	Measurements All measurements for location of structures and foundations shall be made with the aid of steel tapes. On curves, these measurements shall be taken on the outer rail of the middle track in the case of odd number of numbers of tracks and on the inner rail of the first outer track from the center of the formation in the case of an even number of tracks, structures on curves shall be located in the radial offset of the location as determined.	
9.6.6	Bolts, Nuts Etc All bolts, nuts and locknuts screws, locking plates, split cotter pins etc., shall be properly tightened and secured and the contractor shall carry out systematic inspection of this aspect of work after all adjustments to overhead equipment are completed sections of equipment to the purchaser for inspection and testing.	
9.6.7	Damage To Galvanising Painting In loading, transport and erection, all galvanized painted materials shall be handled with care to avoid damage to galvanizing painting is damage in spite of all care taken. The damage part of component shall be put up for inspection, to obtain permission from the purchaser to carry out repairs.	
9.6.8	Foundations The contractor shall carry out soil pressure tests to determine permissible bearing pressure of various representative types of soils during the pegging out of site inspection. .	
9.6.8.1	Location The location of each foundation or anchor block shall be set out correctly in accordance with approved structure cross – section drawings or foundations layout drawings, as the case may be.	

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9.6.8.2 Method Of Installation The contractor may adopt either manual or mechanized method for installation of foundations. He may erect traction masts of structures in the same operation as casting of foundations or erect them subsequently in cored holes left in foundation blocks and grout them separately. In any case the method of casting of foundation blocks and erection of masts or structures shall be subject to the approval of the purchaser. 9.6.8.3 Excavation Normally, excavation of soil for foundations or anchor blocks along side the tracks may be done upto length of 1 to 1.2 m and a depth of 0.8 to 1 m without shoring, provided the excavated hole is concreted immediately and not left overnight. Shoring shall otherwise be done unless the holes is re-filled with soil and tamped. In case the length of excavation is 1 to 1.2 m and depth of excavation for foundation and anchor blocks, along side the tracks is more than 0.8 to 1 m, the excavation may be undertaken only after certification by the Engineer incharge to be safe and concrete is cast on the same day. Shoring shall be done to the satisfaction of the Engineer in charge; 9.6.8.4 Concreting All concreting or grouting shall be done in accordance with Para 9.3.4 with ballast graded for the purpose specified in Para 9.3.5. The concrete shall be poured and tamped properly in accordance with the method approved by the purchaser. The contractor shall arrange to provide concrete testing samples for tests once every week or as and when required by the purchaser, to determine crushing strength after 7 days or 28 days curing as required. Testing shall be arranged by the purchaser at his own cost. 9.6.8.5 Muffs All anchor blocks and foundations of structures carrying overhead equipment shall be provided with concrete muffs. The top of these muffs shall be above the level of ground of the track formation and of adequate height of not less than 15 cm to afford reasonable protection during rainy weather. Muffs may be installed at the same time the masts are grouted or		

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after the mast/structure is loaded with equipment. The foundations of structure of switching stations need not, however be provided with muffs. Such foundations shall be given a slope of 1 in 50 towards the edge to ensure that water not collect at the base of the structure if the frame work of the equipment. Suitable grooves or niches shall be provided in the foundation blocks, wherever required, at the time of casting, to enable embedment of earth strips etc. to avoid the necessity of chipping of concrete. Conduits for cables should be embedded in the foundations blocks, wherever required, to avoid subsequent chipping off and breaking of the foundation blocks. 9.6.9 Masts & Structures 9.6.9.1 Erection In case traction masts or structures are erected in cored foundations, till such time they are grouted, they shall be properly wedged to prevent them leaning towards the track and endanger safety of moving vehicles. In case traction masts or structures are erected simultaneously with the casting of the foundations, the contractor shall provide temporary supports approved by the purchaser. The masts shall be embedded in the foundation blocks for the correct length specified in approved drawings. 9.6.9.2 Reverse Reflection All traction masts and structures shall be erected with the correct reverse deflection so that they become reasonably vertical after they are loaded. The method of erection of mast with the correct reverse deflection shall be submitted to the purchaser for approval. 9.6.9.3 Infringement To Standard Dimensions In erection care shall be taken to ensure that no part of the traction masts, structures or any fittings located on such mast or structure infringement the schedule of dimensions 1676 gauge 1939 printed in metric units in 1973.		

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9.6.9.4 Alignment Of Masts At Gantries The main masts of gantries shall be carefully aligned to enable easy and good assembly of fabricated steel work. 9.6.10 Overhead Equipment A suggested method for erection of traction overhead equipment which would ensure good speed and quality erection is included in section 2 of this part. The contractor may, however, follow other methods which they consider would speed up and ensure good quality work, subject to the approval. Any wiring method should take into consideration appreciable stretch of the catenary & contact wires in the initial days, after they are strung and put under tension. 9.6.10.1 Bracket Tubes In the erection of bracket assemblies, it shall be ensured that the free length of the bracket tube beyond the catenary suspension bracket is at least 150 mm to facilitate adjustment during maintenance. 9.6.10.2 Stay Arms The choice of stay arms shall be such that their adjuster are capable of adjustments of minimum of 90 mm in either direction except as other wise relaxed. 9.6.11 Insulators Before insulators are used in bracket assemblies or dispatched to work site for erection from the contractor's store depot, they shall be tested as specified for routine mechanical test. No chipped or cracked insulators shall be installed. All insulators shall be cleaned before offering completed sections of equipment for inspection and testing. 9.6.11.1 Stringing Catenary Care shall be taken to avoid kinking or bird-caging of the catenary wire in stringing and subsequent observations. While stringing, the wire shall be		

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suspended from pulley blocks hung from the suspension clamp eye of bracket assemblies. The pulleys shall be fitted with ball bearing and shall be of the swiveling type of permit free movement in all directions to prevent damage to the strands of the wire. The design shall also be such that it will prevent slipping off of the wire during stringing operations. The designs of the pulley shall be submitted to the purchaser for approval. After initial stringing of the catenary, it shall be maintained at the no load tension (for a minimum duration of 48 hours before the pulley blocks are removed and the catenary is clamped to suspension clamps of bracket assemblies. 9.6.11.2 Stringing Contract Wire Care shall be taken to avoid formation of kinks, twists and damage to contact wire in stringing and subsequent operations. While stringing the contact wire, it shall be suspended from pulleys hung from droppers fitted to the centenary in their final position. In curves, the contact wire shall be bun in pulleys located at traction masts or supports, corresponding to the approximate final position of the wire. 9.6.11.3 Location Of Droppers Droppers shall be correctly positioned in each span to ensure correct level of contract wire as per dropper chart applicable to the span. 9.6.11.4 Clipping Of Droppers The droppers shall be clipped on to the contract wire only after a minimum duration of 48 hours from the time the automatic tensioning device is brought into action. 9.6.11.5 Auto-Tension Device The auto-tensioning device shall be erected with the correct height of the counter-weight above rail level with corresponding distance between the pulleys of the device for a temperature of 35c before it is connected to the overhead equipment and put into action. The installation of the device shall be such as to permit free, easy and unobstructed movement of counter-weight.		

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9.6.11.6 Cut-In Insulators All insulators in out of run shall best positioning that they are away from the swept zone of the pantographs and will not foul with them. The live parts of these insulators shall also be so located that they are at least 2 m away from structures other than this supporting traction overhead equipment. 9.6.11.7 Section Insulators All sections insulators shall be so located that they are beyond the swept zone of the pantograph running on adjacent tracks and there is no unusual sag due to the same Where section insulators are installed, the contract plane of the runners of the insulators as well as those of overhead equipment connected to it shall be parallel to the track plane. 9.6.11.8 Anti-Wind Clamp Anti-wind clamp shall be provided as per the standard practice. 9.6.11.9 Connections All jumper connections including anti-theft jumpers shall be made properly with parallel clamps and finished neatly without any loose wire or cables. The length of flexible jumpers shall be adequate to avoid any disturbance to overhead equipment or restraint in the relative movement of conductors, but the jumpers should not be excessively long. The ends of jumpers shall be tinned, including the portion inside the first parallel clamp. 9.6.11.10 Separation Between OHE In erection, the physical separation required between overhead equipment's and brackets assemblies on the same structure at insulated overlaps shall be ensured.		

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9.6.11.11 Gradient Of Contact Wire The gradient of the contract wire on either side of over line structures with restricted clearance maintained between the over line structure and live equipment. 9.6.11.12 Adjustment At Turnouts Etc Careful adjustment of equipment shall be made on equipment's at turn-outs cross overs, diamond crossings, overlaps and special locations, for position of bracket assemblies, stay arms and height of contact wire to ensure that pantographs of electrical rolling stock on the run will not foul with any parts of the bracket assemblies and change over of the contract wire is effected smoothly. For wiring in large yards, the contractor shall, prior to the execution of works, submit to the purchaser's Engineer for his approval the sequence of stringing of centenary and contract wires to arrange for proper crossing of wires. Endeavor will be made to arrange for traffic blocks to suit approved sequence of wiring. Insulator switches shall normally be so mounted that when the switches are operated, the operator faces the directions of the motion of trains. The operating handles and contact blades shall be correctly aligned for easy operation. 9.6.11.13 Isolators Isolators switches shall normally be so mounted that when the switches are operated, the operator faces the direction of the motion of trains. The operating handle and contract blades shall be correctly aligned for easy operation. 9.6.12 Busbars And Connection Bus bars and connections shall be neatly shaped and bend to give a good appearance.		

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9.6.13 Earthling The copper earth strips or flats used for earthling shall be bent and shaped neatly before connection to the structure or from work of equipment. The connections of MS flats to steel work shall be made at a height not exceeding 15 cm from the datum level of a switching station. Before making earth connections the shall be cleaned thoroughly and tinned for copper strips. All junctions shall be properly secured to avoid loose contact. Portions of copper earth strips which remain visible above the ground level should be painted with suitable paint to make them inconspicuous. 9.6.14 Tolerance The permissible tolerance in dimension for erection from those included in the appropriate drawings or schedules for different items are given below:- 9.6.14.1 Measurements The span length shall not vary more than 50 mm as measured along the appropriate rail. The cumulative error of measurement of all spans in a kilometer shall be not more than 1000 mm. 9.6.14.2 Setting Of Structures The setting of structure shall be not less than that included in the appropriate cross-section drawings, especially those with the minimum setting of 2.50 m. A tolerance of 20 mm will be permitted subject to minimum specified value if the structure is not located in between tracks. 9.6.14.3 Height Of Contact Wire 20 mm will be permitted on the height of wire at points of supports as shown in the relevant structures where no tolerance will be permitted.		

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9.6.14.4 Stagger Generally 20 mm will be permitted for stagger 9.6.14.5 Dropper Length 5 mm will be permitted for dropper lengths. 9.6.14.6 Dropper Location 100 mm will be permitted for dropper locations. 9.6.15 Wiring Procedure This section deals with the wiring procedure which may be adopted for erection of normal overhead equipment. The following procedure for erection of overhead equipment has been formulated with a view to ensure that: (a) Bracket assemblies (brackets) and regulating equipment are correctly installed in their final position. (b) The conductors are correctly tensioned and (c) The need for final adjustments of overhead equipment immediately before energisation and commissioning is virtually eliminated. 9.6.16 General: In the case of regulated overhead equipment when the regulating equipment's are in action, the tension in the conductors should remain constant, irrespective of variations in the ambient temperature. As the regulating equipment's are brought into action a few days after the stringing of conductors the equipment is unregulated in the intervening period. Any of the following two procedures may followed for tensioning and clamping of conductors of regulated overhead equipment during stringing operations i.e. before regulating equipments are brought into action.		

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9.6.16.1 The catenary is tensioned to 1000 Kgf, the stipulated tension at the mean temperature of 35c, whatever may be the ambient temperature during the stringing operations. In this case, at the time of clamping the catenary to the bracket, the bracket should be placed at angular positions corresponding to temperature at the time of clamping and proportionate to their distance from the anti-creep. 9.6.16.2 The aluminium alloy catenary is tensioned at the calculated tension to correspond to 800 kgf the stipulated tension at the mean temperature of 35c whatever may be the ambient temperature during the stringing operations. 9.6.16.3 The catenary is strained to a stringing tension corresponding to the ambient temperature for the equivalent span of the tension length. In this case, the brackets are placed in the mean position, i.e. at right angles to the track, when the catenary is clamped or the regulating equipment commissioned. The advantage of the second method is there would be necessity to adjust each bracket separately at the time of clamping the catenary or commissioning the regulating equipment. The erection work is thus considerable simplified and the possibility of errors greatly reduced. This is also applicable to erection of unregulated overhead equipment. 9.6.17 Erection Of Brackets After the brackets are fabricated correctly in the contractor's depot, in accordance with the approved structure erection drawings, and provided with indelible labels or/painted marking indicating the intended locations for each bracket, they are to the site of work and erected on traction masts or supports. The brackets are swiveled to a position at right to the track and secured in that position by means of steel wires tied to similar brackets located on the opposite side of the track or other suitable means. 9.6.18 Anti-Creep The anti-creep of the tension length is then installed in its final position. 9.6.19 Locking The Regulating Equipment In the case of regulated overhead equipment, the regulating equipment's are erected on the terminal masts or structures and their movement locked		

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by suitable means in the middle position, with the distance between the pulleys of the regulating equipment corresponding to 35° C 9.6.20 Temporary Arrangement A pulley approximately 30 cm. dia is attached to the overhead equipment and of the regulating equipment by means of temporary accommodation fittings at both ends of the tension length to be wired. Over this pulley a flexible stranded wire is passed over. At each end of the wire to ending clamps, one for catenary and one for contact wire, are attached. This wire is also clipped in the middle by 'U' clamps. The length of this temporary arrangement from the regulating equipment to the extremities of the standard wire passing over the temporary pulley shall be a little longer than the distance between the regulating equipment and ends of the catenary and contact wires in their final position, to permit easy clamping of terminal fittings during the final termination of the wires. 9.6.21 Stringing Catenary The catenary is initially terminated in the ending clamp of the temporary arrangement at one end of the tension length. The catenary is then paid out from the reel of the wiring train and run of pulley blocks hung from the suspension clamps eyes of brackets until the terminating point at the other end of the tension length is reached. 9.6.22 Tensioning Of Catenary The catenary is strained upto the 'stringing tension' corresponding to the equivalent span of the tension length and the ambient temperature at the time of stringing with the aid of a dynamometer, and terminated at the tension For this purpose, the ambient temperature shall be deemed to be the temperature registered by a thermometer tied to a length of catenary wire 3 to 4 metres long, laid flat on the top platform, on one of the wagons of the wiring train. Subsequently, the tension in the wire is checked by measurement of sag with the help of leveling lathe attached to suspension points and to the catenary at mid span by a ladder working party. The sag shall be measured in two spans, each preferably greater than 54 metres and situated on either side of anti-creep approximately midway between the anti-creep and the termination points. The value of sag measured by this		

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method should be within $\pm 5\%$ of the theoretical value for the corresponding stringing tension and the temperature at the time of this measurement. In the case of discrepancy is more, the tension should be adjusted again and sag rechecked as above. After the sag is checked the catenary is terminated at the ending fitting of the temporary arrangement at the terminating point. In order to restrict the duration of traffic blocks to the minimum, in the first block, catenary is strained to the stringing tension with the aid of dynamometers and the catenary is terminated. In a subsequent block, the sag is checked and the tension readjusted with ladders, if necessary. 9.6.23 Clamping The Catenary The catenary is clamped on the brackets placed at right angles to the track. 9.6.24 Droppering Droppers are fitted to the catenary at the correct location. At the contact wire ends these droppers may be provided with small pulley or hooks to act as temporary supports when the contact wire is strung. Hooks made of scrap contact wire suspended from the catenary wire, may also be used as temporary supports. 9.6.25 Stringing Contact Wire The contact wire is initially terminated in the contact wire ending clamp of temporary arrangement at one end of the tension length. The wire is then paid out from the reel wagon of the wiring train and supported on the pulleys hung from droppers or on hooks until the terminating point at the other end of the tension length is reached. In curves, the contact wire shall be supported on pulleys located at traction masts or supports corresponding to the approximate final position of the wire. The axes of these pulleys should be more or less vertical.		

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9.6.26 Tensioning Of Contact Wire The contact wire is strained to a tension of approximately 1.2 times the tension corresponding to the ambient temperature and terminated in the ending clamp of the temporary arrangement. 9.6.27 Regulating Equipment In Action The regulating equipment is put into action with the counter weight at the correct height above rail level and with distance between pulleys or the regulating equipment corresponding to a temperature of 35° C. The regulating equipment is then released and brought, into action. The 'U' clamp connection the flexible stranded wire passing round the temporary pulley is also removed. 9.6.28 Final Adjustment The entire installation is left in this condition as long as it is possible preferable for a period not less than 15 days. The temporary pulleys are removed and the conductors terminated in the permanent ending fittings, compensating plates, insulators and turnbuckles. The equalizer plate is kept vertical or at a slightly inclined position by 2 or 3 cm the contact wire being shorter than the catenary and the position of the regulating equipment is checked in relation to, the temperature at the time. The contact wire is clipped on to droppers (in the vertical position) and on the steady arms. Contact wire height at the bracket is adjusted as also the stagger and register arm clearance. 9.6.29 Concluding Remarks If the above method is followed with care, no further adjustment may be needed. 9.6.29.1 It should be ensured that sagging is done carefully and accurately. The adjustment of tension in the catenary after checking of sag, if required, would be easy if a temporary turnbuckle is inserted in the temporary terminations. The use of leveling lathes is recommended for the following reasons:		

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(a) The accuracy of adjustment is greater than that with a dynamometer (b) No traffic block is required for this operation (c) It obviates the necessity of initial tensioning of the catenary accurately this permitting a reduction in the period of traffic block required for the wiring train. 9.6.29.2 If feasible, without any hindrance to progress of works, the catenary may be maintained at stringing tension for a period of 48 hours before checking sag and clamping it to the brackets. This would ensure equalization of tension in the different spans. 9.6.29.3 If it is difficult to obtain a separate traffic block for stringing contact wire, the wire may be paid out at the same time, as the catenary, with the following precautions. (a) The contract wire is run and suspended from independent pulleys hooked on to the brackets, separately from the catenary pulleys to avoid twisting together of the two conductors. (b) The contact wire should not be suspended from the catenary until the later is clamped on to the brackets. (c) The tension in the contact wire before termination should be about 1500 Kgf. This will ensure that sag is not excessive. (d) The adjustment of tension and checking of sag of the catenary wire is carried out as if the contact wire had not been strung only after adjustment of tension and checking of sag is completed, the contact wire is transferred to the pulleys attached to the droppers or to hooks suspended from the catenary and the tension is adjusted as indicated elsewhere.		

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9.6.29.4 When the contract wire is under tension creep takes place which results in an increase in the length of wire and, consequently, the droppers and the equalizer plates would become oblige. Though creep may continue for along time, about a year, the bulk of it would occur during the days following stringing. If sufficient period of time is allowed the contact wire may be clipped to the droppers and the equalizer plates, all in the vertical position and the necessity for any further adjustments before energisation and commissioning of the OHE may be reduced to a great extent. It this precaution is not taken, at the time of energisation of the OHE, the droppers may not all be vertical and staff would have to be detailed for shifting the dropper clips which is attendant with risk of damage to the contact wire. 9.6.29.5 Before the temporary arrangement is removed a reference mark should be made on each conductor. After final termination of the conductors, it should be ensured that two marks are in the same relative longitudinal position as they were before the removal of the temporary arrangement 9.7 <u>INSPECTION AND TESTING</u> 9.7.1 Scope This part deals with the inspection and testing of completely erected overhead equipment. 9.7.2 Overall Performance The overall performance of the overhead equipment should be such as would permit collection of current by electric rolling stock with full load at speeds, upto and including the maximum specified for the design of overhead equipment, smoothly, without mechanical shocks or prejudicial sparks and without undue heating the case of other equipment. 9.7.3 Responsibility The general tests of overall performance stipulated below are only supplementary to other tests on structures foundations, equipments, components and fittings. Any testing and acceptance by the purchaser of		

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overall performance shall be subject to the general terms of guarantee which shall continue to be valid as provided. 9.7.4 Test In OHE 9.7.4.1 General As soon as a section is ready for inspection and testing the contractor shall advise the purchaser in writing. Tests to be carried out by the contractor's representative and shall include the following apart from other reasonable tests that the purchaser of the soundness of the equipment's and their erection in strict compliance with the satisfactions. 9.7.4.2 Insulation The strength of the insulation and the dielectric strength of the entire equipment as installed shall be tested with a 2500 V Megger. 9.7.4.3 Continuity The electrical continuity of the line and the existence of bad contacts, if any, will be tested with a megger. 9.7.4.4 Electrical Independence The electrical independence of individual elementary sections in relation to one another shall be also tested with megger. 9.7.4.5 Switches All isolators shall be tested for smooth and trouble free operation 9.7.4.6 Tension Devices All automatic tensioning devices installed shall be tested for sensitive functioning and adjustment.		

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9.7.4.7 Stagger And Height The stagger and height of contact wire over the entire section of completed overhead equipment and the clearances available shall be measured and the measurement shall be checked against approved drawings. These measurement shall be carried out at low speed with a vehicle or device to be arranged by the contract, the movement of which will follow the track levels as closely as possible. Tolerance that will be permitted on the dimensions indicated in the approved drawings are shown. The actual position of the two contact wires, relative to each other, overlaps and turnouts shall also be checked. Special attention shall be paid to a smooth movement of pantograph over section insulators, particularly those which are likely to be frequently traversed. 9.7.4.8 Mechanical Behaviour The mechanical behavior of the entire equipment shall be tested at various speeds under normal pantographs pressure without energizing the overhead equipment. 9.7.4.9 Energising If the overhead equipment, after being subjected to the above tests in an un-energised condition, is found to be satisfactory, it will be energized with the normal 25 K.V A.C supply. 9.7.4.10 Power Collection Test shall then be conducted to check if the power collection performance of the overhead equipment is satisfactory after ensuring that the contact wire is adequately clean. For this purpose and observation shall be attached next to the electric locomotive. The behavior of the overhead equipment will be watched at various speeds. Power collection shall be considered unsatisfactory if a long blue flash is observed, indicating that the contact between the contact wire and the pantograph is not continuous.		

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10.0 <u>SIGNALLING & TELECOMMUNICATION FOR RAILWAY SIDING</u> 10.1 <u>SCOPE OF WORK</u> 10.1.1 Scope of work is related to Supply installation testing & commissioning of Signalling & Telecommunication (S&T) System along with its allied works in connection with MSPGCL Railway siding for 1x660 MW project. Bidder to specifically note that the following are only the indicative specification related to the work intended and it shall be bidder's responsibility to consult the ruling codes and standard laid out by Indian Railway and other concerned authorities & carry out design, procurement, construction, testing and commissioning of the work intended in this section. Signal Interlocking plan of in plant Yard (1x660 MW project) shall be finalized with railway authorities and MSPGCL. Scope of work shall also include commissioning of related works i.e. Signals, Track circuits, Magneto Telephone etc. at in plant Yard. The signalling and telecommunication material to be supplied by contractor should be as per the latest RDSO(Research Design and Standard Organisation) specification/drawing. Specification, drawings may be purchased from RDSO Lucknow. The complete work should be carried out according to the Technical specifications and drawings approved by the concerned authorities. The bidder shall bring out comprehensive data support by relevant drawing in his bid for Owner's/Owner's consultant for review. 10.1.2 Signal Lighting All the Signals are provided with LED lamps lit on 110V AC. In case of LED lamp failure, Health Monitoring Unit (HMU) shall generate an audio visual alarm that will be provided on control panel.		

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10.1.3 Single Section Digital Axle Counter (SSDAC) System 10.1.3.1 The installation of all indoor & outdoor equipments including resetting arrangement (Reset Box) must be carried out as per detailed instructions given in installation procedure issued by RDSO. The installation manual of original equipment manufacturer should be followed strictly. 10.1.3.2 Station master should be able to reset the axle counter with permission from verification box. Wiring of verification box is also included in the scope of work. 10.1.3.3 Installation, testing and commissioning of SSDAC system along with track side equipments, wheel detection points, reset boxes etc. This includes supply and installation of housing for EJB as per IR specifications. 10.1.3.4 Supply of technical documentation, track section plan and drawing shall be done by contractor. Supply of all miscellaneous stores required for completion of work shall be supplied by contractor. 10.1.3.5 Axle counter system should detect presence of railway vehicle with standard wheel size within defined section of track. It should not detect push trolley, which is having smaller size wheel. System should work independent of poor track conditions and wet/ flooded track. 10.1.3.6 The necessary testing of each detection point and track section shall be done as per methodology prescribed by the manufacturer and also in the specification. 10.1.3.7 The necessary register with suitable Proforma shall be opened for recording of test results as well routine maintenance along with measured readings. 10.1.4 Relay Rack 10.1.4.1 Outer frame of Relay rack for fixing point group relays shall be made of MS angle iron of minimum size of 65x65x8mm.		

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10.1.4.2 Mounting arrangement for 'Q' style/point group relays should be provided by MS angle iron of size 45x45x6. Size of Relay rack should be such that it can accommodate 'Q' style relays in 9 rows with 14 relays in each row. 10.1.4.3 Relay racks should be painted by two coats of good quality enamel paint after installation in EI room/Hut. 10.1.4.4 Arrangement to insulate the relay racks from ground should be provided. 10.1.5 Wiring: 10.1.5.1 The equipments are to be wired in relay room, Station Master's Office, power supply arrangements, as per circuit diagram. The necessary guide lines given have and followed by railway should be strictly followed while preparing the different wiring diagrams. The two copies of each WD should be checked by concerned agencies. 10.1.5.2 Contact numbering for the relays should be made by the contractor as per the approved circuit diagram issued by the railway and type of relay proposed to be used on the installation. 10.1.5.3 Wiring inside one rack for shelf type and plug in type (Metal to Carbon) Contact relays, Relay rack wiring housing plug in type relays conforming to BRS-930 and BRS-931 and shelf type relays conforming to BS-1659 should be done with "PVC" insulated unsheathed flame retarding type single core flexible wire 1100V grade having 0.6/0.2mm annealed copper conductor and nominal cross sectional area of 0.5 Sq.mm of common colour code to the specification IS:694". For wiring these relays the above wires should be terminated in eyelets/lugs of Standard design. 10.1.5.4 Wiring of proven type relays (metal to metal contact) For wiring the above relays the use of single brand tinned copper wire of 0.6mm and 1.0mm/1100V grade PVC insulated flame proof should be used. The use of multi core cable of 100 cores, 60 core, 40 core and 20 core having the above conductor dia and grade is permitted. Size of conductor		

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should be chosen based on current to be carried through these conductors. The wire and cable used should generally conform to IS: 694. 10.1.5.5 The wiring between the terminal board of the panel and the unwired tag block on the relay rack is to be carried out using multi-core cables (40 core or 60 core) 0.6mm/1.0mm diameter annealed lined copper wire to IS-694. The wiring on the Q series relay rack is to be carried out by 16/0.2mm diameter single core multi strand flexible A.T. copper wire to IS: 694. 10.1.5.6 Soldering at the tag block terminals should made using good quality solder and flux. Care must be taken to prevent dropping of excessive solder from terminal thereby causing failure/unwanted connection or short by fusing of PVC insulation in row below it. It is advisable to raise the wires by mechanical means and temporarily interposing a wooden or plastic sheet between the adjacent rows while soldering, to collect the excessive solder that may be dropping out. 10.1.5.7 After testing, the loose wires on the cable ladder should be neatly bunched and laced with twine black. The contractor should adopt suitable colour code for wiring as required by the Railway's representative. Spare conductors to an extent of 10% are to be provided on the interconnecting wire runs for future developments. 10.1.5.8 Various supplies associated with signalling viz., 110V AC, 110V DC, 60V DC, 24V DC, 12/24V AC and 12/24V DC flashing are to be brought out to the relay/equipment room as per instructions. 10.1.5.9 The incoming cables to the relay room are to be neatly arranged and fixed to the cable supporting and guiding rack. The duct should be filled with sand and plastered neatly to avoid entry of mice or reptiles. 10.1.5.10 After the complete testing and before commissioning the installation, the contractor should arrange necessary sealing leads and wires for sealing the relays. 10.1.5.11 The nomenclature of each relay should be painted both in front and rear side of each relay with contact configuration. The relay index sheet duly painted of details of relay and their position in the relay rack should be manufactured out of Decolum/Novapan sheet and fixed in the relay room.		

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All the relays to be plugged should be checked visually and defect if any, noticed should be replaced, duly reporting the same to the Railways. As made relay rack wiring and contact chart of all relays should be prepared in linen/polyester sheets, duly signed and handed over for preparation of handing over documents to maintenance organisation. 10.1.5.12 Suitable arrangements should be made in the relay rack for fixing condenser and resistance unit, required for slow to release feature. Letter painting should be made against each unit to identify circuit for which it is used. 10.1.5.13 All circuits should be carefully protected by individual fuses in the relay room and locations grouped preferably to facilitate easy fault location. Fuses should be so arranged that they can be easily be placed without causing interference of fuses and the circuits in which they are used should be prepared and kept in the relay room. Fuses for all Signalling circuits should be of the non-deteriorating type as per RDSO specification. 10.1.6 Power Supply System 10.1.6.1 10 KVA DG set with sound proof enclosures, anti vibration mountings and AMF panel is to be installed at Reception yard. Specifications of DG set are given below: Alternator : The Alternator shall be self excited and self regulated of 10 KVA rating in single phase at 240 Volt, 50 Hz, 1500 RPM and 0.8 power factor (lag) and shall conform to IS:13364 (Part 1):1992(reaffirmed 2003). The alternators shall be of brush less type with VG-1 Grade of voltage regulation. The alternators shall be screen-protected drip proof with Min.IP-21 degree of protection as per IS:4691/85.The class of insulation of the Alternator would be 'H'. The rated voltage of Alternator will be 240V single phase. The alternator shall also have following features: - $\pm 1.0\%$ voltage regulation (max.) in static conditions. - Permissible overload of 10% above rated capacity for one hour in 11 hours of operation.		

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10.1.6.2 Diesel engine: Diesel Engine shall be liquid cooled, electric start, developing 18 B.H.P at 1500 RPM with Class A-2 Governing or better for alternator to deliver 10 continuous KVA output at 0.8 lagging pf at NTP conditions(all rating shall be tested at 0.8 PF). The Diesel Engine should be capable of providing 10% overload for one hour for every 11 hours continuous running at full load. Naturally aspirated engines shall conform to IS:10000-1/81 series and engines upto and including 19 KW rating shall be ISI marked and IS:10000-2/81 for engines above 19 KW. Pressure charged engine shall conform to IS:13018/1990 (reaffirmed 2000). The Diesel Engine shall be complete with the following accessories: (a) Fuel tank with capacity for minimum 8 hours continuous running at full load. (b) Engine instrument Panel consisting of starting switch with Key, Lube Oil temperature and pressure gauges, (water temperature gauge in case of water cooled engines), RPM indicator and hour meter. (c) Safety controls to shut down the engine in the event of low lube oil pressure or high cylinder head temperature in case of air-cooled engines or high water temperature in case of water-cooled engines. (d) Radiators for liquid-cooled engines. (e) Exhaust silencer of Residential type. (f) 12V starting system complete with starter motor, charging alternator and Cutout. (g) Lead Acid Battery/ies of suitable ratings with connecting cables. battery/ies shall be supplied in uncharged conditions and shall conform to relevant IS Specn.		

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(h) Standard set of tools consisting of a set of 3 spanners, one screw driver, one standard plier and one nose plier of appropriate size shall be provided to the DDOs along with DG sets free of cost for each of DG sets. 10.1.6.3 Enclosures and Mounting Arrangement: DG Sets shall be provided with integrated accoustic enclosure which should conform to CPCB (Central Pollution Control Board) norms in respect of noise and emission norms. DG sets shall also meet all other statutory requirements as notified by Govt. from time to time. Engine and Alternator shall be mounted on a common MS fabricated base frame with AVM pads. 10.1.6.4 AMF panel The AMF Control Panel shall have the following instruments : (a) Microprocessor based with composite meter for digital display of- (i) Generator voltage/ AC Mains voltage. (ii) Generator Current. (iii) Power Factor. (iv) Three attempts engine start/engine cranking relay. (v) On -delay timer for load change over (vi) On-delay timer for engine shut off (b) Mode selector switch for setting the panel on any one position such as off or auto or manual, or test. (c) Engine On-Off switch (Push button type) (d) MCCB of suitable rating shall be provided.		

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(e) Rectangular aluminum bus bars (one number for each phase, neutral and Earthing terminal) of adequate ratings duly colour coded with heat shrinkable PVC sleeves. (f) Two contactors of suitable rating (one for DG set & one for AC mains) with over load relay. (g) Under-voltage relay for mains. (h) Battery charger complete with voltage regulator, float or booster selector switch, on-off switch, voltmeter and ammeter for charging the battery from mains. This will be in addition to the battery charging alternator fitted on the engine. (i) Instrument & Control Fuses. (j) Five number indicating lamps to indicate 'mains ON', 'load on mains', 'set running', 'load on set' and 'battery charger on'. (k) Audio visual alarm for 'Low lubricating oil pressure', 'High water temperature' (for water/liquid cooled), 'High cylinder head temperature'(for air cooled), 'Start failure' and 'DG over load'. (l) Any other switch, instrument, relay or contactor etc. essential for smooth and trouble free functioning of DG set with AMF panel. (To be specified by the bidders in their offer with complete detail of the item). 10.1.7 Telephones: Electronic magneto Telephones should be provided between Panel Room, ESM and relay room. Desk type Magneto telephone should be fixed on the telephone stands/Location boxes/battery boxes. The wooden stand should be fabricated by the contractor and firmly fixed on to the wall if installed in station building platform/gate lodge. A suitable wooden box should be manufactured for telephone battery with locking arrangements and fixed near the telephone. Telephones if installed in Location boxes/battery boxes near the top points/siding points/home signals it should be securely fixed on wooden shelves. Telephone battery should be kept in the same Location		

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Box/battery box. It should be ensured that no other gadgets should be kept in the Location Box/battery box and separate door lock arrangements should be made to protect the telephone battery if installed near home signal/top point/siding points for traffic purpose. At point machine location the termination should be available for connecting a telephone with station master.		
10.1.8	Block Instruments	
Token less Single line block instruments should be installed as per guidelines given in signal engineering manual. The block proving by single section digital axle counter has to be provided. Block filter unit should be installed as per standards of 25KV RE area.		
10.1.8.1	Block circuit wiring	
The line wires from the point where the lines of two adjacent block sections meet to the terminating point on or near the building shall either be insulated or be so erected as to be not less than 150 mm from any other wire. The provision of insulated wires should be preferred.		
10.1.8.2	The insulated line wires must be easily accessible. Alternatively, a cable, suitably protected, may be used, but a separate cable should be provided for each instrument circuit. The insulated line wires must be led in sloping upward to the building, otherwise a drip loop should be provided.	
10.1.8.3	The wires leading into the building from the terminating point shall be adequately separated from the wires of other circuits and shall be single, braided or metal sheathed run in one length from the pot-heat insulator to the test panel. Alternatively, a cable, suitably protected, may be used, but a separate cable should be provided for each block instrument circuit.	
10.1.9	Indoor wires:	
10.1.9.1	Indoor wires must run in toughing or other suitable form of trunking which provided protection from interference and separation from the wires of any other circuit.	

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10.1.9.2 All wires of cables shall be in accordance with the Indian Railway Standard Specification or other approved specification. 10.1.9.3 Lightning Dischargers shall not be located in the Block Instrument but installed separately and shall be the demarcating point for test purposes. 10.1.10 Protective Measures Against Power Line Parallelism 10.1.10.1 It shall be ensured that induced voltage due to power line parallelism does not exceed 150V and the short circuit fault current does not exceed 430V as prescribed by CCITT. 10.1.10.2 If the induced voltage goes beyond these limits, overhead block circuit shall be transferred to an underground telecom. PET quad cable/ OFC / Radio, so as to bring the induced voltage within the permissible limits. 10.1.10.3 Since the immunity of PR relay is only up to 10V, block filter shall be used in all block instruments using this relay where this limit is exceeded. 10.1.10.4 Block filters shall be used with handle type block instruments using frequency coded signal, where diodes have been used in line circuits. 10.1.10.5 Use of single line push button token less block instruments is permitted in sections where length of parallelism does not exceed 1.5Km., so as to ensure that the DC coding used in these block instruments is not mutilated. 10.1.11 Earth 10.1.11.1 A separate earth shall be provided for each instrument. The earth shall be of an approved type and should be buried at depth of not less than 1.5m and at a distance not less than 2.5m from any other earth. The resistance of the earth should not be more than 10 ohms. 10.1.11.2 The length of the Earth wire shall be as short as possible and cross section of the wire not smaller than the size of the line wire and in any case shall not be smaller than 4mm dia. The earth wire shall not have a sharp bend or spiral. Earth wire should be adequately protected from mechanical injury and be efficiently connected to the earth. All connections to the		

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earth shall be well soldered. 10.1.12 Where two or more block instruments are located in the same room, they shall be fitted with bell units / bell buzzers of distinctive tones. 10.1.13 Painting of indoor gears: All signalling equipments should be painted in accordance with signal engineering manual 10.1.13.1 Painting equipment Rack and wiring all equipment numbering details, painting of hard wood planks provided on the equipment rack and power board racks, details of equipment fixed on power board. 10.1.13.2 Painting numbering on secondary cells, writing circuit details in the battery room as instructed by Section Engineer at site. 10.1.13.3 Painting all termination particulars in the panel, block instruments, EKT's Crank Handle box, axle counter resetting box, resetting plunger box in the SM's Office/Panel room. 10.1.14 Testing and commissioning: The different stages and procedures for testing of indoor and outdoor equipments are given below as guidance: - Testing and commissioning consist of testing of selection circuits, for proper functioning of track circuits, signals and points as per SEM. Energizing and testing of power cables, stabilizers, secondary cells for all circuits, energizing and testing of colours light signals and final commissioning of the entire signalling arrangements for traffic use. All the alterations for improving safety should be carried out before commissioning. The equipments should be first tested by the contractor and then jointly with Site Engineer. The contractor should provide simulation test panel for testing at his own cost. The different stage and procedures for testing of indoor and outdoor equipments are given below as guidance. However detail testing should be done in consultation with Site Engineer.		

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<u>STAGE – I</u> TESTING OF THE RELAY INTERLOCKING (INDOOR) <u>STAGE – II</u> TESTING OF THE OUTDOOR GEARS, Viz., POINTS, SIGNALS, TRACK CIRCUITS, LC GATES ETC. 10.1.15 Testing of interlocking: Testing of relay interlocking consist of: 10.1.15.1 Energisation of relays by connecting the simulation panel. 10.1.15.2 Clearing of signals on the simulation panel and carrying out the following tests as per table of control :- (a) Route test (b) Dead/ Approach locking tests (c) Route/Back locking tests (d) Testing of conflicting signals (e) All other circuits viz., SM's key, HLR, LXPR, KLCPR are proved correctly in the respective signalling circuits 10.1.16 Testing Of Outdoor Gears Testing of outdoor gears consists of testing all the outdoor signalling gears for correspondence and proper functioning: - (a) Signals (b) Motor operated points (c) Track circuits		

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(d) LC gates (Interlocked) (e) Sidings (f) Slots 10.1.17 Commissioning Of Panel Commissioning of panel consists of: - 10.1.17.1 Testing all points & signals from panel 10.1.17.2 Checking the correspondence between the points and their panel indications. 10.1.17.3 Checking the correspondence between the track circuits and its panel indications. 10.1.17.4 Testing of sidings, its electrical transmission of EKT, panel indications. 10.1.17.5 Testing of LC gates, its electrical transmission of EKT, panel indications. 10.1.18 Testing of relay interlocking energisation of relays by connecting simulation panel: 10.1.18.1 For major yards, it is preferable to energise relays, circuitwise and sheetwise, since it involves number of routes and parallel movements. For way station, it is preferable to energise the circuit, route wise. Before taking up the above energisation, the following work should be completed. (a) Wire to wire bell-test of all sheets before soldering and after soldering. (b) Plugging of all relays as per contact configuration. Before plugging of relays, all fingers are to be checked. Any finger found loose or not properly hooked is to be set right. (c) Power supply arrangement with batteries.		

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(d) Connecting the simulation panel. (i) It should be possible to control all TPRs, NWKR/RWKR, CHLRs, KLCRs, LXCPRs etc., from the simulation panel by energising all the relays. (ii) It is desirable to have the simulation panel adjacent to control panel so that the panel indication can be observed simultaneously while testing. 10.1.19 Simulation Panel Simulation panel consists of two Boards:- 10.1.19.1 Board no. 1:- It depicts the yard (painted) with points, track circuits, LC gates and slots. Switches are fixed on the boards to simulate the conditions of the points, track circuits, interlocked LC gates, slots etc. Track circuit switches are fixed on the track. Point control switches are fixed nearer to the points, for small yards. For major yards the switches are grouped as point switches and track circuit switches. Functions requiring ON and OFF switch (with make and break facility i.e. two wires only) with facility to pick up a relay in one position and drop the same in other position. Example: Switch OFF - Track Down - TPR dropped. Switch ON - Track pick up - TPR picked up. For controlling the following function the above type switches should be used: - (a) Track circuits (b) Siding point (c) Crank handle (d) Slot		

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(e) LC gate

Points require ON and OFF switches with facility to pick up conflicting relays (i.e. NWKR and RWKR) in two positions. (These switches require three wires).

10.1.19.2 Board no. 2:-

To simulate the signals the following bulbs are used as dummy loads for the ECRs to pick up and also to observe the aspect of the signals during testing.

(a)	ON aspect	110 V 40 W
(b)	OFF aspect	110 V 25 W
(c)	Route aspect	110 V 75 W

10.1.19.3 Wiring simulation panel to the relay room side wiring at MDF.

Disconnect all the links on cable termination rack. Wires from the switches are connected to the relay room side termination. Similarly the wires from simulation panel board No.2 consisting of lamps are connected to the relay room sides termination.

Multi core 0.6mm dia. cable is used for wiring the simulation boards. To reduce the voltage drop, more conductors are used for supply taken to the test panel and also to the negative since common return is used.

10.1.20 Testing Of Signals

10.1.20.1 Signals should be initially tested from the LOC box to attend to minor troubles of bulb holders, wiring etc.,

10.1.20.2 All the aspects should be checked by giving 110 V AC feed from Loc. Box and then the test should be repeated by giving feed from Relay room CT rack. This test should be done for each aspect, route and pilot lamp of shunt signals.

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10.1.20.3 Care should be taken to ensure that no train is approaching during this test to avoid misleading information to drivers. 10.1.20.4 Ensure that signal number plate is provided and unit back door is fastened and locked properly. Door locking is very important to prevent sun rays falling on to lenses to give phantom indications. 10.1.20.5 Focus the signal aspects, record the aspect voltages and ensure that it is within the permissible limit (90% of rated voltage of the bulb). 10.1.21 Testing Of Points 10.1.21.1 Points Should be tested first locally from the location box when point contactor unit kept in location. Before commencing this test, ensure 110 V DC, 24 V DC are available in location box. If it is cross over point, it is preferable test one by one and then test both at a time. 10.1.21.2 Siemens Points Contactor Unit Connect N 24 V to W4, connect B 24 V to W1, then remove so that N/R picks up and holds, then touch B24 V to W3 to operate points from normal to reverse. All the relays in point contactor unit operate as required and relays in point operated from N to R. Check up whether NWKR supply to relay room is available. For reverse to normal operation, keep N 24 V in W4 touch B 24V on W1 and then on W2. Point operates from reverse to normal. Check up the RWKR supply to relay room is available. The following tests should be carried out on Pt. Machines:- (a) Obstruction test (b) Detection contact break test. (c) Out of correspondence test (in case of cross over point). (d) Track locking test (to be done when operated from panel). This test is to be done for both N to R and R to N operations.		

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(e) Whether point can be hand cranked with interlocked crank handle. (f) Check the correspondence between point position at site, both the ends in case of crossover and NWKR / RWKR in relay room (to be done when tested from panel). 10.1.22 Testing Of Slot Circuits Wherever end panels are available, inter cabin slot circuits should be tested. Slot circuits can be tested similar to that of signal HR circuits. <table border="0"> <thead> <tr> <th></th><th>SLOT CIRCUIT RELAY</th><th>SIMILAR RELAY IN HR CIRCUIT</th></tr> </thead> <tbody> <tr> <td>(a)</td><td>SLRR</td><td>RR</td></tr> <tr> <td>(b)</td><td>SLUCR</td><td>UCR</td></tr> <tr> <td>(c)</td><td>OVSR</td><td>ASR</td></tr> <tr> <td>(d)</td><td>OVYR</td><td>HR</td></tr> </tbody> </table> Negative tests, approach-locking tests, back lock/route holding tests, cancellation of slots should be tested similar to that of any signal in the yard as given in table of control. 10.1.23 Commissioning Of Panel 10.1.23.1 Check up all signal aspects by directly feeding from cable termination rack (110 V AC). Check up operation of points from C.T. rack and check whether NWKR/RWKR incoming feed is available (by connecting 24V DC to W1, W2, W3 & W4 as explained earlier). 10.1.23.2 Check up the incoming feed of TPRs in the C.T. rack. The above checking will confirm the pairing of cable conductors. Remove the wiring connection of simulation board on cable termination rack and make through the links of all TPRs, WKR and signal circuits.				SLOT CIRCUIT RELAY	SIMILAR RELAY IN HR CIRCUIT	(a)	SLRR	RR	(b)	SLUCR	UCR	(c)	OVSR	ASR	(d)	OVYR	HR
	SLOT CIRCUIT RELAY	SIMILAR RELAY IN HR CIRCUIT															
(a)	SLRR	RR															
(b)	SLUCR	UCR															
(c)	OVSR	ASR															
(d)	OVYR	HR															

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First test the points from panel individually and conduct all tests discussed earlier including track locking test, correspondence between point position and NWKR/RWKR in relay room. 10.1.23.3 Check whether all TPRs have picked up and check up the panel indication by individually by dropping each track circuit correspond correctly. 10.1.23.4 Check whether all other required relays viz., CHLR, LXPR, KLCR have picked up. 10.1.23.5 Test all the signals from panel. 10.1.23.6 Check the correspondence between relay from and signal aspects, which is most important. For checking the aspects of home signals, distant signals, staff (not below the rank of Site Engineer) should be deputed to site with walkie-talkie or Magneto telephone and check the correspondence. 10.1.23.7 Remove the signal lamp at site of every aspect and check whether indication disappears on the panel and ECR drops in the relay room. 10.1.23.8 Open all the registers and make entries of counter numbers before handing over to operating staff. 10.1.23.9 Testing and Commissioning of Interlocked Level crossing lifting Barrier THE FOLLOWING REGISTERS SHOULD BE HANDED OVER TO OPERATING STAFF. (a) Relay room key register, (b) Route cancellation register, (c) Crank handle register, (d) Axle counter reset register, Sealing of equipments where required should be done. Entries should be made in the signal history book regarding new S&T assets commissioned.		

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Testing & Commissioning of Panel at Level Crossing Gate. (i) The Level crossing gate should be operating with 24 V DC from Gate Panel provided at the gate lodge. The movement of barriers must be smooth in opening and closing conditions. There shall not be any jerking movement in the barriers while the gate is being closed or opened (ii) The LC gate shall be at 90 degrees while in fully opened condition. (iii) The height of the gate in closed condition shall not be more than 1 meter from the road level. (iv) When the gate is closed, the complete closing of the LC gate shall be ensured through the electrical connection provided through the Circuit breakers and reed switches provided with the level crossing gate assembly. (v) Once the Level crossing gate is closed and signals are lowered, it shall not be possible for the gateman to open the gate until a. the entire train has passed and the signals are gone to On Position. - Or b. 120 seconds after the signals are put back to ON position by the gateman (vi) It shall not be possible to lower any of the gate Home signal until the complete closing and locking of the LC gate has been ensured. (vii) The Gate Home signals shall be replaced to Danger (ON) automatically after passing of the home signals by train in either direction. (viii) It shall not be possible to lower both the Home Signals at a time.		

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(ix) The Signals shall be operated by a Domino panel placed at the Gate lodge. The panel shall indicate the position of all signals and track circuit. 10.1.24 General 10.1.24.1 Signal and interlocking fittings All signal and interlocking fittings should be in accordance with I.R.S. Specification No.S-10 unless other wise specified. 10.1.24.2 All relay interlocking principles contained in I.R.S. S-36 should be applicable for all relay interlocking works. 10.1.25 As made details: After commissioning of the entire installation and approval of draft completion drawings by concern authorities, tracings of documents and plans should be made by the contractor on tracing film of standard size as per tender schedule. 10.1.26 VHF Communication 25 W VHF as per following specifications should be supplied and installed at each of the three panel buildings with 15 mtrs Self supporting mast and antenna. 5 watt VHF sets are to be provided to operating & maintenance staff.		

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<u>TECHNICAL SPECIFICATION</u> <u>5W PORTABLE (HAND HELD) RADIO</u>			
<u>SR.NO.</u>	<u>ITEMS</u>		
1.0	<u>GENERAL :</u>		
1.1	Operation	:	Simplex/Semi duplex with PTT
1.2	Modulation	:	Frequency Modulation (Phase)
1.3	Power Supply	:	1800 mAH, 7.5V, ultra high capacity Ni-MH Battery.
1.4	Frequency Band	:	146-174 MHz.
1.5	Number of Channel	:	16 Channel
1.6	Channel spacing	:	Programmable 12.5/20/25 KHz.
1.7	Frequency stability	:	± 5 ppm.
2.0	<u>TRANSMITTER :,</u>		
2.1	Power output	:	5 Watt.
2.2	Spurious Emission	:	Less than 0.25 Micro Watt.
2.3	A/F Response	:	+ 1 to -3 Db
2.4	Audio distortion	:	Less than 5%.
3.0	<u>RECEIVER :</u>		
3.1	Sensitivity	:	0.30 Micro Volt or better for 12 dB SINAD
3.2	Selectivity	:	Better than 60 dB.
3.3	A/F Response	:	+1 to -3 dB

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3.4	Audio output	:	500 mW.	
4.0	Accessories : Following accessories to be provided with each set.			
4.1	Helical Antenna for Handheld set	:	1 No.	
4.2	Leather case/Belt Clip	:	1 No.	
4.3	Single Unit Rapid Battery Charger for 1800 mAH, 7.5V, Ni-MH battery	:	1 No.	

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<u>SPECIFICATIONS OF 25W VHF RADIO</u>			
<u>SR.NO.</u>	<u>PARAMETERS</u>		<u>CHARACTERISTICS</u>
1.0	<u>GENERAL</u>		
1.1	Frequency Range	:	146TO 174 MHz
1.2	Channel Spacing	:	12.5kHz or 25 kHz
1.3	Emission	:	8K503E OR 16KOF3E
1.4	Frequency Spread	:	28 MHz
1.5	Frequency Stability	:	5 PPM
1.6	Type of Operation	:	Simple / Semi-duplex, Press to talk
1.7	Operating Temperature Range	:	-30°C TO 55°C
1.8	Speaker Impedance	:	8Ω
2.0	<u>TRANSMITTER</u>		
2.1	RF Power Output	:	10 TO 25 WATT
2.2	Frequency Deviation	:	+/- 5 KHz (W type), +/- 2.5 KHz (N type),
2.3	Modulation Sensitivity	:	80 mV for 60% max. deviation at 1000Hz.
2.4	Modulation fidelity	:	Within +1,3 dB of 6dB / Octave
2.5	Spurious and Harmonics	:	-36 dBm. (.25uW)
2.6	Output Impedance	:	50Ω
3.0	<u>RECEIVER</u>		
3.1	Sensitivity	:	0.3μV/-118dbm at 12dB SINAD

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<u>SR.NO.</u>	<u>PARAMETERS</u>		<u>CHARACTERISTICS</u>	
3.2	Selectivity	:	Better than 60dB	
3.3	Image and Spurious rejection	:	Better than 65dB	
3.4	AF distortion	:	Better than 5%	
3.5	Audio output	:	Better than 250 mw with less than 5% distortion at 1 kHz. Ref. measured at specified AF output.	
3.6	Squelch Sensitivity	:	Better than -119 dbm	
3.7	AF Response	:	Within +1, -3dB of 6dB/Octave	

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<u>SPECIFICATINS (POWER SUPPLY FOR 25W VHF SET)</u>				
<u>SR.NO.</u>	<u>ITEMS</u>			
1.0	<u>GENERAL</u>			
1.1.	SCOPE	:	This specification defines the performance characteristics of a 13.5V, 15 AMPs Equipment supply cum battery charger operating on single phase AC supply.	
2.0	<u>INPUT REQUIREMENTS</u>	:		
2.1.	Phase	:	Single phase, 2 wire and ground	
2.2.	Input Frequency	:	50Hz $\pm$ 3Hz	
2.3.	Input Voltage	:	170 to 270 VAC rms.	
2.4.	Efficiency	:	>75% at 230 VAC input, with Output Full load.	
3.0	<u>OUTPUT CHARACTERISTICS</u>			
3.1.	Outputs	:	Equipment supply $\rightarrow$ 13.5V at 15,0 Amps. Max. (When battery drawing No. Current) Battery supply $\rightarrow$ 13.5V at 7.0 Amps max. Battery is to be directly floated across the load, however it has separate terminals. Battery is connected to the load through a fuse and reverse polarity protection circuit.	
3.2.	Output Voltage Regulation	:	Load output (with battery disconnected) will be regulated with in $\pm$ 2% with battery connected will follow the battery voltage.	

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3.3.	Ripple & Noise	:	Ripple on output load terminal (with battery disconnected) will be less than 135mV. Noise will be less than 270mV Pk-Pk.
3.4.	Battery Charging	:	Battery Charging will take place with constant current, Maximum charging current of the battery is limited to 7.0A +20%, Maximum charging voltage is set at 13.5V $\pm$ 2%.
4.0	<u>PROTECTIONS</u>		
4.1.	Output Over Voltage Protection	:	PSU shall trip on over voltage condition (between 15V to 16V) and resume to normal operation on removal of fault condition and AC power recycling with 20Sec. Interval between switch OFF and ON.
4.2.	Output Over Load and Short Circuit Protection	:	Output folds back on over power and resumes normal operation on removal of over power condition. On Short circuit, power supply goes into hick up mode or putput filds back. It resumes normal operation on removal of the Short.
4.3.	Battery Reverse Polarity Protection	:	On reverse polarity, a fuse of 15A rating mounted on the rear panel will below isolating battery from the equipment.
5.0	<u>INDICATIONS</u>		
5.1.	Mains On Indicator	:	Will be ON when AC is available.
5.2.	Battery On Indicator	:	Will be ON when battery is supplying

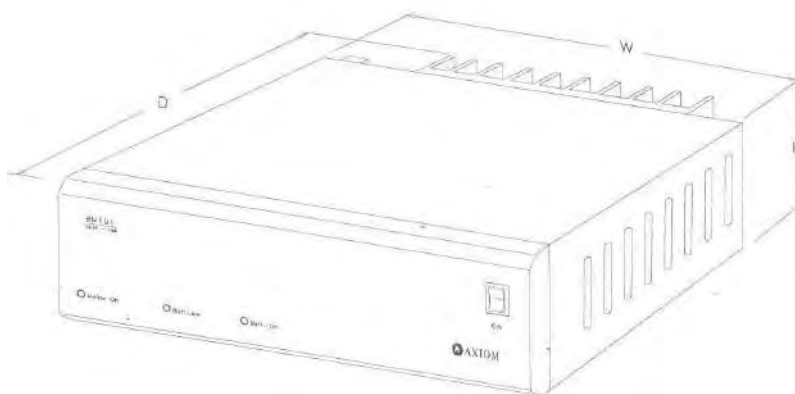
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			power to the Radio.	
5.3.	Battery Low Indicator	:	Will be ON when Battery is < 11.4V.	
6.0	<u>COOLING</u>	:	Free air convection cooling.	
7.0	<u>ENVIRONMENT</u>			
7.1.	Temperature	:	Operation -5 to +50 °C Storage -5 to +60 °C	
7.2.	Humidity	:	Operation 5 %RH to 85% RH non-considering Storage 5 %RH to 95% RH non-considering	
8.0	<u>PRODUCT SAFETY</u>			
8.1.	Di-Electric Voltage Withstand test	:	Tested at 1.5KVAC rms at 50Hz for 60 sec. With a trip current of 5mA. 1 Between INPUT and CHASSIS. 2 Between INPUT and OUTPUT.	
8.2.	Earth Ground Resistance	:	To be less than 200mΩwith a test current of 10A through GND.	
9.0	<u>ENCLOSURE</u>			
9.1.	Dimensions	:	W=190mm H=75mm D=195mm.	
9.2.	Weight (Unpacked)	:	Approx. 1.9kgs.	

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10.1.27 Cable Laying

10.1.27.1 Cable plan:

Cable plan with distribution chart for each cable should be prepared for each station by the contractor leaving adequate spare conductors in each cable i.e. **20% of working** conductors on each cable should be left spare upto outer most points and 10% beyond outer most points. Provision should also be made for additional cable conductors required for repeater relays as per 25KV AC electrified section – The similar cable layout plans should be prepared for telecommunication cables. The necessary approval of layout plan and cable core distribution chart etc. should be obtained from the site engineer before start of cable laying work. Copy of this plan should also be sent to client. A distance of approximately 10 cm. must be maintained between Telecommunication cable and Signalling cables. The Signalling cables must be separated from power cables by a row of bricks between them.

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10.1.27.2 Cable trench:

Excavation of cable trench should be made in all kinds of soils including clearing roots of trees, rocks etc., to a depth of 1.0 m and to a width of not less than 0.30 m, proper protection as required by Site Engineer should be provided while crossing power cables, pipe lines, gas lines etc. The bottom of the trench should be leveled and got rid of any sharp materials. Trenches should be straight as far as possible and steep angles should be avoided. Alignment of the main cable route as well as track/road crossings will be indicated in the cable layout plan.

- (a) Signalling/Power cables should be laid as close to the track as possible in the station limit but not less than 3 m from the nearest track centre. The cable track separation distance both within station limits and in the block section generally not to exceed 6 metres. However outside the station limits, the cables should generally be laid at not less than 5.5 metres from the centre or the nearest track.
- (b) It is desirable that the excavation of trenches is not done in long lengths and does not remain uncovered overnight. It is preferable that trenches are dug, cable laid and refilling done on the same day.
- (c) Wherever rock formation is encountered and trenching cannot be done to a depth of one metre, the trench should be dug as far as possible and protective measures taken to avoid damages of cable as decided by site engineer. The drawing in this regard shall be given by OWNER/CONSULTANT. Payment of trenching should be made proportionate to the depth of trench and no payment should be made for any extra excavation carried out in the slope and width of the trench. The contractor, who supervises the excavation, should take the shoring materials ready on hand, so that on banks where ashes or loose materials are encountered, shoring can be adopted. However, the minimum depth should not be less than 300 mm for laying DWC pipes in hard morrum. Whenever rocky soil is experienced, concreting has to be done for a depth of 150 mm after laying the cables to protect them.

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(d) During excavation of the trenches, the earth should not be thrown on the ballast. The earth should be thrown by the side of the trenches, away from the track. Complete excavated earth should be back filled in the trench after laying the cable and well rammed. (e) Wherever Power Cables are to be laid alongwith other cables bricks are to be laid lengthwise approximately, five bricks per metre for separating Power Cables from other Signalling Cables. 10.1.27.3 Before the cables are laid, a visual inspection of cable should be made and it should be tested for insulation and continuity of cores. The insulation resistance of new cable should not be below 500 MOhms per KM at 20 degrees centigrade. The cable meggering record should be maintained in a register and should be signed by contractor's representative & Owner's representative. If there is wide disparity between insulation of different conductors, the conditions of the cable should be thoroughly checked before permitting its use. Bedding and armoring should be inspected to see that there has been no damage during transit or in storage. In case where the wheels are not available or the area is not convenient for rolling the wheels along with route, the drum should be mounted on the axle at one end of trench and cable paved out. It should be carried out by adequate number of men ensuring that the insulation of the cable is not damaged and no kink/twist is formed. In no case should the drum be rolled on the road for laying of cables and the cable dragged on the ground for laying purposes. The cables should be laid gently into the trench and not thrown out under any circumstances. Before laying of cable in the trench, a visual inspection should be adequate for any damage or defect through out its length. Normally, cable laying should be commenced only after the relay room and cable termination box on the route at the respective stations are ready, and the cable should be duly terminated at the relay room/Location Boxes, immediately after the cables are laid. However, if for any reasons the cables are to be laid in advance, special care should be taken to ensure that the coiled cable near the relay room/Location Box is fully protected before and during final termination. The coiled cable should be fully covered with a layer of bricks in its entire length and provided with adequate number of cable markers. On no occasion the ends of the cable should be left		

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unprotected. The cable ends should be sealed with cable compound. All the cable terminals should be sign written with point describing the function. 10.1.27.4 Cable laying should commence only after the depth and width of trench, quality of bricks and sand are jointly inspected by the Site Engineer and Contractor's representative and approved. The necessary record of such approvals should be maintained in a register. 10.1.27.5 Cable should not be normally taken over the running tracks at the time of cable laying by the contractor as this is likely to cause accident to trains and damage to cable. If at any time the cable has to be taken across the track either in full drums or in spread out conditions, it should be done only in the presence of site engineer and also after safety precautions have been taken to post flagmen on all the sides as may be required to stop any train approaching the site of the fouled line. The stationmaster should be informed in writing and a acknowledgement obtained for this work. 10.1.27.6 At each end of the main cable/tail cable/power cables an extra coil length of 6 to 8 metres should be kept. 10.1.27.7 At the time of commissioning of cables, the insulation values of the cable should again be checked and the value obtained should not be below 500 M.Ohms per KM at 20 degree C. If there is wide disparity between insulation of different conductors, the conditions of the cable should be thoroughly checked before permitting its use. The readings should be recorded in a register called Cable Insulation Record Register. This should be recorded for all cables. 10.1.27.8 The Contractor thereafter should supply the completion cable layout/termination plan and cable route plan showing the distance of cables from the nearest track centre at every 30 M interval and location of location boxes. The distance of location box from nearest track centre should be indicated. 10.1.27.9 After the signaling cable/power cables are laid, one layer of country bricks of size 225mm x112mm x 75mm (9 bricks per Mtr.) approximately, should be placed closely in breadth wise.		

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10.1.27.10 Refilling of the cable trenches with the earth and placing and concreting of cable markers at an interval of 30 M throughout the cable route and also on either side of track crossings along the cable route should be done. The cable marker should be concreted to a depth of 0.3 M from the top of the cable marker to avoid theft. 10.1.27.11 As unscreened signalling cables are used, the necessary arrangements are made to comply with the instructions issued at Part 'B' of Special requirements of signalling in AC electrified area (1989) with latest amendments. 10.1.27.12 Contractor should be fully responsible for making necessary preventive arrangements to avoid theft/damage to cables, during construction period and also up to handing over of station after commissioning. 10.1.28 Track/Road Crossings Wherever signalling/power cable has to cross the track/road, it should be ensured that: 10.1.28.1 The cable crosses the track/road at right angles to track as far as feasible. 10.1.28.2 The cable normally does not cross in between or inside points and crossings. 10.1.28.3 The track/road crossings shall be carried out as per standard specification 10.1.28.4 The work includes removal of ballast, cutting of trench across track/road at the places indicated by the Site Engineer and covering the trenches after placing DWC pipe/pipes in position. 10.1.28.5 HDPE DWC pipe/pipes 120/200 mm outer dia. should be provided for track/road crossings. For each road crossing, required number of DWC pipes should be provided depending upon the width of the road and number of cables.		

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10.1.29

Hdpe Double Wall Corrugated Pipe

All the cables in road /track crossing should be laid inside the HDPE DWC pipe. It shall confirm to IS:14930 part-II and be used for track crossing and FOB crossings.

10.1.30

Technical Data Sheet

Type of pipe	Outer Wall
Double Wall Corrugated (DWC) pipes OF hdpe	Being Corrugated imparts, excellent ring stiffness (compression strength)
Inner Wall	Colour
Smooth allowing easy insertion of cables	Black outer wall with non-black inner wall. Other colours on request
Jointing	Fittings available
Snap-fir couplers	End Caps
Heat shrink sleeves	Belnds
Electro butt-welding	Tees
Screw type compression couplers	Reducers
Split couplers	Spacers

Material	Governing specification
High Density Polyethylene (HDPE)	IS-14930 (Part-II)

Dimensions :

Nomin al Size	mm	50	63	77	90	110	120	145	160	175	200
O.D.	mm	50	63	77	90	110	120	145	160	175	200

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I.D.	mm	38	51	63	75	95	102.5	12	135	147	174																																																																																																																																																
Min. Bending	Radius	700	1100	1100	2000	3600	3600	N/A	N/A	N/A	N/A																																																																																																																																																
I.D. of Coil	mm	1400	750	N/A	NA	NA	NA	N/A	N/A	N/A	N/A																																																																																																																																																
<table border="1"> <tr> <th colspan="6">Compression strength</th><th colspan="6">Impact strength</th></tr> <tr> <td colspan="6">Compression strength at 5% applied</td><td colspan="6">5 kg striker falling through a height of 570 MM</td></tr> <tr> <td colspan="6">Deflection load $\geq 450N$</td><td colspan="6">Energy = 28 joules</td></tr> <tr> <th colspan="6">Bending test</th><th colspan="6">External influences</th></tr> <tr> <td colspan="6">While bent at a bending radius given In Dimensions table, a sphere of Diameter 95% of ID passes smoothly At room temperature & - 5° C.</td><td colspan="6">Ingress of dust-the joint is dust proof. Ingress of water-the joint is water proof</td></tr> <tr> <th colspan="6">Special properties only on request at At extra cost</th><th colspan="6">Packing :</th></tr> <tr> <td colspan="6">Non-flame propagation properties</td><td colspan="6">Bars – 6 mtr. Length except 50mm DWC pipe only</td></tr> <tr> <td colspan="6">Permanently lubricated inner wall</td><td colspan="6">100 mtr in coil connected only by compression coupler.</td></tr> <tr> <td colspan="6">Anti-Rodent properties</td><td colspan="6"></td></tr> <tr> <th colspan="6">Installation</th><th colspan="6"></th></tr> <tr> <td colspan="6">Refer out instructions Sheets Nos. L1-1 for</td><td colspan="6"></td></tr> <tr> <td colspan="6">Laying J-1 for jointing & TI-1 for Trenching</td><td colspan="6"></td></tr> </table>												Compression strength						Impact strength						Compression strength at 5% applied						5 kg striker falling through a height of 570 MM						Deflection load $\geq 450N$						Energy = 28 joules						Bending test						External influences						While bent at a bending radius given In Dimensions table, a sphere of Diameter 95% of ID passes smoothly At room temperature & - 5° C.						Ingress of dust-the joint is dust proof. Ingress of water-the joint is water proof						Special properties only on request at At extra cost						Packing :						Non-flame propagation properties						Bars – 6 mtr. Length except 50mm DWC pipe only						Permanently lubricated inner wall						100 mtr in coil connected only by compression coupler.						Anti-Rodent properties												Installation												Refer out instructions Sheets Nos. L1-1 for												Laying J-1 for jointing & TI-1 for Trenching											
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The values given above are indicative only. This Technical Data Sheet is not to be treated as an Inspection Report.

**SIZES OF Double Wall Corrugated Pipes (with IS: 14930 – II Mark)
Recommended for PVC sheathed Cables as per the recommendations of IS-1255***

RATING OF CABLE	SUITABLE DWC PIPE	
	O.D. (mm)	I.D. (mm)
2.5 Sq.mm to 16 Sq.mm cable	50	38
2.5 Sq.mm to 35 Sq.mm cable	77	63
50 Sq.mm cable	90	76
95 Sq.mm to 185 Sq.mm cable	120	102
240 Sq.mm cable	145	126
300 Sq.mm cable	175	148
400 Sq.mm cable	200	175

Clause 6.3.4.3.1(of IS-1255)

The diameter of the cable conduit or pipe or duct should at least 1.5 times the outer diameter of cable. The ducts/pipes should mechanically strong to withstand forces are to heavy traffic when are laid across road/ railway tracks.

10.2 BRIDGE CROSSINGS:

On bridges, the cables are to be laid through GI pipe/trough and taken through GI pipe on either ends suitably buried on both sides of the bridges for a sufficient depth so as to meet the bottom of the cable trench, then fixing the pipe in concrete of size 0.5m x 0.5m in both abutments. Separate pipes/troughs should be used for power/signalling cables. Suitable supporting clamps should be manufactured as required at the rate of 2

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clamp/pipe depending upon the type of girder. Before fixing GI pipes, perforated holes of 20mm dia should be drilled at an interval of 0.3 Mts. to avoid theft of GI pipes. In case cables/cable is laid through trough, it should be filled in with cable compound/bitumen compound to prevent theft of cables. In theft prone area a special concreting arrangement should be developed in consultation with site engineer in both sides of the bridge from where cable leaves the pipe. The cable laying on Girder Bridges should be carried out as per relevant document 10.3 <u>CROSSING OF CABLES FROM FOOT OVER BRIDGE</u> Wherever it is possible cables should be taken from the foot over bridge for the purpose of track crossing. Cable should be laid inside DWC pipe of suitable diameter and the DWC pipe should be properly clamped to the FOB structure. It should be ensured the DWC pipe doesn't hang below the FOB structure. 10.4 <u>FOUNDATIONS</u> 10.4.1 The top level of the foundation should be in level with the existing rail level. The proportion of cement, sand and ballast should be in the proportion of 1:3:6 for casting foundations for signals, location boxes, and the proportion will be cured for a period of not less than 7 days. 10.4.2 Fine aggregate must consist of sand, stone ballast not exceeding 40mm x 40mm size and cement. The sand and ballast must be clean and free from soil, clay, shells, soft or flaky materials or any vegetable. Ballast must be washed when necessary to ensure cleanliness. 10.4.3 Sand used must be tidal river sand and must be free from any salts. 10.4.4 Water used for mixing must be clean and free from any oil, alkali, and acid. 10.4.5 Materials for concrete must be carefully and accurately measured for every batch.		

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10.4.6 Mixing must be done in a mixing trough or a M.S. Sheet which should not be more than half full at the time of mixing. Two men should use square ended shovels and not phowrahs. Water must be added by pouring, water must be continuous until all materials and water are thoroughly mixed and uniformly combined. 10.4.7 When batch is fully mixed, it must be used without any delay. The aggregate should be deposited in uniform layer not exceeding 15cms. Tamping and spreading of each layer to be done as to cause it to settle thoroughly in the form and produce a dense mass. 10.4.8 Forms must be drenched with water before the concrete is placed against them and must not be removed in less than 36 hours afterwards. 10.4.9 A template for each foundation should be prepared suiting the holes in the base of the location box or signal post (for which foundation is cast) in order to hold the anchor bolts in position till the foundation is cured. The template should be removed before the top of the foundation is given fine finishing. 10.4.10 The exterior surface of the foundation should be finely finished leaving 4 cms of thread portion of the anchor bolt free to enable erection of signal post or location boxes. All foundations should be cast under the direct supervision of the Site Engineer of the work. Curing must be done for all foundation for not less than 7 days. 10.4.11 No payment should be made for any extra excavation carried out in the slope and width of the pit, including for foundations where soil is loose and pit is to be dug for more depth. 10.5 <u>LOCATION BOX/ APPARATUS CASE</u> 10.5.1 The work consists of pit excavation, casting foundations with bolts of adequate size having cement concrete of ratio of 1:3:6 with stone ballast of 40mm size The position of Location Boxes will be finalised by the site engineer. It should be fixed taking care that staff working on location boxes are not in		

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danger from running train. All the location boxes will be erected perpendicular to the track. 10.5.2 All Location Boxes/battery boxes should be erected on concrete foundation and plumbed. It should be clear of infringement when the doors kept open perpendicular to the track. All foundations should be plastered on all sides and earthwork should be made upto the required level. All the Location Box/battery boxes used should be painted on inner side with white paint before fixing the shelf planks and terminal board after a primary coating with red oxide and with aluminum paint after a primary coating with red oxide on outer side after installation at site. 10.5.3 Teak Wood planks of 20 to 25 mm thick to be used for keeping track chargers & choke. ARA Terminal/fuse block will be fixed on hylam sheet. Wood screws of proper size should be used. Size of terminal boards and shelf planks should be finalised by Site Engineer. Two holes on either side of terminal/fuse block should be made if required for carrying out wiring termination. Shelf plank should be securely fixed in level on suitable M.S. angle brackets. Wood polish/varnish of good quality should be applied before fixing terminal/gadgets. 10.5.4 The underground signalling cable should be taken into the Location Box/ battery boxes and properly secured by wooden clamps. 10.5.5 The cables should be neatly skinned, bunched and terminated. All cores of cable should be terminated on the terminal board at locations and in Relay rack at the required places in the order as approved by Site Engineer. All the power cables (aluminum) should be provided with aluminum lugs using crimping tool. 10.5.6 All Location Boxes should be provided with 'E' type lock arrangements on one or both the doors as per instructions at site. Contractor should procure material and fabricate for fixing of 'E' type lock if such provision did not exist on the Location. 10.5.7 After all the signalling cables are taken inside the Location Box/battery box the side opening should be closed with masonry work and plastered. The inner side is then filled with sand and finally the bottom is sealed with sealing compound.		

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10.5.8	All the underground cable should be provided with punched name plates, showing total number of cables, cross section of each core, aluminum or copper and from and to details etc., inside each Location Box.	
10.5.9	The armours of all the cables and Location Box/battery box should be earthed as per RE standards.	
10.5.10	The earth resistance should not be more than 10 Ohms. Earth resistance and date are to be painted on earth pit.	
10.5.11	Track relays, line relays, point contractors, overload relays, transformers, transformer chargers, rectifiers, charged secondary cells, track feed resistance, EKT, telephone plugs etc., should be fixed neatly in the Location Box as required by the Site engineer. The wiring should be carried out in a neat manner with 3/0.75mm PVC copper wires and terminated, bunched and tested. The relays wherever fixed should be fixed in such a manner that they can not be easily removed or tilted. Details of cable terminations and wiring particulars should be painted inside the Location Boxes door in addition to documentation. Contractor should procure and fabricate M.S. flats/angle for relay fixing, inside Location Box. The design of such fabrication will be issued by Site Engineer. Relay fixing arrangements should be firm and rigid to avoid any chance of vibration due to train movements.	
10.5.12	All electrical equipments wherever provided should be earthed to RE Standard. Description of equipments, relay etc., should be neatly painted inside the Location Boxes door. All the internal wiring should be tested from Point to point in full, jointly by contractors authorised Engineer and Site Engineer/ Supervisor.	
10.5.13	Charged secondary cells if installed inside Location Boxes, should be fixed firmly leaving enough working space for taking specific gravity reading and during distilled water topping. Anti corrosive black paint to be coated inside the Location Box. Additional ventilation arrangements should be made. The date of installation, capacity and serial number should be painted on each cell and the inner side of the door. The record should be maintained in a proper format for each battery set as per railways laid down practice.	

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10.5.14	Battery links (lead) with suitable bolts and nuts should be used for connecting cells. Petroleum jelly is to be applied on terminals immediately after connection. The specific gravity and voltage reading should be recorded in a separate register and handed over to Site Engineer duly signed	
10.6	<u>SIGNALS</u>	
10.6.1	The work includes excavation of pits and casting of Signal foundations. The exact position/location of signals will be indicated/decided by Site Engineer.	
10.6.2	Foundation for Signal post should be of cement concrete in the ratio of 1:3:6 using stone ballast of 40 x 40mm size to be cast at location shown by Site Engineer. The foundations are to be plastered in all sides.	
10.6.3	Signal pole should be securely fixed to surface base and erected on signal foundation and plumbed. The gap between the signal pole and surface base should be filled up with lead wool or any other approved substance to avoid tilting. Multi unit colour light Signal upto 2/3/4 aspect should be properly mounted on Signal post with or without route indicator. Soon after installation, the pole should be painted with aluminum/white enamel after giving a coat of primer and the Signal unit should also be painted as per the Standard practice.	
10.6.4	Wherever route indicator junction type or stencil type is to be erected, it should be mounted on the top of the Signal pole and a large off set bracket should be fixed with 'U' Bolts of 20mm dia 2 Nos. on the Signal pole for mounting multi unit colour light signal. A 21.5mm through hole should be drilled on pole just below the off set bracket and a through bolt provided to prevent the offset bracket from sliding down. The tail cable should be first terminated on the route indicator and separate wiring (PVC 3/0.75 copper) should be run to colour light multi unit signal from route indicator. The LED lamp lit on 110v DC, with inbuilt current regulator should be used for junction type route indicator.	
10.6.5	To take the wires into the Multi unit, a vertical slot of not less than 25mm x 37mm in size should be made on the Signal pole. Suitable protection should be provided on the slotted pole before cable is taken through it and	

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care should be taken that no damage to insulation of tail cable is caused. 10.6.6 Signal units door should be locked using hand cuff (Universal) locks. 10.6.7 Necessary earthwork should be made for each signal as required by Site Engineer. The cables are to be taken through the pole to the unit without damaging the insulation and armour. Armour should then be skinned and terminated. 10.6.8 All the signal units are to be wired as per approved practice by railway. The wiring is to be tested jointly. The signal should be focused correctly in daytime at bright light at 90% of rated voltage. 10.6.9 The signal post should be properly plumbed and fitted with ladder having a platform and guarding on the top. Necessary ladder supports as required should be provided. All the signal posts and signals should be installed clear of infringements (i.e. 2.36 Mts. from the central line of the nearest track. Extra clearance to be catered for, to commensurate with the degree of curvature, if the, signal to be installed is situated on the curve). Markers and number plates should be fixed wherever necessary as per signalling-plan using suitable clamps. Signal No. has to be painted on the "Number plate" as well as on the door outside. All fittings are to be tightened properly. Signal unit should be looked properly. The back cover of the signal should be crossed by white lines (X). The signals should be preferably LED lit, however in case of non availability of LED lit signals, the commissioning can be done by lamp lit signals temporarily. 10.6.10 Earth work should be made around the ladder foundation to Railway electrification Standard and consolidated and concreted. Protective mesh should be provided for all signal units as per RE Standard. Ladder should be painted with black paint. 10.7 <u>CALLING ON SIGNALS/POST TYPE SHUNT SIGNAL</u> Off set bracket should be fixed with 'U' Bolts of suitable size on Signal pole for mounting Calling on Signal. A 21.5mm through hole should be drilled just below the off set bracket and through bolt of diameter 20mm should be provided to prevent the offset bracket from sliding down. Vertical slotted hole not less than 25x50mm in size should be provided on the Signal pole		

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to take tail cable. Care should be taken that no damage is caused to insulation. 10.8 <u>POSITION LIGHT SHUNT SIGNAL GROUND TYPE</u> 10.8.1 The work includes excavation of pits casting of shunt signal foundations as per relevant document. 10.8.2 Foundations for shunt signal should be of cement concrete with ratio of 1:3:6 using stone ballast of 20/25mm size to be cast at location shown by the Site Engineer. The foundation to be plastered in all sides. 10.8.3 The position light shunt signal should be properly mounted on post and plumbed. 10.8.4 Necessary earthwork should be made for each Position Light Shunt Signal as required by Site Engineer. The cables are to be taken through the post to the unit, skinned and terminated. 10.8.5 Position light shunt signals are to be wired as per approved practice by Railway. The wiring is to be tested jointly. The shunt signal to be focused correctly in daytime at bright light at rated voltage. The signal unit's back door covers are to be locked using universal locks. Soon after installation, the pole should be painted with a aluminum/white enamel paint after giving a coat of primer and the Signal unit should be painted as per the Standard practice. 10.8.6 The position light Shunt Signals are to be earthed to RE standard. 10.9 <u>POINT MACHINES</u> 10.9.1 Electrically operated point machines of IRS design should be fitted in level to all points as per signalling plan on long sleepers on extended insulated gauge tie plate, clear of infringement as per the latest RDSO Drawing.		

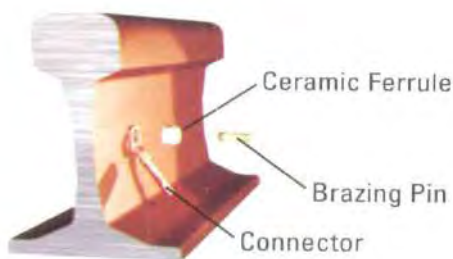
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10.9.1.1 The point machine should be installed after cleaning both inside and outside the machine, after greasing/oiling to all moving parts. The point machine should be hand operated and detection and motor-controlling contacts should be adjusted before taking to site. All unwanted openings should be covered with MS sheets. 10.9.2 The point machines should be fixed with proper bolts, nuts and flat/spring washers with correct size of holes through the special sleepers to avoid lateral/ longitudinal play, on extended insulated Gauge Tie Plate. 10.9.3 All point connecting rods should be connected to point machines without any strain and with Min. offset. All connecting rods should be in level and correct size of bolts and nuts should be used to avoid longitudinal play. Any changes in the connecting roddings during installation, which necessitates welding and offset should be carried out by the Contractor at site. The welding should be by smithy process. Lengthy roddings should be supported suitably by roller guides assembly. The point roddings should be suitably provided with insulation joints as per track circuit requirements. 10.9.4 All the wooden sleepers on which the point machine is installed should be strapped on both sides with 50mm x 20mm M. S. Strap. Necessary holes 21.5mm dia. should be drilled on the strap and 20mm dia. bolts and nuts should be used for fixing to the sleepers. Point Machine is installed on PSC sleepers at point & crossing PSC sleepers set are laid for 1:8 ½ and 1:12 (LH or RH) arrangements. 10.9.5 Separate track lead junction box/boxes should be installed clear of infringement near the point machine and the respective cables should be terminated. The leading in wires from the boxes should be taken through flexible conduit PVC pipes and securely fixed. The wiring inside the point machine for motor and detector circuit should be carried out neatly. All the electrical wiring should be tested for insulation and earth and all connections tightened. 3/0.75mm. PVC copper wire/cable should be used for wiring point machines as per Standard practice approved by Railways.		

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10.9.6 Point machines and track lead junction boxes should be painted and point numbers should be painted neatly. Wiring diagram should be painted on the inside of the point machine cover. The point switches web should also be written with point number. 10.9.7 Where IRS type point machines are installed, fixing of additional heavy-duty contactors (2 Nos. per point machine) of 40 amp. Only Siemens/IRS design point machines 110V DC operated should be used. The installation should meet with the requirement of the electrified section. 10.10 <u>ADJUSTMENT AND TESTING</u> 10.10.1 The point machine should be worked by crank handle and the housing of switch rail with the stock rail should be checked. 10.10.2 The point machine should be worked both ways with proper feed without undue friction and working current should be recorded. 10.10.3 The point detector and lock connections are adjusted in such a way that with a 3.25mm thick test piece obstruction placed between the switch and stock rail at 150mm from the toe of the switch The point do not get locked, and The point detection circuit is not completed. The point machine de- clutch arrangement should be properly adjusted is that it works satisfactorily under condition of obstruction. The feed to motor should also be disconnected after a period or 9 to 11 seconds. 10.10.4 Fixing Point/Trap indicator stand and Point/Trap indicator including lenses with required bolts and nuts, washers, connecting the Point Indicator base with connecting rod to the switch rail, adjusting the Point Indicator for correct operation as per SEM and focussing. 3 Nos. of 20mm x 200/250mm bolts are required to fix Point/Trap indicator stands onto the sleepers. If the Point happens to be in the track circuit zone, necessary arrangements for insulating the split lock stretcher, switch extension pieces from switch rail has to be carried out by enlarging holes on split lock		

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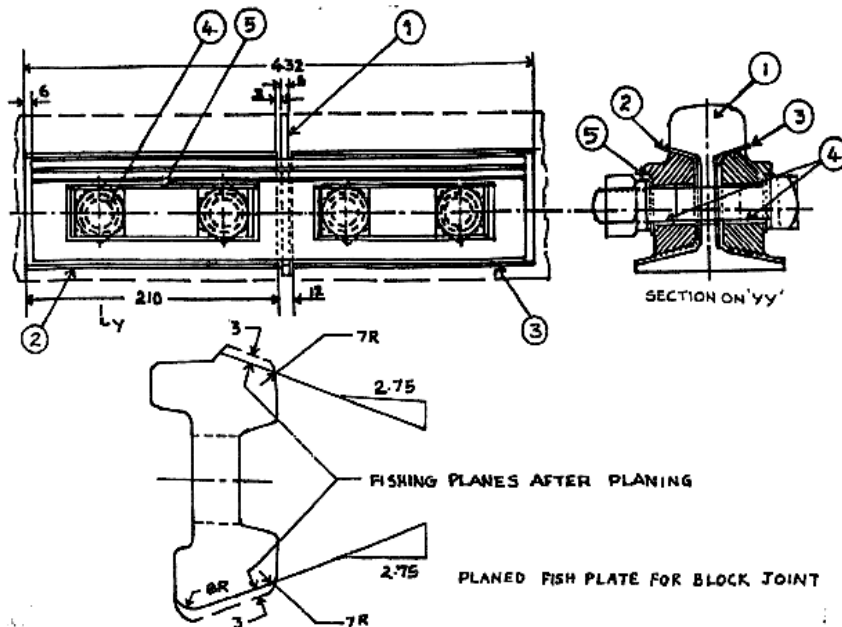
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stretchers and switch extension pieces. Painting of fittings etc. The necessary arrangements should be provided to meet with requirement of RE standard. 10.11 <u>TRACK CIRCUITS</u> 10.11.1 Pin brazing technique shall be used for fixing lead wires and jumpers to the rail and for providing continuity bond at rail joints. Figure below shows the components used in pin brazing:  The diagram illustrates the components used in pin brazing. It shows a cross-section of a rail head with a ceramic ferrule inserted into the web. A brazing pin is shown passing through the ferrule and the rail head. A connector is shown attached to the end of the brazing pin. Brazing equipment shall be battery powered, light weight portable unit and no external power at site shall be required. Following are the specifications of typical brazing equipment: Batteries Voltage : 36 V, DC Brazing Current : 250 Amps. Brazing Time : under 2 Sec. Brazing Temp. : 650°C max. Brazing per Charge of battery: 30-40 nos. Contractor will bring his own Pin Brazing Machine and Consumable like Ceramic ferrule and brazing pin for installation of track circuit at site and. 10.11.2 Continuity bonds and lead wires: Rail head continuity bond in track circuit area for installation by Pin Brazing will be of 20mm² galvanized steel wire rope, length 145mm. With copper lugs machine crimped at both ends.		

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Continuity bond for point zone track circuit area for installation by Pin Brazing will be of 20mm² galvanized steel wire rope PVC insulated, length 1mtr. with copper lugs machine crimped at both ends. Track Lead Wire (Near End) for installation by Pin Brazing will be of 20mm² galvanized steel wire rope PVC insulated, length 2.5m. With copper lugs machine crimped at both ends. Track Lead Wire (Far End) for installation by Pin Brazing will be of 20mm² galvanized steel wire rope PVC insulated, length 4m. With copper lugs machine crimped at both ends. 10.11.3 Insulated Rail Joint (IRJ) Glued joints shall be provided on track circuited area. Where it would not be possible to insert glued joint, thermoplastic poly urethane (TPU) moulded insulated rail joints shall be provided. The glued joints shall be fabricated in situ at site and inserted in the track. In dry conditions, insulation resistance of glued joint shall not be less than 25 Mega ohms when a meggering voltage of 100V DC is applied across the joint. In wet condition resistance shall not be less than 3 kilo ohms when obtained with application of 100V DC and by dividing the voltage reading with that of current. Details of components and assembly of TPU joint is shown in figure below:		

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The insulation components of the TPU insulated rail joint are:

(a)	End post	1 No
(b)	Left hand Side channels	2 Nos.
(c)	Right hand Side channels	2 Nos.
(d)	Ferrules or Bushes	8 Nos.
(e)	Backing plates with collar	4 Nos.
(f)	Washers	2 Nos.

10.11.3.1 Two TLJ boxes one at track feed end and another at relay end should be fixed clear of infringement and the respective track circuit tail cable 2 x 2.5 Sq.mm PVC copper conductor from the Location Box should be terminated. The connection from the TLJ boxes to the rail should be through the PVC insulated flexible wire rope seven strand of overall dia 8mm. (steel wire dia of 5mm.) which should be fixed to the Rail by channel Bond pin both at feed and relay ends.

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10.11.4 All the TLJ boxes shall be fixed on 50X75mm MS channel as per relevant document. TLJ boxes should be painted and track circuits should be neatly numbered as required by Railways. 10.11.5 Jumpers should be provided as per track bonding plan approved by engineer incharge. 10.11.6 Any alteration to existing track circuits should be done by the contractor at his own cost. 10.11.7 After completing the installation of track circuit, it should be energized, tested, adjusted and readings recorded in a register/track circuit history cards. The bonding and jumping plan should be prepared for each track circuit. 10.11.8 The additional work like skimming of fish plates, insulation of fish plate holes etc required in connection with provision of RDSO type insulation Joint for track circuits should be done by contractor. The insulation provision should not be required where glued joints are supplied by Civil Engineers for Track Circuit. 10.12 <u>CABLE TERMINATION RACK:</u> 10.12.1 Cable termination racks should be erected in the relay room at the required location as shown by the Site engineer with suitable foundation bolts and cement concreted. The cable termination racks should be painted soon after installation before cable termination work is taken up. Suitable cable ducts wherever required should be provided to bring all outside cables to the termination rack. All the cables are to be neatly skinned, fixed on the cable bracket and terminate in order. The cable armours and the rack should be earthed. Internal wiring and termination particulars are to be written with paint. 10.12.2 6 way terminal blocks are to be fixed on 10mm. thick hylam sheet which is fitted to the cable termination rack. The number of 6 way terminals is to be painted serially on the C.T Rack and details of termination are painted on		

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Hylam sheet. All the cables should be identified by punched labels tied on each cable. Painted cable termination index board should be fixed in the relay room showing the terminal numbers circuit wise. As made terminal particulars should be prepared in linen/polyester tracing. 10.13 <u>WIRING of OUTDOOR GEARS:</u> 10.13.1 The equipments and power supply are to be wired in location boxes, battery boxes and in other locations as per circuit diagram and location details. These circuit diagrams should be prepared and submitted by contractor in advance for approval of the railways. The necessary guide lines given by the concern railway should be strictly followed while preparing the different wiring diagrams. The two copies of each WD should be checked by EMPLOYER/CONSULTANT and one approved copy should be returned to contractor to carry out the work. 10.13.2 Contact numbering for the relays should be made by the contractor as per the approved circuit diagram issued by the EMPLOYER/CONSULTANT and type of relay proposed to be used on the installation. 10.13.3 Wiring of shelf type and plug in type (Metal to Carbon) Contact relays : Plug in type relays conforming to BRS-930 and BRS-931 and shelf type relays conforming to BS-1659 should be done with "PVC" insulated unsheathed flame retarding type single core flexible wire 1100V grade having 0.6/0.2mm annealed copper conductor and nominal cross sectional area of 0.5 Sq.mm of common colour code to the specification IS:694". For wiring these relays the above wires should be terminated in eyelets/lugs of Standard design. 10.13.4 Soldering at the relay contact pin should made using good quality solder and flux. Care must be taken to prevent dropping of excessive solder from relay contact pin thereby causing failure/unwanted connection. It is advisable to raise the wires by mechanical means and temporarily interposing a wooden or plastic sheet below the relay while soldering, to collect the excessive solder that may be dropping out.		

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10.13.5	After testing, the loose wires should be neatly bunched and laced with twine black. The contractor should adopt suitable colour code for wiring as required by employer's representative. Spare conductors to an extent of 10% are to be provided on the interconnecting wire runs for future developments.	
10.13.6	The incoming cables to location boxes are to be neatly arranged and fixed to the cable supporting guides. The cable entry should be filled with sand and plastered neatly to avoid entry of mice or reptiles.	
10.13.7	After the complete testing by the EMPLOYER/CONSULTANT representative and before commissioning the installation, the contractor should arrange necessary sealing leads and wires for sealing the relays.	
10.13.8	The nomenclature of each relay in location boxes should be painted both in front and rear side of each relay with contact configuration.. All the relays to be plugged should be checked visually and defect if any, noticed should be replaced, duly reporting the same to the owner /Railways.	
10.13.9	Wiring of EKT/HKT, telephone using 16/0.2mm wire and testing as per approved circuit diagram and commissioning, the same wiring has to be neatly clipped wherever necessary.	
10.14	<u>WARNING/ STOP BOARD / SIGHTING BOARD</u>	
10.14.1	Warning/stop boards fitted on the MS angle/channel should be erected and concreted at locations as indicated by Site Engineer and as per approved signalling plan, and should be clear of all infringement. If necessary, existing warning/stop boards should be shifted and re-erected on the place required by Site Engineer. These should be of retro-reflective design or painted with luminous paints. Design of Goods warning board and SLB shown in fig. below:	

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(a) Colour light signal post complete with route indicators, ladders, calling on signals, shunt signals are to be painted both insides and outside including numbering of signals, cable termination details as per Standard practice. (b) location boxes/Apparatus case both inside and outside with location number, particulars of cable termination and other equipments kept inside the location. (c) Track circuits: Painting block joint numbers fed/relay end details on rails, TLDs, details of feed equipments with track circuit numbers and battery with track circuit number and date of installation. (d) Point Machine lay out complete including Point Number, Circuit Diagram inside the cover, Junction box details Point contactor unit number in location box etc. (e) Key locked points with HPLs, connecting rods, point indicator, HKT tail cable termination particulars in the location box etc. 10.16.1 Signal posts and fittings: (a) COLOUR LIGHT SIGNAL: (i) Post: 'White' (Aluminum paint should be used) (ii) Fittings (Hood and Mechanism box): 'Black' The rear of the mechanism box and background may be painted white where necessary, with the approval of Site Engineer 10.16.2 Electrical signalling location: (a) Point machines, key transmitters.... 'Black' 10.16.3 Junction boxes, battery boxes and location boxes:		

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Junction Boxes - Post type : (a) Inside .. 'White' (b) Outside .. 'Chocolate' (Red oxide paint should be used). (c) Junction Boxes - Ground type and Location Boxes: (d) Inside .. 'White' (e) Outside .. 'White' (Aluminum paint should be used).		

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GEOTECHNICAL INVESTIGATION

FINAL REPORT

BHUSAWAL REPLACEMENT PROJECT. (1x 660 MW)

THE GENERAL MANAGER (C),
MAHARASHTRA STATE POWER GENERATION CO. LTD.,
CIVIL CONSTRUCTION CIRCLE.,
MSPGCL., BHUSAWAL.

S.W. to G.M.C. - III
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19 SEP 2011

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INTRODUCTION

The Soil Investigations for Bhusawal Replacement Project – 1 x 660 MW have been recently completed under the directives of **Executive Engineer (Civil)**, Civil Construction Division under Superintending Engineer Construction Circle , Maharashtra State Power Generation Co. Ltd. Bhusawal . The object of the investigations was to study the subsoil characteristics for proposed Bhusawal Replacement Project .

The works of the subsoil explorations covering field and Laboratory tests were awarded to M/s Renuka Engineers , Thane , vide their work Order No. CGMC/Gen.I/Bhusawal Replacement/Soil Investigation/T-484/3184 dated 15/12/2008. The work was executed as per specified specifications and under the directives of Project Engineer , Mumbai .

The specified scope of the total project work consists of :

- 1) Boring and drilling of 32 nos. bore holes in the proposed planned lay out for Bhusawal Replacement Project in Bhusawal including collection of undisturbed and disturbed soil samples .
- 2) Conducting field tests such as i) Standard Penetration Tests , ii) Plate load test and iii) Cross Bore hole tests .
- 3) Various Laboratory tests to be conducted on the undisturbed as well as disturbed soil and rock samples . Electrical Resistivity tests have been conducted as directed .
- 4) Submission of expert's report based on the above studies including foundations.

WORKS FEATURES :-

The field work consists of drilling of bore holes , standard penetration tests , and collection of disturbed and undisturbed soil and water samples and carrying out the various field tests . The samples collected from the site are transported and tested at “**Renuka Engineering Research Laboratories**”, Thane .

This report has been prepared after careful study of the data collected from the site and Laboratory test results on different soil and rock samples . The report deals with subsoil conditions which were encountered up to a depth of maximum about 11.50 m or Rock level below ground level and indicates the strength and other related parameters of at specified layer of subsoil profile deposit . It also includes the important field test parameters related to the present objectives .

Based on the analysis of different field and laboratory test results , this report is prepared and presented in the following different sections and related annexes .

Section – 1 : General Site Conditions , Nature and Procedure of Investigations
Geology.

Section – 2 : Discussions on field and Laboratory tests including soil profile .

Section – 3 : Discussion on foundations.

Section – 4 : Recommendations.

Annexure – 1 : Location Sketch of Site and bore logs data Sheets, Soil profile .

SECTION - I

SECTION - I

GENERAL SITE CONDITIONS, TOPOGRAPHY AND NATURE OF INVESTIGATIONS

1. LOCATION AND TOPOGRAPHY:

The site for the proposed Bhusawal Replacement Project is situated adjacent to the existing power plants and office premises along the Road Bhusaval Dhule of Maharashtra State Power Generation Company Limited, Bhusawal on outskirts of Jalgaon Dist.. The proposed plot portion is a basically an agricultural land and has a gentle slope with level difference varying from 0.300 m to 1.00 m. The location plan of the proposed layout is attached (Figure nos. 1.1). Major bore holes are planned in Main Plant building area of the proposed 1 x 660 MW project and ancillary facilities like CHP and Chimney. Surface soils are generally agricultural black cotton soils followed by residual soils. The investigations were carried out on the given layout of proposed power plant infrastructure as per the directives of the authorities through Superintending Engineer (C) and Executive Engineer (Civil), Bhusaval. The location sketch plan highlights the details of site locations and bore holes as proposed by the authorities.

2. DETAILS OF EXPLORATIONS:

The exploratory works at site were carried out using 100.0 mm and 76.0 mm core cutters with Rotary drilling system. The rock / hard stratum drilling is achieved and terminated as per the directives of the Engineer-In-Charge. The field tests, sampling and specifications have been exclusively followed as per the directives and schedule of the tender. The details of bore hole locations are given in Table - 1.1 of this Report. The bore logs details have been provided in Annexure - 1.

2.1. DISTURBED REPRESENTATIVE SAMPLES :

The disturbed representative samples were collected from shell, cutting shoes of the undisturbed soil sampler and split spoon sampler. The samples collected in such a manner are logged, labeled and depth wise placed in polythene bags. Wash samples were also collected. The S.P.T. samples were also waxed for evaluation of laboratory moisture content and grain size analysis.

In all total 32 nos. undisturbed soil and 21 nos. disturbed soil samples excluding S.P.T. (35) samples have been collected from 32 nos. bore holes of proposed layout site and the details of have been presented in Table no. 1.2.

TABLE NO. 1.1
DETAILS OF BORE HOLES LOCATION

B.H. No.	North – South Co-ordinate	East – West Co-ordinate	Remarks
1.	520 N'	1220 E'	
2.	600 N'	1155 E'	
3.	750 N'	1130 E'	
4.	819 N'	1130 E'	
5.	550 N'	1068 E'	
6.	550 N'	1250 E'	
7.	600 N'	1192 E'	
8.	820 N'	1250 E'	
9.	932 N'	1353 E'	
10.	900 N'	1300 E'	
11.	845 N'	1500 E'	
12.	785 N'	1600 E'	
13.	710 N'	1725 E'	
14.	788 N'	1800 E'	
15.	928 N'	1575 E'	
16.	420 N'	1665 E'	
17.	420 N'	1500 E'	
18.	300 N'	1500 E'	
19.	200 N'	1700 E'	
20.	92 N'	1497 E'	
21.	58 N'	1700 E'	
22.	503 N'	1130 E'	
23.	545 N'	1150 E'	
24.	568 N'	1220 E'	
25.	568 N'	1080 E'	
26.	520 N'	1080 E'	
27.	600 N'	1118 E'	
28.	750 N'	1060 E'	
29.	668 N'	1340 E'	
30.	155 N'	1526 E'	
31.	200 N'	1526 E'	
32.	730 N'	1248 E'	

TABLE NO. 1.2
DETAILS OF BORE HOLES AND SOIL / WATER SAMPLES
PROPOSED BHUSAWAL REPLACEMENT PROJECT.

B. H. no.	Depth Below G.L.	Ground Water Level	U D S S1	S.P.T. S2(DS)	D.S. S3	Water
1.	10.50 m	4.50 m	1	3	2	1
2.	7.45 m	4.10 m	1	3	--	1
3.	9.75 m	4.60 m	1	3	--	1
4.	7.00 m	4.30 m	1	3	--	1
5.	8.15 m	4.00 m	1	3	1	1
6.	9.00 m	4.20 m	1	3	--	1
7.	11.00 m	4.10 m	1	3	2	1
8.	9.90 m	4.55 m	1	2	1	1
9.	10.50 m	4.40 m	1	4	2	1
10.	9.50 m	4.30 m	1	3	1	1
11.	10.30 m	4.30 m	1	3	1	1
12.	9.95 m	4.10 m	1	2	--	1
13.	11.00 m	4.10 m	1	1	--	1
14.	10.25 m	4.30 m	1	2	--	1
15.	10.10 m	4.80 m	1	3	2	1
16.	11.05 m	4.70 m	1	1	--	1
17.	11.50 m	4.30 m	1	3	--	1
18.	9.45 m	4.70 m	1	3	1	1
19.	10.50 m	4.20 m	1	4	--	1
20.	10.15 m	4.20 m	--	2	1	1
21.	10.60 m	4.90 m	1	1	1	1
22.	8.50 m	4.20 m	--	2	1	1
23.	10.00 m	4.30 m	2	2	--	1
24.	10.25 m	4.90 m	1	2	--	1
25.	10.20 m	4.10 m	1	3	2	1
26.	10.50 m	4.50 m	1	3	1	1
27.	8.50 m	5.00 m	1	3	--	1
28.	10.00 m	4.10 m	1	2	1	1
29.	9.00 m	5.10 m	2	2	1	1
30.	7.75 m	5.30 m	1	2	--	1
31.	10.30 m	5.20 m	1	2	--	1
32.	10.50 m	5.40 m	1	3	--	1
			32	80	21	

3. WATER SAMPLES:

The water samples were collected from each bore hole. The water samples were collected before the start of the further boring work of the day so as to collect the natural ground water contents.

4. FIELD TESTS CONDUCTED :

4.1 STANDARD PENETRATION TESTS : (IS 2131-1981)

This test was carried out using a Terzaghi spoon sampler driven by a 63.50 k.g. Hammer weight falling freely through a height 750 m.m. The penetrometer was lowered inside the bore hole on a string of drill rods and blow count of the number of blows for every 150 mm of penetration was maintained till total penetration was 450 mm. In some cases 600 mm penetration is also obtained.

The "N" value adopted was the number of blows required to penetrate 300 mm length (i.e. from 150 mm to 450 mm depth of penetration.) inside the soil or the available ground stratification. The soil so recovered in the penetrometer tube was placed in polythene bags and labeled.

The no. of bore holes, S.P. tests and sample collection have been executed with adequate frequency as per the scope of works.

4.2. PLATE LOAD TEST:

A Single Plate Load test has been conducted as per IS: code-1888-1982. A regular steel stanchion reaction load platform is erected at the proposed location of the Bhusawal T.P.S. Replacement project. The depth of the section on which loading is planned is 2.00 m below ground level. The stratification at the proposed site is completely weathered rock formation. Plate load test no. 1 has been conducted in T.G. Block area near B.H. Nos. 25 of main plant area.

4.3 CROSS BORE HOLE TEST :

4.3.1. General :

Two nos. Seismic Cross Hole tests have been performed to determine the various soil and rock parameters at the proposed site. Both the tests have been conducted at B.H. No. 4 and B.H. No. 23 respectively.

4.3.2. Theory and Methodology :

The general principle of the cross bore hole test is to establish the shear wave (S- wave) and compression wave (P- wave) velocity of the soil and rock layer at 2.00 m selected depth . The waves are generated in an "impulse" bore hole and detected by the geophone(s) in "receiver" bore hole drilled at known distance from the impulse bore hole . (Refer Figure no. 1.6)

The wave form detected by the geophone (s) is recorded on a signal enhancement seismograph (Geode) . The travel time of the generated S and P wave is interpreted from the wave front recorded by the seismograph . The travel time and the distance between the "impulse" and the "receiver" bore hole is used to calculate the S and P wave velocities .

The tests have been carried out as per IS 13372 - Part - 2 of 1992 . The preliminary results for the both the Cross Hole tests comprising of P- wave and S- wave are incorporated .

5. GEOLOGY:

Geology in this area is volcanic basaltic rocks as found in Maharashtra in general . Columnar joints , fractured rocks are common. The overburden varies from few meters to 15 m.

6. SOIL PROFILE:

Soil profile description presented below gives relative strata thickness in general .

1) RESIDUAL BROWNISH GRAVELLY SAND CLAY:

(Average thickness 1.15 m) :

Residual brownish to yellowish Gravelly sandy clay is common to all the area of the proposed project . The fine grained soils in this zone vary from 15 % to 40 % generally . The sand contents are generally within 20 % with extreme variation of 30 % to 40 % are also observed . The soils are of very stiff to very hard consistency and with loss of moisture content in ground at lower depth S.P.T. refusals are common . S.P.T. values in the stratum are within 15 to 20 only . The average thickness of the stratum is 1.20 m . However thickness upto 1 m – 2 m are also common .

In upper zone S.P.T. values above 20 are common . Stratum is quite hard as such . This stratum has consolidation characteristics and with 50 % to 65 % finer presence , short and long term settlements both are very important . Soils are of medium compressibility and low plasticity . In general these soils show low swelling potential .

II) COMPLETELY WEATHERED BASALT ROCK : (1.15 m onwards)

S.P.T. values of refusal range i.e. greater than 50 have been observed within a depth of 3.00 m to 10.00 m depth. Even S.P.T. values in shallow depths refusal have been observed. All the bores display completely weathered, fractured, disintegrated basalt rocks. The disintegration is severe to such an extent that R.Q.D. is invariably below 30 % in most of the bores. In hardly few bores good hard R.Q.D. has been observed in patches only. Recoveries vary from nil to 65 % and R.Q.D. values are invariably nil with exceptions at some places up to 40 %.

7. GROUND WATER :

The ground water table variation is of extreme nature. In general ground water average depth is at 4.00 m to 5.40 m. The samples of the same have been collected and are subjected to chemical analysis. Water levels have been recorded for all the bores. In near area 2 nos. well are present and indicate water presence at about 4.0 m to 5.00 m depth.

Plan View

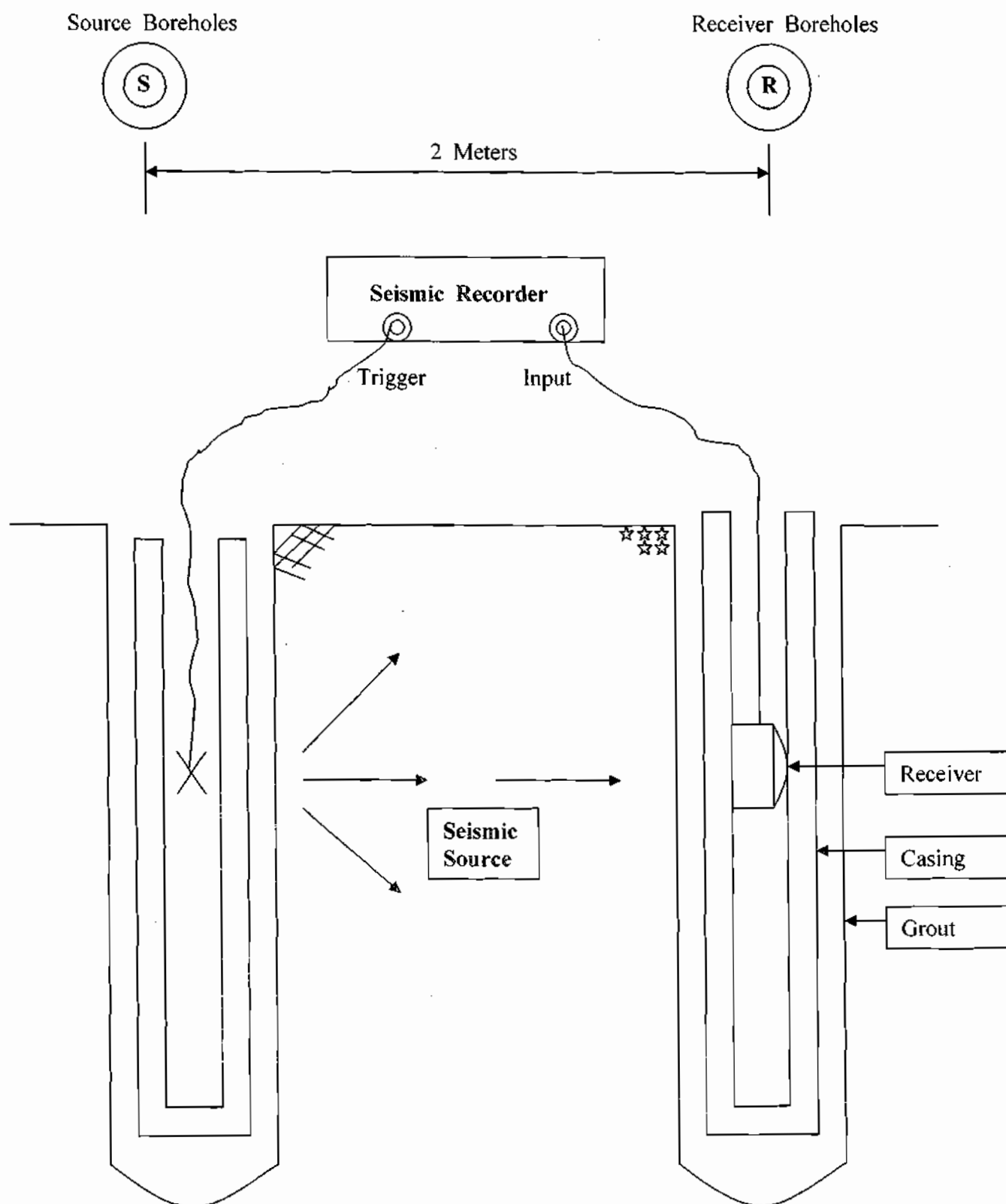


Figure No. 1

SECTION - II

SECTION II**FIELD AND LABORATORY TESTS**

This section deals with the results of field and laboratory tests conducted on various insitu soil and rock samples during the execution process of the proposal.

1. FIELD TESTS :

The field tests conducted cover the standard penetration tests . The details of the same are summarised in following paras . Generally 2 nos. to 4 nos. S.P.T. have been conducted for each bore holes . In rock stratum to ascertain the quality of weathering S.P. Tests have been conducted . The actual values have been entered in bore logs and details have been provided in Field Daily Reports (Refer Annexure - I) . However the final results are summarised in Table no. 2.1 .

1.1. STANDARD PENETRATION TESTS :

This test was carried out using a Terzaghi spoon sampler driven by a 63.50 k.g. Hammer weight falling freely through a height 750 m.m. A comparative study of " N " values (i.e. no. of blows / 30 cm) penetration using Terzaghi's split spoon sampler , are presented in Table no. 2.1.

The actual values of S.P.T. such as (N₂ + N₃) have been reported . The refusal of the test has been considered when the penetration is not possible . Refusals have been indicated by mentioning penetration in centimeters and the no. of blows . The S.P.T. values help in assessing the stratum strength in general .

TABLE 2.1
STANDARD PENETRATION TEST RESULTS

B.H. No.	Sr. No.	Depth of test m	" N " Value blows/30 cms	Remarks
1.	1	0.45 --- 0.90	06-08-09	17 Residual Soils
	2	1.30 --- 1.45	19 (10 cm)	R Refusal
	3	1.85 --- 2.00	31 (10 cm)	R Refusal
2.	1	1.00 --- 1.45	18-23-25	48 Hard Rock
	2	2.80 --- 3.00	22 (5 cm)	R Refusal Rock
	3	3.90 --- 4.00	31 (10 cm)	R Refusal Rock

Continued

B.H. No.	Sr. No.	Depth of test m	"N" Value blows/30 cms	Remarks
3.	1	0.50 --- 0.95	05-06-10	16 Residual Soils
	2	1.00 --- 1.00	20 (0 cm)	R Refusal Rock
	3	3.00 --- 3.60	32-33-35	R Hard Rock
4.	1	0.00 --- 0.45	05-07-08	15 Residual Soils
	2	1.70 --- 2.00	24-28 (0 cm)	R Refusal Rock
	3	4.00 --- 4.00	22 (0 cm)	R Refusal Rock
5.	1	0.50 --- 0.70	07-09-10	19 Residual Soils
	2	1.00 --- 1.10	18 (10 cm)	R Refusal Rock
	3	2.10 --- 2.15	25 (5 cm)	R Refusal Rock
6.	1	0.00 --- 0.50	04-04-09	13 Residual Soils
	2	0.95 --- 1.35	05-07-13	20 Residual Soils
	3	2.35 --- 2.50	30 (5 cm)	R Refusal Rock
7.	1	0.45 --- 0.90	03-05-08	13 Residual Soils
	2	1.35 --- 1.45	19 (10 cm)	R Refusal Rock
	3	2.00 --- 2.05	31 (5 cm)	R Refusal Rock
8.	1	0.50 --- 0.95	03-06-08	14 Residual Soils
	2	1.20 --- 1.25	21 (5 cm)	R Refusal
9.	1	0.45 --- 0.60	32 (10 cm)	R Refusal
	2	1.00 --- 1.05	21 (5 cm)	R Refusal
	3	1.65 --- 1.69	39 (4 cm)	R Refusal Rock
	4	1.80 --- 2.00	18 (5 cm)	R Refusal Rock
10.	1	0.45 --- 0.50	26 (5 cm)	R Refusal
	2	1.00 --- 1.10	30 (10 cm)	R Refusal
	3	1.50 --- 1.60	29 (10 cm)	R Refusal Rock
11.	1	0.45 --- 0.60	10-12-10	22 Gravelly Clays
	2	0.90 --- 1.00	27 (10 cm)	R Refusal
	3	1.50 --- 1.60	32 (10 cm)	R Refusal Rock
12.	1	0.45 --- 0.90	04-07-09	16 Gravelly Clays
	2	0.90 --- 1.05	36 (10 cm)	R Refusal Rock

Continued

B.H. No.	Sr. No.	Depth of test m	"N" Value blows/30 cms	Remarks
13.	1	0.35 --- 0.80	05-07-10	17 Gravelly Clays
14.	1	0.40 --- 0.85	06-08-10	18 Gravelly Clays
	2	0.85 --- 0.85	21 (0 cm)	R Refusal Rock
15.	1	0.45 --- 0.55	19 (10 cm)	R Refusal
	2	0.85 --- 1.05	25 (5 cm)	R Refusal
	3	1.45 --- 1.57	30 (12 cm)	R Refusal
16.	1	0.40 --- 0.50	22 (10 cm)	R Refusal
17.	1	0.50 --- 1.00	03-03-06	09 Residual Soils
	2	1.90 --- 2.00	19 (10 cm)	R Refusal Rock
	3	5.00 --- 5.00	22 (0 cm)	R Refusal Rock
18.	1	0.65 --- 0.90	15-18 (0 cm)	R Refusal
	2	1.60 --- 1.90	25-35-17	R Hard Rock
	3	6.50 --- 6.60	22 (10 cm)	R Refusal Rock
19.	1	0.50 --- 1.10	06-09-12-14	21 Residual Soils
	2	2.10 --- 2.15	27 (5 cm)	R Refusal Rock
	3	3.25 --- 3.25	21 (0 cm)	R Refusal Rock
	4	4.00 --- 4.00	19 (0 cm)	R Refusal Rock
20.	1	0.55 --- 0.60	19 (5 cm)	R Refusal
	2	1.00 --- 1.10	26 (10 cm)	R Refusal Rock
21.	1	0.50 --- 0.60	23 (10 cm)	R Refusal
22.	1	0.55 --- 1.00	12-14-16	30 Yellowish Soils
	2	2.00 --- 2.10	20 (10 cm)	R Refusal Rock
23.	1	0.45 --- 0.90	07-09-11	20 Residual Soils
	2	1.20 --- 1.25	27 (5 cm)	R Refusal
24.	1	0.50 --- 0.95	06-06-08	14 Residual Soils
	2	2.00 --- 2.10	25 (10 cm)	R Refusal Rock

Continued

B.H. No.	Sr. No.	Depth of test m	"N" Value blows/30 cms	Remarks
25.	1	0.55 --- 1.00	04-09-18	27 Brownish Clay
	2	1.20 --- 1.50	15-20-30-27	50 Sandy Clay
	3	5.00 --- 5.11	23 (11 cm)	R Refusal Rock
26.	1	0.45 --- 0.90	05-07-14	21 Sandy Clays
	2	1.40 --- 1.50	22 (10 cm)	R Refusal
	3	2.05 --- 2.10	39 (5 cm)	R Refusal Rock
27.	1	0.50 --- 0.90	04-06-09	15 Residual Soils
	2	1.90 --- 2.00	33 (10 cm)	R Refusal Rock
	3	4.00 --- 4.00	23 (0 cm)	R Refusal Rock
28.	1	0.45 --- 0.90	06-08-10	18 Residual Soils
	2	3.25 --- 3.25	21 (0 cm)	R Refusal Rock
29.	1	0.45 --- 0.90	05-08-13	21 Blackish Soils
	2	2.00 --- 2.00	12 (0 cm)	R Refusal
30.	1	0.50 --- 0.95	03-05-06	11 Residual Soils
	2	2.00 --- 2.00	22 (0 cm)	R Refusal Rock
31.	1	0.50 --- 0.95	03-04-09	13 Residual Soils
	2	1.95 --- 2.00	22 (5 cm)	R Refusal Rock
32.	1	0.50 --- 0.85	18 (15 cm)	R Refusal
	2	1.90 --- 2.00	31 (10 cm)	R Refusal Rock
	3	3.00 --- 3.00	21 (0 cm)	R Refusal Rock

In general S.P.T. values are invariably refusal in lower stratum area .

1.2. PLATE LOAD TEST:

A single plate load tests has been conducted as per location details provided in Figure no. 1.1. The Plot is presented in Figure No. 2.1 .

The stratification and the ground water table aspects have been given due consideration for arriving the allowable safe bearing capacity . Completely weathered rock stratum stratification is observed at plate load conduction level .

The plate load test has been conducted at the proposed site with ultimate load intensity of 74 t/m^2 . Limitations of plate load test in present stratification context needs to be presented.

- i) Plate load test indicates only the strength of stratum located within a depth of twice the width of plate.
- ii) The test is of short duration.
- iii) Size and water table effects need to be accounted.

Water table in the area varies from 4.00 m to 5.40 m below ground.

Hence in light of above considerations and the plot of plate load test Figure no. 2.1 an allowable safe bearing capacity with factor of safety 2.0 is of 25 t/m^2 . The water table consideration need to be accounted considering the stratum.

Hence we recommend an allowable safe bearing capacity 25 t/m^2 at 2.00 m depth below ground level. This allowable safe bearing capacity is within the allowable settlement of 25 mm.

1.3. CROSS BORE HOLE TEST:

An adjustable device, generating the wave front is lowered in the proposed "impulse" hole. The multi-directional geophone placed in the receiver hole detected both the P-and S-waves. Smartse is Seismograph collected the data and geophones recorded the P- & S-waves. The Seismograph has stacking capabilities and an automatic floating point to determine the first break. The P- and S-wave measurements were made at every 2 m interval below the ground surface.

The necessary cognizance of bore hole data has been taken into account before conduction of the test.

The cables marked with 1 m interval ensured the lowering of geophone and hammer at same depth. The hammer is secured in position by inflating the rubber tubes by air pressure. In similar manner the geophones are also secured in receiving holes. The tests were started by pulling the strike rod up with the help of a string and then allowing it to fall under it's own weight. The signals are enhanced by stacking i.e. by repeating the process as described above.

The procedure is repeated a number of times until the first arrival of Seismic waves corresponding to the known stratigraphy is identified. The procedure is repeated at each test depth. Locations of Cross Bore Hole tests are presented in Location Sketch nos. 1.1.

1.3.1. DATA EVALUATION :

The various dynamic soil parameters are determined through the data collected. The recorded first arrivals of P-wave (t_p) and S-wave (t_s) include the time required by the "impulse" wave to travel through the medium.

The following equations were used to determine various parameters.

No.	Parameters	Equation
1.	Primary Wave velocity (V_p)	$V_p = 1,000 X / t_p$
2.	Shear Wave Velocity (V_s)	$V_s = 1,000 X / t_s$
3.	Poisson's Ratio (μ)	$\mu = (m^2 - 2) / 2 * (m^2 - 1)$
4.	Dynamic Shear Modulus (G)	$G = (\gamma_t V_s^2) / g$
5.	Dynamic Young's Modulus (E)	$E = 2(1 + \mu) * G$

where,

X	= Distance between the impulse and the receiver holes
V_p & V_s	= Primary and Shear wave velocities, m/sec.
t_p, t_s	= time of first arrival of primary and Shear waves respectively, milliseconds.
m	= V_p / V_s
G	= Dynamic Shear Modulus, MPa
γ_t	= Total unit weight, KN/m ³
g	= Acceleration due to gravity m/sec/sec/
E	= Dynamic Young's Modulus, Mpa

Parameters calculated from above equations are presented in a tabular in Table Nos. 2.2 & 2.3 for a distance of 3m and 6m respectively.

1.3.2. COMMENTS ON TEST RESULTS :

In general the P- and S-wave velocities indicated an increasing trend with depth and the increasing trend indicates increased densities. The calculated velocities indicate slight increase in completely weathered rock stratum and density with depth.

The values obtained represent a completely weathered basalt rocks in deeper depths (up to depth 10 m).

The calculated velocities from the surface to a 4 m depth indicates the presence of Silty Sands to compact sandy Clayey gravel with depth. Relatively thin zones have not been observed.

Soil "P" wave velocities vary between 590 m/sec to 700 m/sec. and "S" wave velocities vary 270 m/sec to 300 m/sec. The pattern confirms that stratum is quite compact overburden compared to over burden in other corresponding soft media.

As compared to this Completely weathered Basalt Rocks represent "P" wave velocities of 1000 m/sec. to 1400 m/sec.. Such low velocities indicate completely weathered rock stratum. Results of both the tests are presented in Table no. 2.2 and Table no. 2.3 respectively.

2.0. LABORATORY TESTS :

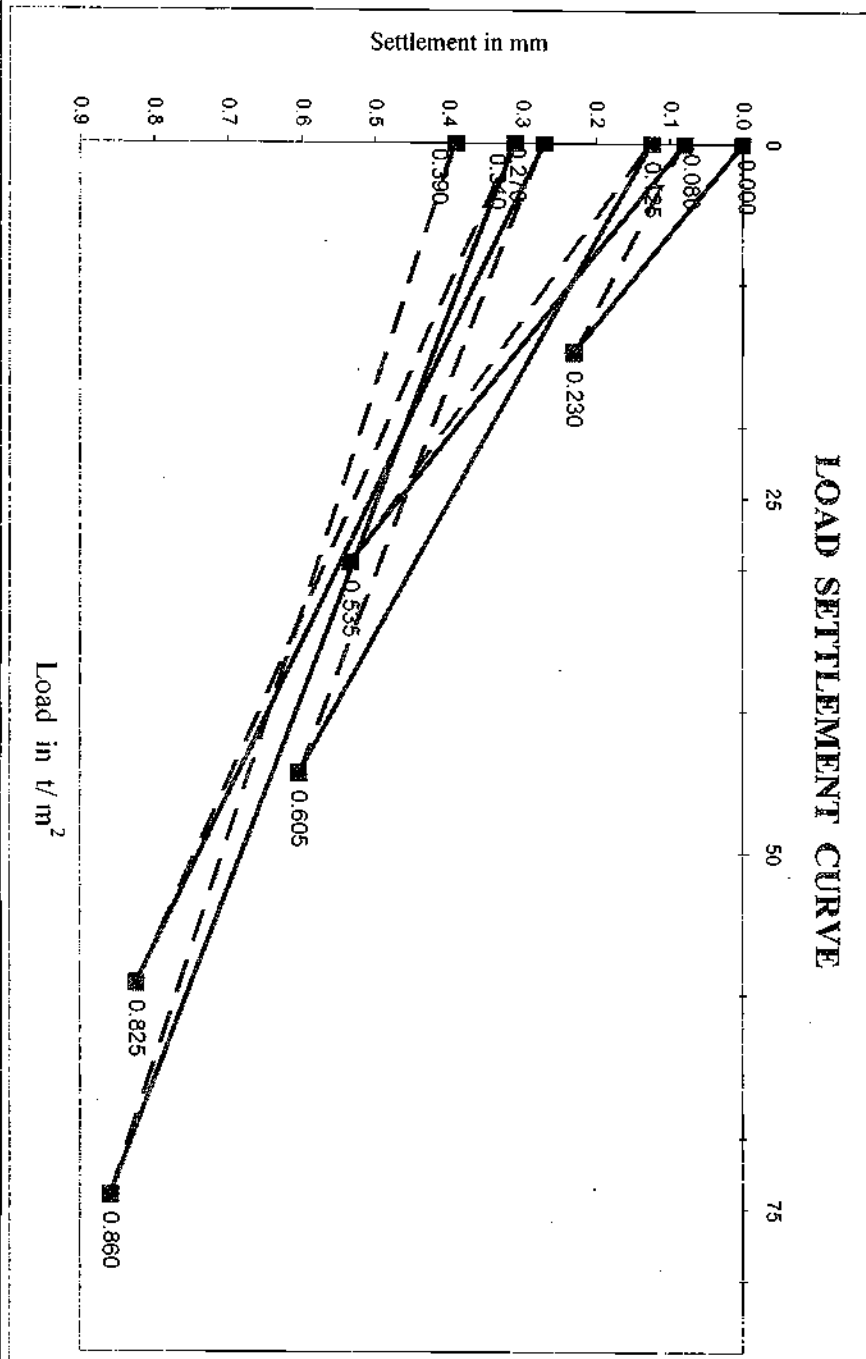
The laboratory tests conducted on undisturbed, disturbed soil samples and rock samples recovered from bore holes are given in Table No. 2.4 and Table No. 2.5 respectively.

PLATE LOAD TEST

PROJECT: Soil Investigation/Exploration work by Bhusawal Replacement Project.

Test No. 1 Client: M.S.P.G.C.L., Bhusawal.
 Location: As per sketch Strata: Weathered rock
 Depth: 2.00 m below G.L.
 Size of plate: 45 x 45 square plate
 Allowable safe bearing capacity = 25 t/m².

Load in t/m ²	Settlement t in mm
0.00	0.000
14.81	0.230
0.00	0.080
29.63	0.535
0.00	0.125
44.44	0.605
0.00	0.270
59.26	0.825
0.0	0.310
74.07	0.860
0.0	0.390



Site-1(3000)

TABLE NO. 2.2
CROSS BORE HOLE TEST NO.1
PRIMARY ,SECONDARY WAVE VELOCITIES , POISSON'S RATIO , BULK ,
YOUNG AND SHEAR MODULUS

Depth in m.	P-wave Velocity m/sec	S-wave velocity m/sec	Poissons ratio $\frac{(m^2-2)}{2*(m^2-1)}$	Bulk Density Kn/m3	Dynamic Shear Modulus, $(\gamma_t * V_s)/g$	Dynamic Youngs modulus $2*(1+\mu)*G$	Layer	Remarks
2	590	280	0.333	19	152	405	Soft	Overburden
4	670	320	0.333	20	209	557	Soft	Overburden
6	1100	610	0.333	22	834	2223	Rock	Weathered
8	1300	730	0.333	23	1249	3330	Rock	Weathered
10	1400	750	0.333	24	1376	3668	Rock	Weathered

* Units for Bulk, Shear and Youngs Modulus are Newtons/mm² or megabars

Site-2(2000)

TABLE NO. 2.3
CROSS BORE HOLE TEST NO.2
PRIMARY ,SECONDARY WAVE VELOCITIES ,POISSON'S RATIO , BULK ,
YOUNG AND SHEAR MODULUS

Depth in m.	P-wave Velocity m/sec	S-wave velocity m/sec	Poissons ratio $\frac{(m^2-2)}{2*(m^2-1)}$	Bulk Density Kn/m3	Dynamic Shear Modulus, $(\gamma_t * V_s)/g$	Dynamic Youngs modulus $2*(1+\mu)*G$	Layer	Remarks
2	590	300	0.333	19	174	464	Soft	Overburden
4	760	325	0.333	21	226	603	Soft	Overburden
6	1150	610	0.333	23	853	2274	Rock	Weathered
8	1320	740	0.333	24	1340	3572	Rock	Weathered
10	1600	900	0.333	24	1982	5284	Rock	Weathered

* Units for Bulk, Shear and Youngs Modulus are Newtons/mm² or megabars

TABLE NO. 2.4
DETAILS OF LABORATORY TESTS CONDUCTED ON SOIL AND
WATER SAMPLES

S.No	Description	Table Nos.	Nos.	Remarks
1.	Bulk Density & N.M.C.	2.6	32	
2.	Grain Size Analysis	2.7	32	
3.	Liquid Limit, Plastic Limit, Plasticity Index and Shrinkage Limit	2.8	32	
4.	Triaxial Shear Test (UU)	2.9	32	
5.	Unconfined Compression	2.10	32	
	Direct Shear Test	2.10	32	
6.	Consolidation test	2.11	32	
7.	Soil Chemical Test	2.12	32	
8.	Water Chemical Test	2.13	11	
11	C.B.R. Test	2.14	2	

TABLE NO. 2.5
DETAILS OF LABORATORY TESTS CONDUCTED ON ROCK SAMPLES

S.No.	Description	Table Nos.	Nos.	Remarks
1.	Unconfined Compression Strength	2.15	32	
2.	Unit Wt. Test, Water absorption	2.16	32	

The laboratory tests results have been presented in following pages .

**LABORATORY TESTS
ON
UNDISTURBED SOIL SAMPLES
BULK DENSITY AND N.M.C.
TABLE NO. 2.6**

Sr. No.	Bore hole No.	Depth, m	Type of Sample	Bulk Density gm/cc	N.M.C. %
1.	1	0.00 – 0.45	UDS1	1.65	19.75
2.	2	0.00 – 0.50	UDS1	1.69	18.20
3.	3	0.00 – 0.50	UDS1	1.62	17.30
4.	4	0.45 – 0.90	UDS1	1.59	19.90
5.	5	0.00 – 0.45	UDS1	1.71	20.10
6.	6	0.50 – 0.95	UDS1	1.73	17.65
7.	7	0.00 – 0.45	UDS1	1.60	19.20
8.	8	0.00 – 0.50	UDS1	1.65	17.45
9.	9	0.00 – 0.45	UDS1	1.58	17.87
10.	10	0.00 – 0.45	UDS1	1.67	18.20
11.	11	0.00 – 0.45	UDS1	1.70	19.35
12.	12	0.00 – 0.25	UDS1	1.73	21.20
13.	13	0.00 – 0.25	UDS1	1.57	18.10
14.	14	0.00 – 0.20	UDS1	1.60	17.70
15.	15	0.00 – 0.45	UDS1	1.63	19.00
16.	16	0.00 – 0.40	UDS1	1.66	16.20
17.	17	0.00 – 0.50	UDS1	1.70	17.80
18.	18	0.00 – 0.65	UDS1	1.58	17.00
19.	19	0.00 – 0.50	UDS1	1.67	18.70
20.	21	0.00 – 0.50	UDS1	1.62	20.20
21.	23	0.00 – 0.45	UDS1	1.65	19.30
22.	23	0.90 – 1.70	UDS2	1.72	18.70
23.	24	0.00 – 0.50	UDS1	1.69	16.20
24.	25	0.10 – 0.55	UDS1	1.73	15.92
25.	26	0.00 – 0.45	UDS1	1.73	17.30
26.	27	0.00 – 0.50	UDS1	1.70	16.75
27.	28	0.00 – 0.45	UDS1	1.68	17.35
28.	29	0.00 – 0.45	UDS1	1.73	18.15
29.	29	0.90 – 1.35	UDS2	1.69	17.37
30.	30	0.00 – 0.50	UDS1	1.72	17.20
31.	31	0.00 – 0.50	UDS1	1.70	18.60
32.	32	0.00 – 0.50	UDS1	1.71	19.30

**LABORATORY TESTS
ON
UNDISTURBED SOIL SAMPLES
TABLE NO. 2.7
PARTICLE SIZE DISTRIBUTION**

Sr. No.	B. H. No.	Depth, m	Type of Sample	Gravel %	Sand %	Silt %	Clay %
1.	1	0.00 – 0.45	UDS1	5.00	18.20	76.80	
2.	2	0.00 – 0.50	UDS1	10.20	29.50	60.30	
3.	3	0.00 – 0.50	UDS1	4.90	33.20	61.90	
4.	4	0.45 – 0.90	UDS1	3.50	22.20	74.30	
5.	5	0.00 – 0.45	UDS1	7.00	12.70	80.30	
6.	6	0.50 – 0.95	UDS1	9.50	20.20	70.30	
7.	7	0.00 – 0.45	UDS1	5.00	21.20	73.80	
8.	8	0.00 – 0.50	UDS1	2.50	22.60	74.90	
9.	9	0.00 – 0.45	UDS1	6.20	19.20	74.60	
10.	10	0.00 – 0.45	UDS1	2.90	27.30	69.80	
11.	11	0.00 – 0.45	UDS1	7.00	31.20	61.80	
12.	12	0.00 – 0.25	UDS1	4.50	16.20	79.30	
13.	13	0.00 – 0.25	UDS1	8.20	19.70	72.10	
14.	14	0.00 – 0.20	UDS1	12.70	23.80	63.50	
15.	15	0.00 – 0.45	UDS1	10.00	21.35	68.65	
16.	16	0.00 – 0.40	UDS1	16.20	29.70	54.10	
17.	17	0.00 – 0.50	UDS1	11.30	30.00	58.70	
18.	18	0.00 – 0.65	UDS1	13.90	28.50	57.60	
19.	19	0.00 – 0.50	UDS1	9.30	16.30	74.40	
20.	21	0.00 – 0.50	UDS1	12.70	22.10	65.20	
21.	23	0.00 – 0.45	UDS1	20.20	18.70	61.10	
22.	23	0.90 – 1.70	UDS2	7.80	29.20	63.00	
23.	24	0.00 – 0.50	UDS1	3.50	17.50	79.00	
24.	25	0.10 – 0.55	UDS1	9.70	24.10	66.20	
25.	26	0.00 – 0.45	UDS1	5.00	17.20	77.80	
26.	27	0.00 – 0.50	UDS1	10.30	29.00	60.70	
27.	28	0.00 – 0.45	UDS1	12.70	24.20	63.10	
28.	29	0.00 – 0.45	UDS1	6.70	27.50	65.80	
29.	29	0.90 – 1.35	UDS2	11.20	18.90	69.90	
30.	30	0.00 – 0.50	UDS1	14.10	33.70	52.20	
31.	31	0.00 – 0.50	UDS1	6.20	36.90	56.90	
32.	32	0.00 – 0.50	UDS1	5.70	26.20	68.10	

**LABORATORY TESTS
ON
UNDISTURBED SOIL SAMPLES
LIMIT STATES AND SPECIFIC GRAVITY
TABLE NO. 2.8**

Sr. No.	Bore hole No.	Depth, m	Type of Sample	Specific Gravity	Liquid Limit	Plastic Limit	Plasticity Index
1.	1	0.00 – 0.45	UDS1	2.59	55.00	26.00	29.00
2.	2	0.00 – 0.50	UDS1	2.61	48.00	25.00	23.00
3.	3	0.00 – 0.50	UDS1	2.65	49.00	24.00	25.00
4.	4	0.45 – 0.90	UDS1	2.63	56.00	27.00	29.00
5.	5	0.00 – 0.45	UDS1	2.67	59.00	28.00	31.00
6.	6	0.50 – 0.95	UDS1	2.63	50.00	26.00	24.00
7.	7	0.00 – 0.45	UDS1	2.66	52.00	27.00	25.00
8.	8	0.00 – 0.50	UDS1	2.63	51.00	26.00	25.00
9.	9	0.00 – 0.45	UDS1	2.65	53.00	27.00	26.00
10.	10	0.00 – 0.45	UDS1	2.62	50.00	26.00	24.00
11.	11	0.00 – 0.45	UDS1	2.59	47.00	24.00	23.00
12.	12	0.00 – 0.25	UDS1	2.64	53.00	27.00	26.00
13.	13	0.00 – 0.25	UDS1	2.60	51.00	26.00	25.00
14.	14	0.00 – 0.20	UDS1	2.58	49.00	25.00	24.00
15.	15	0.00 – 0.45	UDS1	2.65	42.00	25.00	17.00
16.	16	0.00 – 0.40	UDS1	2.61	43.00	22.00	21.00
17.	17	0.00 – 0.50	UDS1	2.66	44.00	23.00	21.00
18.	18	0.00 – 0.65	UDS1	2.68	43.00	22.00	21.00
19.	19	0.00 – 0.50	UDS1	2.63	53.00	27.00	26.00
20.	21	0.00 – 0.50	UDS1	2.67	49.00	25.00	24.00
21.	23	0.00 – 0.45	UDS1	2.62	45.00	23.00	22.00
22.	23	0.90 – 1.70	UDS2	2.66	47.00	24.00	23.00
23.	24	0.00 – 0.50	UDS1	2.63	56.00	27.00	29.00
24.	25	0.10 – 0.55	UDS1	2.68	49.00	25.00	24.00
25.	26	0.00 – 0.45	UDS1	2.65	55.00	26.00	29.00
26.	27	0.00 – 0.50	UDS1	2.69	45.00	24.00	21.00
27.	28	0.00 – 0.45	UDS1	2.64	47.00	24.00	23.00
28.	29	0.00 – 0.45	UDS1	2.61	49.00	24.00	25.00
29.	29	0.90 – 1.35	UDS2	2.67	52.00	25.00	27.00
30.	30	0.00 – 0.50	UDS1	2.61	41.00	22.00	19.00
31.	31	0.00 – 0.50	UDS1	2.65	47.00	23.00	24.00
32.	32	0.00 – 0.50	UDS1	2.69	49.00	24.00	25.00

**LABORATORY TESTS
ON
UNDISTURBED SOIL SAMPLES
TABLE NO. 2.9
UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST**

Sr. No.	Bore hole No.	Depth, m	Type of Sample	Cohesion Kg/cm ²	Angle of Friction " ϕ^0 "
1.	1	0.00 – 0.45	UDS1	0.310	12.65
2.	2	0.00 – 0.50	UDS1	0.235	16.20
3.	3	0.00 – 0.50	UDS1	0.210	18.78
4.	4	0.45 – 0.90	UDS1	0.305	11.90
5.	5	0.00 – 0.45	UDS1	0.347	10.82
6.	6	0.50 – 0.95	UDS1	0.289	17.35
7.	7	0.00 – 0.45	UDS1	0.315	12.30
8.	8	0.00 – 0.50	UDS1	0.337	10.82
9.	9	0.00 – 0.45	UDS1	0.341	9.92
10.	10	0.00 – 0.45	UDS1	0.270	12.90
11.	11	0.00 – 0.45	UDS1	0.278	16.20
12.	12	0.00 – 0.25	UDS1	0.330	11.45
13.	13	0.00 – 0.25	UDS1	0.308	9.87
14.	14	0.00 – 0.20	UDS1	0.245	16.20
15.	15	0.00 – 0.45	UDS1	0.268	14.60
16.	16	0.00 – 0.40	UDS1	0.210	19.85
17.	17	0.00 – 0.50	UDS1	0.231	16.25
18.	18	0.00 – 0.65	UDS1	0.217	17.68
19.	19	0.00 – 0.50	UDS1	0.357	12.27
20.	21	0.00 – 0.50	UDS1	0.269	14.64
21.	23	0.00 – 0.45	UDS1	0.240	16.32
22.	23	0.90 – 1.70	UDS2	0.230	15.70
23.	24	0.00 – 0.50	UDS1	0.315	12.05
24.	25	0.10 – 0.55	UDS1	0.248	14.69
25.	26	0.00 – 0.45	UDS1	0.279	15.20
26.	27	0.00 – 0.50	UDS1	0.240	16.10
27.	28	0.00 – 0.45	UDS1	0.262	14.20
28.	29	0.00 – 0.45	UDS1	0.239	16.35
29.	29	0.90 – 1.35	UDS2	0.230	17.05
30.	30	0.00 – 0.50	UDS1	0.240	16.70
31.	31	0.00 – 0.50	UDS1	0.215	17.30
32.	32	0.00 – 0.50	UDS1	0.257	13.90

**LABORATORY TESTS
ON
UNDISTURBED SOIL SAMPLES
TABLE NO. 2.10
UNCONSOLIDATED UNDRAINED DIRECT SHEAR TEST**

Sr. No.	Bore hole No.	Depth, m	Type of Sample	Cohesion Kg/cm ²	Angle of Friction " ϕ^0 "	Unconfined Compression Strength Kg/cm ²
1.	1	0.00 – 0.45	UDS1	0.357	11.90	0.530
2.	2	0.00 – 0.50	UDS1	0.269	17.05	0.479
3.	3	0.00 – 0.50	UDS1	0.289	18.90	0.505
4.	4	0.45 – 0.90	UDS1	0.320	12.35	0.582
5.	5	0.00 – 0.45	UDS1	0.387	11.70	0.610
6.	6	0.50 – 0.95	UDS1	0.301	16.35	0.592
7.	7	0.00 – 0.45	UDS1	0.365	13.50	0.627
8.	8	0.00 – 0.50	UDS1	0.370	12.05	0.589
9.	9	0.00 – 0.45	UDS1	0.369	10.65	0.630
10.	10	0.00 – 0.45	UDS1	0.289	13.70	0.520
11.	11	0.00 – 0.45	UDS1	0.297	15.89	0.560
12.	12	0.00 – 0.25	UDS1	0.349	12.72	0.620
13.	13	0.00 – 0.25	UDS1	0.337	11.65	0.592
14.	14	0.00 – 0.20	UDS1	0.293	15.90	0.530
15.	15	0.00 – 0.45	UDS1	0.305	13.65	0.570
16.	16	0.00 – 0.40	UDS1	0.265	20.10	0.480
17.	17	0.00 – 0.50	UDS1	0.253	16.82	0.470
18.	18	0.00 – 0.65	UDS1	0.231	16.10	0.410
19.	19	0.00 – 0.50	UDS1	0.367	13.75	0.575
20.	21	0.00 – 0.50	UDS1	0.272	15.31	0.502
21.	23	0.00 – 0.45	UDS1	0.259	16.50	0.421
22.	23	0.90 – 1.70	UDS2	0.280	16.30	0.470
23.	24	0.00 – 0.50	UDS1	0.365	10.35	0.590
24.	25	0.10 – 0.55	UDS1	0.285	15.30	0.485
25.	26	0.00 – 0.45	UDS1	0.305	15.80	0.592
26.	27	0.00 – 0.50	UDS1	0.278	17.15	0.501
27.	28	0.00 – 0.45	UDS1	0.288	15.12	0.497
28.	29	0.00 – 0.45	UDS1	0.295	16.78	0.510
29.	29	0.90 – 1.35	UDS2	0.259	16.50	0.492
30.	30	0.00 – 0.50	UDS1	0.268	17.08	0.505
31.	31	0.00 – 0.50	UDS1	0.237	18.30	0.450
32.	32	0.00 – 0.50	UDS1	0.269	14.37	0.492

**LABORATORY TESTS
ON
UNDISTURBED SOIL SAMPLES
TABLE NO. 2.11
CONSOLIDATION TEST**

Sr. No.	Bore hole No.	Depth, m	Type of Sample	Void Ratio "e"	Compression Index "C _c "
1.	1	0.00 - 0.45	UDS1	1.3732	0.320
2.	2	0.00 - 0.50	UDS1	1.2950	0.217
3.	3	0.00 - 0.50	UDS1	1.1826	0.195
4.	4	0.45 - 0.90	UDS1	1.2165	0.267
5.	5	0.00 - 0.45	UDS1	1.4155	0.297
6.	6	0.50 - 0.95	UDS1	1.3220	0.365
7.	7	0.00 - 0.45	UDS1	1.2257	0.218
8.	8	0.00 - 0.50	UDS1	1.2655	0.276
9.	9	0.00 - 0.45	UDS1	1.2944	0.297
10.	10	0.00 - 0.45	UDS1	1.3326	0.365
11.	11	0.00 - 0.45	UDS1	1.2367	0.312
12.	12	0.00 - 0.25	UDS1	1.1725	0.217
13.	13	0.00 - 0.25	UDS1	1.2036	0.260
14.	14	0.00 - 0.20	UDS1	1.1730	0.210
15.	15	0.00 - 0.45	UDS1	1.2354	0.198
16.	16	0.00 - 0.40	UDS1	1.1739	0.205
17.	17	0.00 - 0.50	UDS1	1.1522	0.221
18.	18	0.00 - 0.65	UDS1	1.1967	0.232
19.	19	0.00 - 0.50	UDS1	1.2354	0.249
20.	21	0.00 - 0.50	UDS1	1.2065	0.235
21.	23	0.00 - 0.45	UDS1	1.1487	0.187
22.	23	0.90 - 1.70	UDS2	1.2227	0.265
23.	24	0.00 - 0.50	UDS1	1.2852	0.307
24.	25	0.10 - 0.55	UDS1	1.2581	0.319
25.	26	0.00 - 0.45	UDS1	1.3221	0.389
26.	27	0.00 - 0.50	UDS1	1.2277	0.402
27.	28	0.00 - 0.45	UDS1	1.1448	0.302
28.	29	0.00 - 0.45	UDS1	1.2758	0.287
29.	29	0.90 - 1.35	UDS2	1.2235	0.250
30.	30	0.00 - 0.50	UDS1	1.1851	0.210
31.	31	0.00 - 0.50	UDS1	1.1553	0.188
32.	32	0.00 - 0.50	UDS1	1.2457	0.267

**LABORATORY TESTS
ON
UNDISTURBED SOIL SAMPLES
TABLE NO. 2.12
CHEMICAL ANALYSIS OF SOILS**

Sr. No.	Bore hole No.	Depth, m	pH	Chloride %	Sulphate %
1.	1	0.00 – 0.45	8.85	0.0035	0.018
2.	2	0.00 – 0.50	7.80	0.006	0.005
3.	3	0.00 – 0.50	8.50	0.012	Traces
4.	4	0.45 – 0.90	8.60	0.008	0.005
5.	5	0.00 – 0.45	8.00	0.009	0.021
6.	6	0.50 – 0.95	8.20	0.014	0.018
7.	7	0.00 – 0.45	8.10	0.010	0.008
8.	8	0.00 – 0.50	8.00	0.007	0.0072
9.	9	0.00 – 0.45	8.20	0.008	0.027
10.	10	0.00 – 0.45	8.00	0.015	0.021
11.	11	0.00 – 0.45	7.90	0.012	0.017
12.	12	0.00 – 0.25	8.30	0.0050	0.020
13.	13	0.00 – 0.25	8.70	0.0067	0.023
14.	14	0.00 – 0.20	8.50	0.0080	0.019
15.	15	0.00 – 0.45	8.30	0.012	Traces
16.	16	0.00 – 0.40	8.35	0.018	0.025
17.	17	0.00 – 0.50	8.50	0.020	0.030
18.	18	0.00 – 0.65	8.60	0.027	0.016
19.	19	0.00 – 0.50	8.75	0.012	0.011
20.	21	0.00 – 0.50	8.90	0.007	0.008
21.	23	0.00 – 0.45	8.30	0.008	0.007
22.	23	0.90 – 1.70	8.20	0.015	Traces
23.	24	0.00 – 0.50	8.10	0.0070	0.009
24.	25	0.10 – 0.55	8.37	0.0020	0.010
25.	26	0.00 – 0.45	8.50	0.0029	0.012
26.	27	0.00 – 0.50	8.00	0.0065	0.019
27.	28	0.00 – 0.45	8.20	0.0087	0.023
28.	29	0.00 – 0.45	8.10	0.0039	0.030
29.	29	0.90 – 1.35	8.45	0.0082	Traces
30.	30	0.00 – 0.50	8.30	0.0035	0.031
31.	31	0.00 – 0.50	8.25	0.0065	0.026
32.	32	0.00 – 0.50	8.10	0.016	0.020

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LABORATORY TESTS
TABLE NO. 2.13
CHEMICAL ANALYSIS OF WATER

Sr. No.	Bore hole No.	Depth, m	pH	Chloride ppm	Sulphate ppm
1.	1	2.00	8.00	87	108
2.	2	2.00	7.80	104	Traces
3.	3	2.00	8.20	115	97
4.	4	2.00	8.10	125	56
5.	5	2.10	8.30	120	104
6.	6	2.50	8.40	105	76
7.	7	2.00	8.45	87	37
8.	9	1.65	8.50	132	102
9.	10	1.50	8.60	112	110
10.	15	1.45	8.70	110	52
11.	16	2.90	8.50	110	105

TABLE NO. 2.14
C.B.R. TEST

Sr. No..	B.H. No.	Depth, m	C.B.R. Test	
			2.5 mm	5 mm
1.	1	0.80	8.60	8.18
2.	8	1.00	12.10	11.85

**LABORATORY TESTS
ON
ROCK SAMPLES
TABLE NO. 2.15
UNCONFINED COMPRESSION STRENGTH**

Sr. No.	B.H. No.	Depth, m	Unconfined Compression Strength, kg/cm ²
1.	1	8.50 – 10.50	65.10
2.	2	6.00 – 7.45	102.50
3.	3	7.00 – 7.75	111.70
4.	4	5.50 – 6.00	76.90
5.	5	7.00 – 8.15	89.20
6.	6	6.00 – 7.65	125.20
7.	7	10.00 – 11.00	145.90
8.	8	7.50 – 8.50	122.30
9.	9	7.65 – 8.70	135.80
10.	10	7.00 – 7.90	157.20
11.	11	7.50 – 9.00	187.20
12.	12	8.00 – 9.00	192.30
13.	13	10.00 – 11.00	135.20
14.	14	8.50 – 9.50	143.20
15.	15	6.20 – 8.53	145.20
16.	16	8.15 – 9.10	127.20
17.	17	7.00 – 7.50	119.70
18.	18	8.60 – 9.45	146.20
19.	19	5.10 – 6.25	127.70
20.	20	4.90 – 6.50	97.50
21.	21	9.60 – 10.10	137.50
22.	22	7.50 – 8.50	131.65
23.	23	9.00 – 10.00	143.10
24.	24	8.50 – 9.75	132.30
25.	25	9.20 – 10.20	153.20
26.	26	7.00 – 8.40	115.45
27.	27	7.50 – 8.50	130.30
28.	28	7.75 – 8.40	88.20
29.	29	8.00 – 9.00	147.20
30.	30	6.00 – 7.75	126.35
31.	31	6.00 – 7.00	143.65
32.	32	7.00 – 8.50	183.20

**LABORATORY TESTS
ON
ROCK SAMPLES
TABLE NO. 2.16
UNIT WT. TEST**

Sr. No.	B.H. No.	Depth, m	Unit Wt. Gm/cc	Moisture Absorption %
1.	1	8.50 – 10.50	2.60	0.52
2.	2	6.00 – 7.45	2.57	0.82
3.	3	9.00 – 9.75	2.70	0.48
4.	4	5.50 – 6.00	2.50	0.928
5.	5	7.00 – 8.15	2.52	0.730
6.	6	6.00 – 7.65	2.60	0.56
7.	7	10.00 – 11.00	2.62	0.320
8.	8	7.50 – 8.50	2.58	0.465
9.	9	7.65 – 8.70	2.60	0.388
10.	10	7.00 – 7.90	2.63	0.292
11.	11	7.50 – 9.00	2.53	0.832
12.	12	8.00 – 9.00	2.70	0.179
13.	13	10.00 – 11.00	2.57	0.321
14.	14	8.50 – 9.50	2.54	0.287
15.	15	6.20 – 8.53	2.59	0.265
16.	16	8.15 – 9.10	2.50	0.820
17.	17	7.00 – 7.50	2.53	0.687
18.	18	8.60 – 9.45	2.60	0.390
19.	19	5.10 – 6.25	2.49	1.05
20.	20	4.90 – 6.50	2.48	1.18
21.	21	9.60 – 10.10	2.60	0.780
22.	22	7.50 – 8.50	2.58	0.830
23.	23	9.00 – 10.00	2.62	0.370
24.	24	8.50 – 9.75	2.57	0.956
25.	25	9.20 – 10.20	2.53	0.962
26.	26	7.00 – 8.40	2.60	0.372
27.	27	7.50 – 8.50	2.58	0.565
28.	28	7.75 – 8.40	2.61	0.387
29.	29	8.00 – 9.00	2.53	1.09
30.	30	6.00 – 7.75	2.58	0.55
31.	31	6.00 – 7.00	2.63	0.87
32.	32	7.00 – 8.50	2.60	0.382

SECTION - III

SECTION III

The purpose of this detailed Geotechnical investigation has been to study the subsoil characteristics for founding of the proposed 1 x 250 MW Bhusawal Replacement Project, at Bhusawal. The works involves investigations for various complex units of Thermal power project such as Switch yard bay, control room, Transfer Tower etc.. Detailed evaluation of allowable safe bearing capacity based on exploration studies, various field tests and laboratory tests is presented in this section. Various recommendations related to construction activity are also included.

2. BEARING CAPACITY:

The foundation design must take into account both the bearing capacity and settlement aspect.

A) The bearing stress at the interface of structure foundation system must be less than the bearing capacity of the said strata.

B) The settlement of the structure caused by deformation of the ground material must be less than the allowable settlement for the structure.

Keeping these constraints, the foundations for present structural system are formulated. Obviously we have to consider the foundations for a general structural buildings as well as important heavy structural systems. The following discussions highlight both the aspects and necessary recommendations are proposed accordingly.

3.0 FOUNDATIONS :

Considering the importance of the project and related activities structural units involved presentation covers both the heavy structural load units as well as light structural load units. Exploration studies and related tests convey that for major portion of the area soft strata depths is hardly 2.50 m below the ground level.

Hard stratum is invariably completely weathered rock stratum lying below ground from 1.00 m to 2.00 m depth. The only cautious note is that this stratum of hard strata is invariably completely weathered and fractured and disintegrated. Hence necessary precautions and design parameters will have to take into account the vibrational modes of the heavy loads in relation to weak hard strata.

All exploration Bore holes and related Soil Profiles show that "Soft Stratum with relative stiffness" is predominant for about 3 m depth. Hence open foundations, Isolated spread, Special footings, Combined footings, Floating Foundations, Raft / Mat with various combinations of thickened Plates, pedestals and possible basement combinations foundations are the possible avenues. Hence in light of exploration studies open foundation schemes and related allowable safe bearing capacities have been presented.

4. OPEN FOUNDATIONS :

4.1. BORE HOLE NOS. 1, 6 to 10, 15, 18, 23, 25, 26, 29 :

ALLOWABLE SAFE BEARING CAPACITY AT VARIOUS DEPTHS BELOW GROUND LEVEL :

Considering soft stratum overburden we recommend an allowable safe bearing capacities as below. Allowable Safe bearing capacities at shallow depths 3.00 m, 4.00 m and 5.00 m have been recommended as below. (Table No. 3.1)

TABLE NO. 3.1

Sr. Nos.	Sizes of Footings Length * Width	Depth below ground, m	Allowable Bearing Capacity t/m ²
1.	3*3, 3*5, 3*7, 3*10	3.00	25, 22, 21, 20
2.	5*5, 5*7, 5*10,	4.00	45, 42, 40
3.	5*5 and above	5.00	60

The allowable bearing capacity of the stratum have been recommended on the basis of samples, SPT, and rock tests.

4.2. BORE HOLE NOS. 2 to 5, 11 to 14, 16, 17, 19 to 22, 24, 27, 28, 30 to 32 :

ALLOWABLE SAFE BEARING CAPACITY AT VARIOUS DEPTHS BELOW GROUND LEVEL :

Considering soft stratum overburden we recommend an allowable safe bearing capacities as below. Allowable Safe bearing capacities at shallow depths 3.00 m, 4.00 m and 5.00 m have been recommended as below. (Table No. 3.1)

TABLE NO. 3.1

Sr. Nos.	Sizes of Footings Length * Width	Depth below ground, m	Allowable Bearing Capacity t/m ²
1.	3*3, 3*5, 3*7, 3*10	3.00	30, 25, 23, 20
2.	5*5, 5*7, 5*10,	4.00	47, 45, 43
3.	5*5	5.00	60

5.0. ADDITIONAL CONSIDERATIONS FOR FOUNDATIONS :

5.1. LATERAL SEPARATION OF ADJACENT FOUNDATIONS :

Net allowable bearing pressures and settlement estimates are based on the assumption that foundation soils underlying a footing are not significantly affected by adjacent footings. The minimum lateral distance between adjacent individual spread footings bearing at the same grade on soil should be $B/2$, where B is the footing width or diameter of the larger footing. For strip footings of width B , the minimum lateral separation distance should be not less than B . Where lateral spacing is less than recommended, the stress distribution beneath adjacent footings should be analyzed. Typically, footings spaced between $B/2$ and $B/5$ apart may experience 10 to 20 percent higher settlement.

5.2. OVERTURNING:

Wind loads acting on tall structures, which have dimensions less than their heights, will induce overturning moments and lateral forces. The overturning moment should be balanced by the structure and footing dead weights, and soil overburden pressure. The structure's resistance to overturning should be at least 1.5 times the applied moment.

For individual foundations, the ratio of moment to vertical load (M/v) should not exceed $B/6$ and $R/4$ for square and circular footings, respectively. B and R are footing width and radius, respectively. If necessary, anchor piles can be used to resist large uplift loads due to overturning forces. Alternatively, the foundation width could be increased.

For lightly-loaded structures, the above recommendation may result in conservative foundation sizes. We recommend that the effect of eccentricity be checked using a procedure proposed by Vesic (1975) and illustrated on Plate - 5. In this method, an "Effective area" is calculated from the load-eccentricity. This area is given by standard references. This is particularly important for Chimney structure.

The average bearing pressure on this effective area should be less than the allowable bearing pressure from bearing capacity and settlement considerations.

5.3. SLIDING RESISTANCE

The sliding resistance of shallow foundations can be computed from the following equation :

$$S = 0.42 V$$

where S = allowable horizontal resistance, kN; and

V = minimum vertical load on foundation; kN

The above allowable horizontal resistance includes a factor of safety of 1.5. The equation is based on a 25° friction angle between the concrete and foundation soils. Horizontal loads acting on foundations will be resisted by friction along the base of foundation and by the net passive pressure acting on sides of the foundation. The net passive resistance is negligible for most shallow foundations and has not been considered in the equation given above.

6.0. FOUNDATION CONSTRUCTION CONSIDERATIONS:

6.1. EXCAVATION :

We believe excavation in soil can be done easily. Rock excavations may arise in present case. Slopes of temporary open-cut excavations in surface soil need to be 1-vertical on 2-horizontal.

In completely weathered rock stratum 1V: 1.5 H and permanent side slopes and embankment slopes through soil should not be steeper than 1-vertical on 3-horizontal for stability considerations. Both open-cut and embankment side slopes should be protected from wind and water erosion.

Excavations for below-grade facilities can be made by either sheeted vertical cuts or open-cut procedures. Open-cut methods of completing excavations are considered generally satisfactory for relatively shallow below-grade structures. For deeper-seated facilities, because of increased space requirements to accommodate side slopes and associated difficulties in effectively dewatering such excavations, open-cut methods may not be feasible. Vertically cut excavations retained by using conventional sheeting may, therefore, be the most effective method of completing excavations for deep below-grade structures. Back-filling around completed structures should be carried out with proper compaction. Hence excavated portions to be concreted need to be protected from erosion and weathering effects. Surface portions excavations may be carried out instantaneously.

6.2. DEWATERING

Water level at the site varies from 3.50 m to 4.50 m below the existing ground during field investigation time. However, during monsoon season this water level may rise. Excavations extending deeper than the reported water level will encounter ground water. Seepage of ground water into excavations deeper than the ground water level may be excessive and some positive means of effectively controlling ground water level should be provided to enable construction to be completed in the dry.

Excavations may be carried to about 0.5 m below ground water level by open pumping from carefully constructed gravel-filled sumps. Excavations extending 4 to 5 m below ground water level can probably be effectively dewatered using a vacuum well point system or submersible pumps. Excavations deeper than 5 m below ground water level may require either a staged vacuums well point system or jet ejection wells to satisfactorily control the ground water level.

6.3. FOUNDATIONS BEARING SURFACE:

Foundations soils should be protected against disturbance from construction activities. Soils exposed at the bearing grade, or any backfill place to establish the bearing grade, should be watered and compacted. After compaction the soil should be kept moist until the foundation concrete is poured.

Foundation concrete should be poured the same day that the excavation is made to grade. If this is impractical, a thin seal slab of lean concrete should be poured over the base of the excavation to protect the bearing level.

In addition, positive drainage should be established away from foundation excavations to prevent water from pounding within the excavations or around the completed foundation, prior to, or during backfill placement.

6.4. RETAINING WALLS

Permanent or temporary walls retaining in excess of 0.5 m of backfill should be designed to resist lateral earth pressure. A freestanding retaining wall not restrained from minor rotational movement should be designed for the active earth pressure case. Foundation walls restrained from rotational movement, such as the walls for basements should be designed for the at-rest condition.

Resistance to lateral movement of a retaining wall is provided by net passive earth pressure. The active, passive and at-rest lateral earth pressure may be calculated using the earth pressure diagrams at the location point.

The earth pressure values are based on the assumption that the backfill will be free-draining material and will be compacted in accordance with structural fill recommendations.

If compaction using heavy equipment is performed near retaining walls, or buried structures, soil pressures against these structures can be as much as two times the normal values. It is recommended that large vibratory rollers not be used within 2 m from retaining walls and within 2 m directly above any buried structures. Small hand-guided plate tampers should be used in pipe trenches and next to retaining walls.

7. FOUNDATION PROTECTIONS:

7.1. WIND AND WATER EROSION

Sand fill, if placed outside building areas and not covered by paving, should be protected from wind and water erosion. One method of protection commonly employed is to place and compact a minimum 300 mm thick murrum (gravel) cap.

The rock content plus cementation of the murrum have proven adequate resistance against wind and water erosion. Other alternatives that may be considered for protection against wind and water erosion include asphalt paving, planned landscaping, or sprayed on polymer based erosion inhibitors.

7.2. WATER PROOFING :

Ground floor slabs and other buried structures placed less than 1.0 m above ground water level should be protected from ground water infiltration. Methods that could be used to protect the buried structures include bitumen coatings if the structures are less than 3 m below the ground water level. For deep basements, consideration should be given to permanent drainage systems to control seepage of ground water into the basement.

8.0. SITE PREPARATION :

8.1. GENERAL:

We recommend that all fill placement and compaction, including raising the site grades and back filling of foundation utility trench excavations, be done in accordance with our recommendations given in the following sections of this report. In the present case surface soils are agricultural soils with moderate Swelling potential. Hence these soils need to be removed or stabilized using stabilisation technique.

All vegetation and deleterious material should be removed from areas to receive fill, prior to fill placement. The thickness of vegetation layer is @ 150 mm to 200 mm. The surface of the existing natural soils should then be scarified, watered and compacted and stabilized in accordance with the recommendations. The natural ground surface should be thoroughly stabilised.

8.2. FILL CHARACTERISTICS:

Clean sand, defined as sand with less than 10 percent passing the no. 200 sieve or 75µm sieve is considered the most suitable fill material. Silty sand or sandy silt intermixed with sandstone fragments, locally called marl may also be used as fill material.

However, the use of Marl requires close control of moisture content and lift thickness to achieve compaction.

In general suitable marl should consist of material with less than 30 percent passing the No. 200 sieve. The minus No. 40 fraction should have maximum Liquid Limit of 25 and a Plasticity Index less than 8. Dune sand, if available, is considered as suitable fill material.

8.3. COMPACTION EQUIPMENT

The procedures used for fill placement and compaction generally depend upon material used and equipment available. A 10 ton vibratory roller is most suitable for conducting granular soils. Large quantities of water may be needed to facilitate compacting. The lift thickness can be effectively compacted will depend on gradation of the fill material.

8.4. STRUCTURAL AND GENERAL FILL

Fill placed for paved areas or below specific facilities should be compacted in accordance with the recommendations given here for structural fill. We recommend that structural fill extends a minimum distance equal to twice the average foundation width beyond the outer perimeters of the structure foundations. Permanent slopes beyond this limit should not exceed 1V:3H. Clean sand placed for land scraping purposes outside buildings or roadway areas is considered to be general fill.

8.5. CAP LAYER.

We recommend that if clean sand is used as fill material then a cap layer be placed to provide wind erosion protection in exposed areas. A cap layer of gravel or marl placed and compacted in accordance with the above recommendations may be used for this purpose. We recommend that a cap layer be a minimum of 300 mm thick. Consideration may be given to use of soil cement, asphalt paving or spread-on, polymer based erosion inhibitors.

8.6. PLACEMENT CONTROL:

Fill placement and compaction can be monitored by nuclear density or sand cone density test. Dry densities and moisture contents may be determined by any one of these tests. Selection of the appropriate procedures will depend upon the types of fill material and expertise of the personnel performing the test.

8.7. CUT AND FILL SLOPES

Both cut and fill slopes may be required at the site during excavation and for raising the site grades. We recommend that permanent slopes in soil not exceed 3H:1V. Temporary slopes in natural material cut areas may be steeper but should not exceed 1.5H:1V. All permanent slopes should be provided with some form of protection against erosion. The recommendation for the cap layer above is applicable.

9. CEMENT CONTENT :

The water and soil contents have been tested for chloride / sulfate contents. Both the Chloride and Sulphate contents are minimal. The fluctuations of water table are up to 2.0 m to 7.0 m below ground level. Considering IS 456: 2000 the minimum cement content need to be adopted. The durability and the importance of the structure needs to be considered. We recommend that normal Portland cement content should not be less than 380 kg/m^3 . The minimum concrete cover of 75 mm should be ensured. The water cement ratio need to be restricted within 0.45 only.

ANALYSIS OF BEARING CAPACITY

Stratification in shallow depths is completely weathered rock. Completely weathered rock is a combination of rock mass and soil. Disintegrated mass may contain soil mass to extent of 75 % to 80 %. S.P.T. values in this zone are refusal for major extent. The lowest prorated S.P.T. values vary from 56 to 100 and above. Ground water table is at shallow depths.

K.W. Kule and M. A. Stroud (Piles in weak rocks, The Institution of Engineers, London, 1977) provide Scale of Shear strengths and N values for weak rocks and soils. Accordingly shear strengths vary from 38 t/m^2 to 70 t/m^2 .

Considering water table, actual S.P.T. locations, footing areas allowable safe bearing capacities have been recommended.

In first group allowable safe bearing capacity recommended is 25 t/m^2 and in second group same is 30 t/m^2 based on insitu conditions.

Based on various footing sizes slight modifications have been proposed. Present stratifications is not expected to be subjected to long term settlements as the same have no consolidation characteristics. Present recommendations are based on allowable safe minimum bearing capacity.

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SECTION - IV

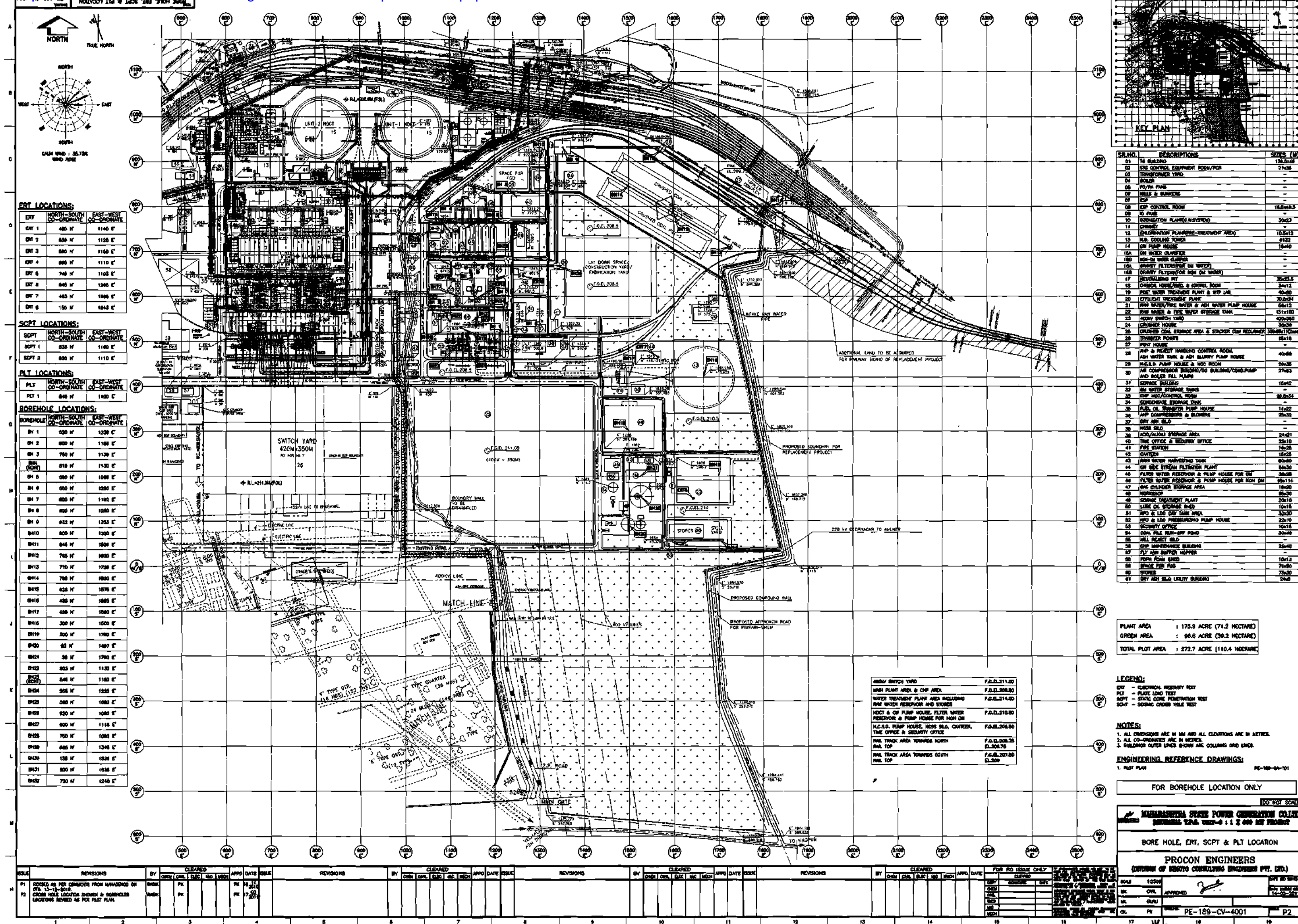
SECTION IV RECOMMENDATIONS

1. Exploration studies convey the presence of maximum soft stratum thickness hardly 2.50 m. Completely weathered Basalt rocks are observed beyond about average 1.5 m overburden thickness. In few cases completely weathered rock is present at 0.5 m to 1.0 m below ground level. Water table presence varies 4.00 m to 5.40 m depth below ground in general cases. Monsoon water table rises considerably in surface soils. Hence this consideration needs to be taken while designing open foundations.
2. Considering the importance of the project foundation in surface soils are ruled out. Surface soils show low to moderately swelling potential. Surface soils need stabilisation or removal to the extent. Roads and pathways need to be planned in gravelly sandy Soils. Surface soils of upper 0.50 m to 1.00 m should not be used for plinth filling or similar activity. Surface soils cover extends 2.00 m to 2.50 m below ground.
3. Open foundation scheme has been recommended. Allowable safe bearing capacities have been recommended for various levels below ground level. Each bore wise and in combined way allowable safe bearing capacities have been recommended.
4. Before laying concrete, trench bottom surfaces need to be protected from atmospheric conditions either by leaving partial excavation as protection or protecting the excavated surface by thin concrete layers.
5. Soil and water contents display chloride and sulphate contents within limitations. Hence a cement content of minimum 380 kg/m^3 of concrete is recommended with maximum water cement ratio of 0.45 from durability considerations.
6. The slope of excavations should be 1:2 in surface soils. The angle of repose for the excavated material below fill material is 19.50° . Rotationally restrained retaining walls for the basements should be designed for at the rest condition.
7. The basement portions as well as ground floor slabs and other buried structures placed below ground water level should be protected from ground water infiltration. Bitumen coatings and permanent drainage system to control the seepage water need to be considered.
8. The foundations need to be designed for earthquake resistance in general accordance to the criteria given in IS: 1893 - 1984.

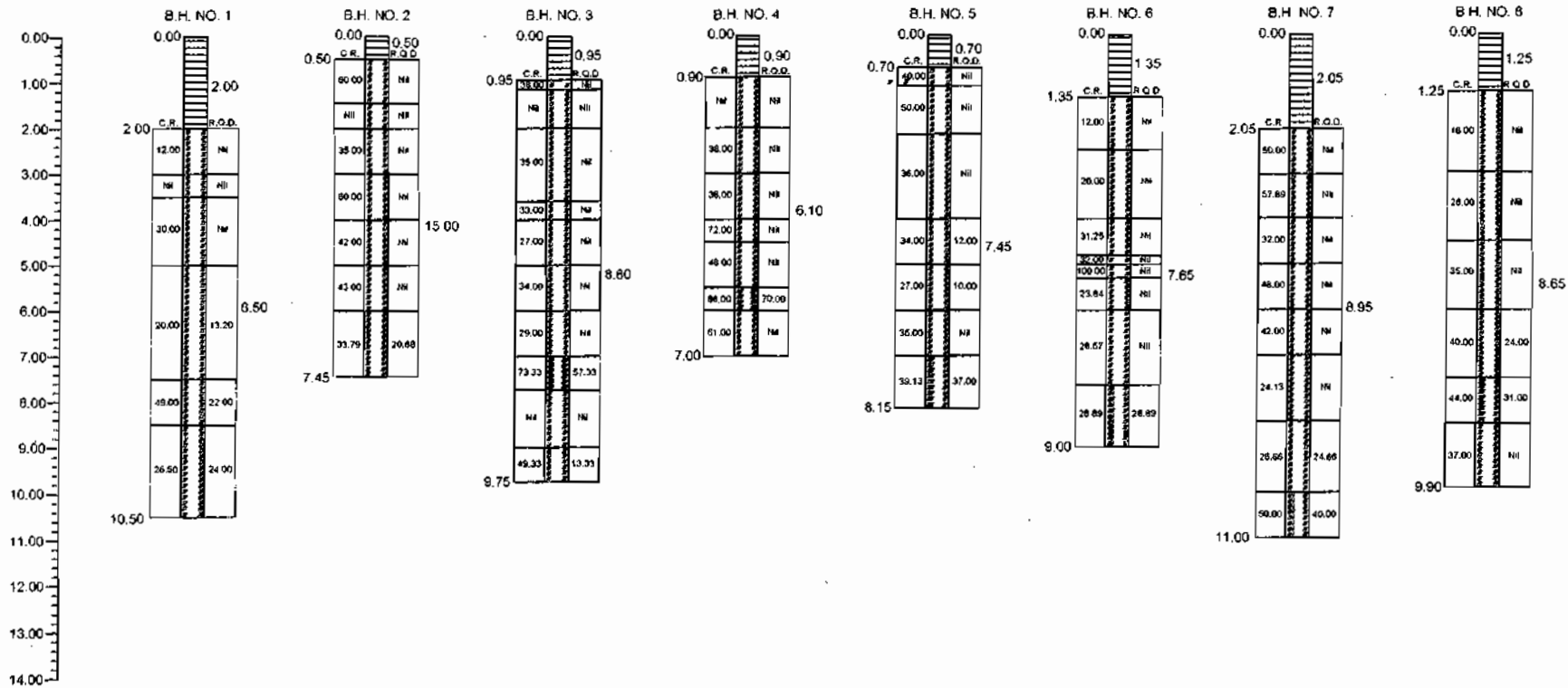
 **RENUKA ENGINEERS**

ANNEXURE - I

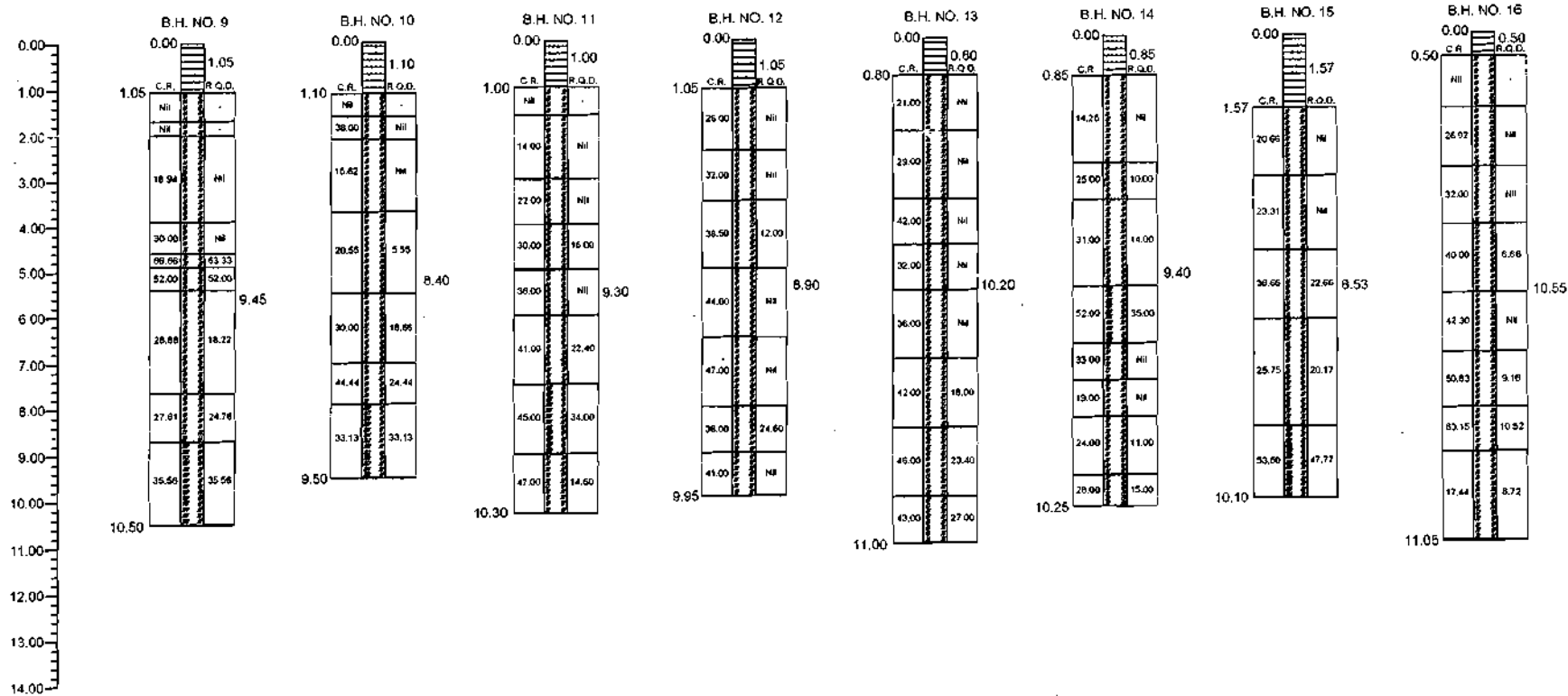
**LOCATION SKETCH,
SOIL PROFILE
&
BORE LOGS DATA SHEETS**



SOIL PROFILE FOR PROPOSED BHUSAWAL REPLACEMENT PROJECT.



SOIL PROFILE FOR PROPOSED BHUSAWAL REPLACEMENT PROJECT.



- ALL DIMENSION IN METRE
- STRATIFICATION INDICATED IS ONLY AT BORE HOLE LOCATION & NOT BETWEEN THE BORE HOLES

LEGEND	
	- RESIDUAL BROWNISH GRAVELLY SAND CLAY.
	- COMPLETELY WEATHERED BASALT ROCK.

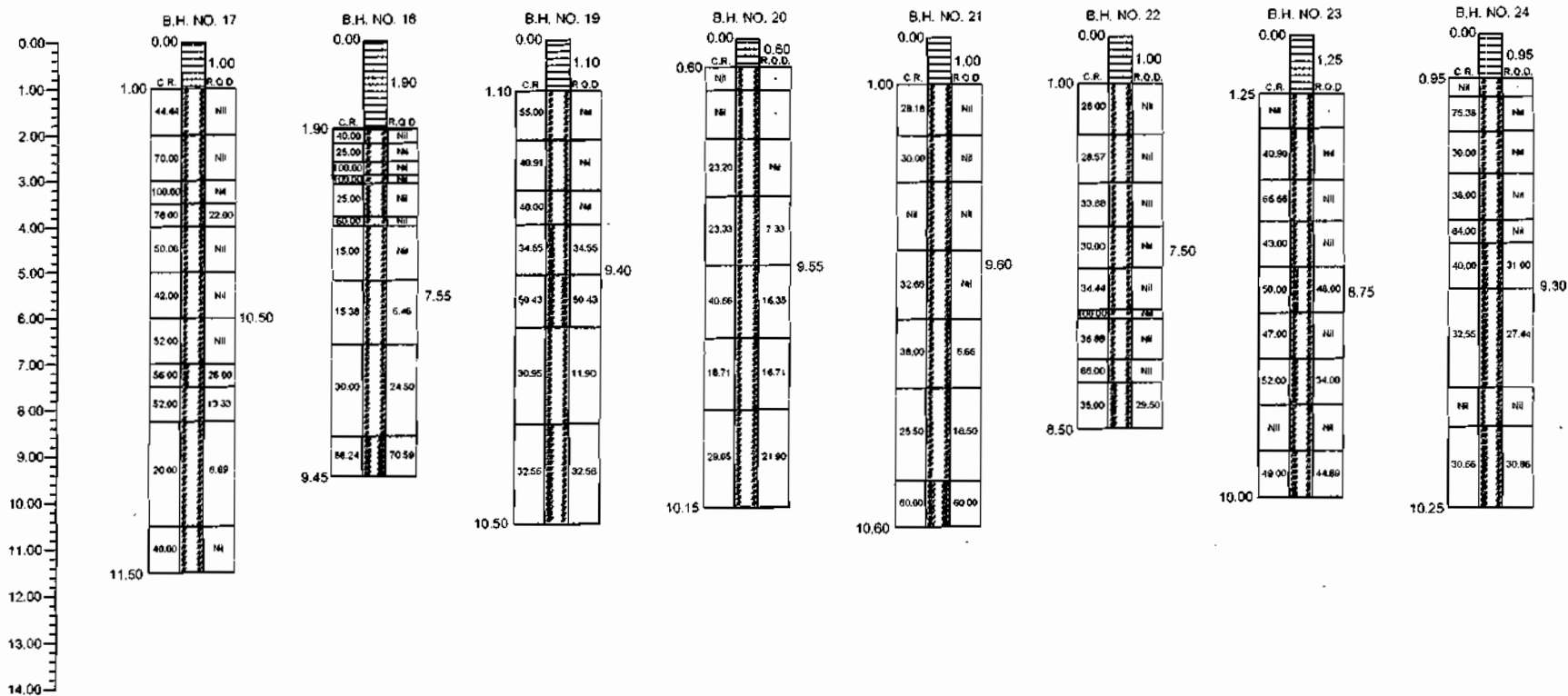
RENUKA ENGINEERS
 SHOP NO. 1, MEERA MOHAN CHS.
 SECTOR - 3, OPP. KRANTI TOWER,
 THANE (W) - 400 604

PROJECT: PROPOSED BHUSAWAL REPLACEMENT PROJECT

CLIENT: M.S.P.G.C.L., CHUMMERY BUILDING,
 DEEPNAGAR, BHUSAWAL.

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SOIL PROFILE FOR PROPOSED BHUSAWAL REPLACEMENT PROJECT.



- ALL DIMENSION IN METRE
- STRATIFICATION INDICATED IS ONLY AT BORE HOLE LOCATION & NOT BETWEEN THE BORE HOLES

LEGEND	
	RESIDUAL BROWNISH GRAVELLY SAND CLAY.
	COMPLETELY WEATHERED BASALT ROCK.

RENUKA ENGINEERS
 SHOP NO. 1, MEERA MOHAN CHS.,
 SECTOR - 3, OPP. KRANTI TOWER,
 THANE (W) - 400 604.

PROJECT: PROPOSED BHUSAWAL REPLACEMENT PROJECT.

CLIENT: M.S.P.G.C.L. CHUMMERY BUILDING,
 DEEPNAGAR, BHUSAWAL.

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Figure 10 displays seven vertical cross-sections of boreholes, labeled B.H. NO. 25 through B.H. NO. 32. Each section shows a vertical scale on the left (0.00 to 11.00) and a central column for soil profile data. The sections are labeled with their respective borehole numbers and depths.

- B.H. NO. 25:** Depth 0.00 to 1.50. Soil profile data: 60.00, 34.00, 35.00, 10.13, 58.75, 12.50, 11.00, 45.00, 10.00. Total depth: 10.20.
- B.H. NO. 26:** Depth 0.00 to 1.50. Soil profile data: 25.00, 20.00, 30.00, 35.00, 25.00, 27.14, 30.63, 42.00, 20.00. Total depth: 10.50.
- B.H. NO. 27:** Depth 0.00 to 1.00. Soil profile data: 40.00, 32.00, 30.00, 36.00, 40.00, 30.00, 64.00, 40.00, 30.00. Total depth: 8.50.
- B.H. NO. 28:** Depth 0.00 to 1.35. Soil profile data: 48.00, 55.00, 29.00, 43.00, 37.00, 25.00, 59.00, 35.00, 22.00. Total depth: 10.00.
- B.H. NO. 29:** Depth 0.00 to 2.00. Soil profile data: 36.00, 40.00, 70.00, 53.00, 50.00, 45.00, 37.00. Total depth: 9.00.
- B.H. NO. 30:** Depth 0.00 to 0.95. Soil profile data: 34.28, 47.00, 29.00, 34.00, 48.00, 28.00, 28.57, 11.42. Total depth: 7.75.
- B.H. NO. 31:** Depth 0.00 to 0.95. Soil profile data: 30.00, 27.00, 32.00, 33.00, 45.00, 40.00, 44.00, 20.00, 12.22. Total depth: 10.30.
- B.H. NO. 32:** Depth 0.00 to 0.85. Soil profile data: 11.11, 30.00, 31.00, 28.00, 30.00, 25.00, 32.00, 37.00, 27.00. Total depth: 10.50.

- ALL DIMENSION IN METRE
- STRATIFICATION INDICATED IS ONLY AT BORE HOLE LOCATION & NOT BETWEEN THE BORE HOLES

RESIDUAL BROWNISH GRAVELLY SAND CLAY.

COMPLETELY WEATHERED BASALT ROCK.

CLIENT: M.S.P.G.C.L., CHUMMERY BUILDING,
DEEPNAGAR, BHUSAWAL.

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.					Borelog As per IS 1892 : 2002					Job No. 11-62 Date: 29/04/011 to 05/06/011 Page No. 1 of 1						
Project :- Bhusawal Replacement Project (1 x 250 MW)																
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.																
Co-ordinates :- North-South Co-ordinate: 520 N', East-West Co-ordinate: 1220 E' Bore Hole No. 1																
R. L. Existing ground level 0.0 m Depth of Bore Hole : 10.50 m																
Location : As per Location Sketch Depth of Casing : 2.00 m																
Depth of GWT : 4.50 m Date of Commencement : 30-04-2011																
Date of Completion : 02-05-2011																
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No	Type	Depth (m)		SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests
	0.00	-					From	To	15	30	45	60	N			
0.00			-----	Residual brownish low plasticity soils	1	UDS	0.00	0.45								
			-----	sandy soils with pebbles boulder	1	SPT	0.45	0.90	6	8	9	-	17			
			-----	mixed soil formation.	1	DS	0.90	1.30								
1.00			-----		2	SPT	1.30	1.45	19	-	-	-	R			
			-----		2	DS	1.45	1.85								
2.00			-----		3	SPT	1.85	2.00	31	-	-	-	R			
2.00				Grayish basalt completely weathered		CORE	2.00	3.00						12.00	Nil	
				basalt rock soft to hard weak rock												
				pieces.												
3.00						CORE	3.00	3.50						Nil	Nil	
						CORE	3.50	5.00						30.00	Nil	
4.00																
5.00				Grayish fractured basalt rock.		CORE	5.00	7.50						20.00	13.20	
6.00																
7.00						CORE	7.50	8.50						49.00	22.00	
8.00				Weak friable soft rock.		CORE	8.50	10.50						26.50	24.00	
9.00																
10.00																
10.50																
DS : Disturbed Sample CR : Core Recovery K : Permeability Test UDS : Undisturbed Sample RQD : Rock Quality Designation PT : Packer Permeability Test SPT : Standard Penetration Test PR : Rate of Penetration WS : Wash Sample VST : Vane Shear Test																
Site Engg. Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande			Client Rept.		Bore Termination Depth: 10.50 m							

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.					Borelog As per IS 1892 : 2002					Job No : 11-62 Date: 29/04/011 to 05/06/011 Page No : 1 of 1						
Project :- Bhusawal Replacement Project (1 x 250 MW)																
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.																
Co-ordinates :- North-South Co-ordinate: 600 N', East-West Co-ordinate: 1155 E' Bore Hole No. 2																
R. L.: Existing ground level 0.0 m Depth of Bore Hole : 7.45 m																
Location : As per Location Sketch Depth of Casing : 2.00 m																
Depth of GWT : 4.10 m Date of Commencement : 06-05-2011																
Date of Completion : 08-05-2011																
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests
	0.00	-					From	To	15	30	45	60	N			
0.00	0.50	-	----	Residual gravelly soils.	1	UDS	0.00	0.50								
1.00			W W	Completely weathered soft highly fractured basalt rock.	1	CORE	0.50	1.00						80.00	Nil	
			W W			SPT	1.00	1.45	18	23	25	-	48			
			W W		CORE	1.45	2.00							Nil	Nil	
2.00			W W		CORE	2.00	2.80							35.00	Nil	
			W W													
3.00			W W		2	SPT	2.80	3.00	22	-	-	-	R			
			W W			CORE	3.00	3.90						60.00	Nil	
4.00			W W		3	SPT	3.90	4.00	31	-	-	-	R			
			W W			CORE	4.00	5.00						42.00	Nil	
5.00			W W		CORE	5.00	6.00							43.00	Nil	
			W W													
6.00			W W		CORE	6.00	7.45							33.79	20.68	
			W W													
7.00			W W													
	7.45	-	W W													
DS : Disturbed Sample UDS : Undisturbed Sample SPT : Standard Penetration Test WS : Wash Sample					CR : Core Recovery RQD : Rock Quality Designation PR : Rate of Penetration VST : Vane Shear Test					K : Permeability Test PT : Packer Permeability Test						
Site Engg. Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande		Client Repr.		Bore Termination Depth: 7.45 m								

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.					Borelog As per IS 1892 : 2002					Job No : 11-62 Date: 29/04/2011 to 05/06/2011 Page No : 1 of 1					
Project :- Bhusawal Replacement Project (1 x 250 MW)															
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist Jalgaon - 425 307.															
Co-ordinates :- North-South Co-ordinate: 750 N', East-West Co-ordinate: 1130 E' Bore Hole No. 3															
R.L.: Existing ground level 0.0 m Depth of Bore Hole : 9.75 m															
Location : As per Location Sketch Depth of Casing : 2.00 m															
Depth of GWT : 4.60 m Date of Commencement : 09-05-2011															
Date of Completion : 11-05-2011															
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)	SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests
	0.00	-					From To	15	30	45	60	N			
0.00			----	Blackish to grey residual soils.	1	UDS	0.00 0.50								
	0.95	-	----		1	SPT	0.50 0.95	5	6	10	-	16			
1.00			\\ \\	Completely weathered greyish to reddish soft to hard basalt rock.	2	CORE	0.95 1.00						38.00	Nil	
			\\ \\			SPT	1.00 1.00	20	-	-	-	R	Nil	Nil	
			\\ \\			CORE	1.00 2.00						Nil	Nil	
2.00			\\ \\			CORE	2.00 3.00						35.00	Nil	
			\\ \\												
3.00			\\ \\		3	SPT	3.00 3.60	32	33	35	-	68			
			\\ \\			CORE	3.60 4.00						33.00	Nil	
4.00			\\ \\			CORE	4.00 5.00						27.00	Nil	
			\\ \\												
5.00			\\ \\			CORE	5.00 6.00						34.00	Nil	
			\\ \\												
6.00			\\ \\			CORE	6.00 7.00						29.00	Nil	
			\\ \\												
7.00			\\ \\	A patch of good hard rock		CORE	7.00 7.75						73.33	57.33	
			\\ \\												
			\\ \\			CORE	7.75 9.00						Nil	Nil	
8.00			\\ \\												
			\\ \\												
9.00			\\ \\			CORE	9.00 9.75						49.33	13.33	
			\\ \\												
	9.75	-	\\ \\												
DS : Disturbed Sample UDS : Undisturbed Sample SPT : Standard Penetration Test WS : Wash Sample					CR : Core Recovery RQD : Rock Quality Designation PR : Rate of Penetration VST : Vane Shear Test					K : Permeability Test PT : Packer Permeability Test					
Site Engg. Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande			Client Rept.		Bore Termination Depth: 9.75 m						

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.						Borelog As per IS 1892 : 2002		Job No : 11-62 Date: 29/04/011 to 05/06/011 Page No : 1 of 1							
Project :- Bhusawal Replacement Project (1 x 250 MW)															
Client :- MSPGCL, Chummery Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.															
Co-ordinates :- North-South Co-ordinate: 819 N', East-West Co-ordinate: 1130 E'						Bore Hole No. 4									
R. L. : Existing ground level 0.0 m						Depth of Bore Hole : 7.00 m									
Location : As per Location Sketch						Depth of Casing : 2.00 m									
Depth of GWT : 4.30 m						Date of Commencement : 09-05-2011									
						Date of Completion : 11-05-2011									
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)	SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests
	0.00	-					From To	15	30	45	60	N			
	0.00		-----	Brownish residual soils .	1	SPT	0.00 0.45	5	7	8	-	15			
	0.90	-	-----		1	UDS	0.45 0.90								
1.00				Completely weathered disintegrated greyish blackish basalt rock		CORE	0.90 1.70						Nil	Nil	
					2	SPT	1.70 2.00	24	28	-	-	R			
2.00						CORE	2.00 3.00						38.00	Nil	
3.00						CORE	3.00 4.00						36.00	Nil	
4.00					3	SPT	4.00 4.00	22	-	-	-	R			
						CORE	4.00 4.50						72.00	Nil	
						CORE	4.50 5.50						46.00	Nil	
5.00															
				A patch of good hard rock.		CORE	5.50 6.00						88.00	70.00	
6.00						CORE	6.00 7.00						61.00	Nil	
7.00															
	7.00	-													
DS : Disturbed Sample UDS : Undisturbed Sample SPT : Standard Penetration Test WS : Wash Sample						CR : Core Recovery RQD : Rock Quality Designation PR : Rate of Penetration VST : Vane Shear Test				K : Permeability Test PT : Packer Permeability Test					
Site Engg. Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande		Client Rept.		Bore Termination Depth: 7.00 m							

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.					Borelog As per IS 1892 : 2002		Job No : 11-62 Date: 29/04/011 to 05/06/011 Page No : 1 of 1				
Project :- Bhusawal Replacement Project (1 x 250 MW)											
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.											
Co-ordinates :- North-South Co-ordinate: 550 N', East-West Co-ordinate: 1068 E'					Bore Hole No. 5						
R. L.: Existing ground level 0.0 m					Depth of Bore Hole : 8.15 m						
Location : As per Location Sketch					Depth of Casing : 2.00 m Date of Commencement : 10-05-2011 Date of Completion : 12-05-2011						
Depth of GWT : 4.00 m											
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)	SPT 'N' Value	CR (%)	RQD (%)	Remarks / Other Tests
	0.00	-					From To	15 30 45 60 N			
0.00			-----	Blackish cotton type residual soils.	1	UDS	0.00 0.45				
			-----		1	DS	0.45 0.50				
	0.70	-	-----		1	SPT	0.50 0.70	7 9 10 - 19			
1.00				A completely weathered basalt rock	2	CORE	0.70 1.00		40.00	Nil	
				grayish black basalt rock.		SPT	1.00 1.10	18 - - - R			
						CORE	1.10 2.10		50.00	Nil	
2.00					3	SPT	2.10 2.15	25 - - - R			
						CORE	2.15 4.00		36.00	Nil	
3.00											
4.00						CORE	4.00 5.00		34.00	12.00	
5.00						CORE	5.00 6.00		27.00	10.00	
6.00						CORE	6.00 7.00		35.00	Nil	
7.00						CORE	7.00 8.15		39.13	37.00	
8.00											
	8.15	-									
DS : Disturbed Sample UDS : Undisturbed Sample SPT : Standard Penetration Test WS : Wash Sample					CR : Core Recovery RQD : Rock Quality Designation PR : Rate of Penetration VST : Vane Shear Test					K : Permeability Test PT : Packer Permeability Test	
Site Engg. Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande		Client Rept.		Bore Termination Depth 8.15 m			

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.					Borelog As per IS 1892 : 2002					Job No : 11-62 Date: 29/04/11 to 05/06/11 Page No : 1 of 1						
Project :- Bhusawal Replacement Project (1 x 250 MW)																
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.																
Co-ordinates :- North-South Co-ordinate: 550 N', East-West Co-ordinate: 1250 E										Bore Hole No. 6						
R.L.: Existing ground level 0.0 m										Depth of Bore Hole : 9.00 m						
Location : As per Location Sketch										Depth of Casing : 2.00 m						
Depth of GWT : 4.20 m										Date of Commencement : 13-05-2011 Date of Completion : 15-05-2011						
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests
	0.00	-					From	To	15	30	45	60	N			
0.00			-----	Residual soils.	1	SPT	0.00	0.50	4	4	9	-	13			
			-----	Blackish to brown low plasticity soils.	1	UDS	0.50	0.95								
1.00			-----		2	SPT	0.95	1.35	5	7	13	-	20			
	1.35	-	-----													
2.00				Completely weathered fractured basalt rock.	3	CORE	1.35	2.45						12.00	Nil	
						SPT	2.45	2.50	30	-	-	-	R			
						CORE	2.50	4.00						20.00	Nil	
3.00																
4.00						CORE	4.00	4.80						31.25	Nil	
5.00						CORE	4.80	5.00						32.00	Nil	
						CORE	5.00	5.30						100.0	Nil	
						CORE	5.30	6.00						23.84	Nil	
6.00																
						CORE	6.00	7.65						28.57	Nil	
7.00																
						CORE	7.65	9.00						28.89	28.89	
8.00																
9.00																
	9.00	-														
DS : Disturbed Sample					CR : Core Recovery					K : Permeability Test						
UDS : Undisturbed Sample					RQD : Rock Quality Designation					PT : Packer Permeability Test						
SPT : Standard Penetration Test					PR : Rate of Penetration											
WS : Wash Sample					VST : Vane Shear Test											
Site Engg. Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande			Client Rept.			Bore Termination Depth: 9.00 m						

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.					Borelog As per IS 1892 : 2002					Job No: 11-62 Date: 29/04/011 to 05/06/011 Page No. 1 of 2						
Project :- Bhusawal Replacement Project (1 x 250 MW)																
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.																
Co-ordinates :- North-South Co-ordinate: 600 N', East-West Co-ordinate: 1192 E' Bore Hole No. 7																
R.L.: Existing ground level 0.0 m Depth of Bore Hole: 11.00 m																
Location: As per Location Sketch Depth of Casing: 2.00 m																
Depth of GWT: 4.10 m Date of Commencement: 06-05-2011																
Date of Completion: 08-05-2011																
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests
	0.00	-					From	To	15	30	45	60	N			
0.00			----	Blackish to greyish residual soils.	1	UDS	0.00	0.45								
			----		1	SPT	0.45	0.90	3	5	8	-	13			
			----		1	DS	0.90	1.35								
1.00			----		2	SPT	1.35	1.45	19	-	-	-	R			
			----	Greyish gravelly soils	2	DS	1.45	2.00								
2.00	2.05	-	----		3	SPT	2.00	2.05	31	-	-	-	R			
				Completely weathered greyish hard basalt rock.		CORE	2.05	3.05						50.00	Nil	
3.00						CORE	3.05	4.00						57.89	Nil	
						CORE	4.00	5.00						32.00	Nil	
4.00						CORE	5.00	6.00						48.00	Nil	
						CORE	6.00	7.00						42.00	Nil	
5.00						CORE	7.00	8.45						24.13	Nil	
						CORE	8.45	10.00						26.66	24.66	
6.00						CORE	10.00	11.00						50.00	40.00	
7.00																
8.00																
9.00																
10.00																

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.					Borelog As per IS 1892 : 2002					Job No : 11-62 Date: 29/04/011 to 05/06/011 Page No : 2 of 2					
Project :- Bhusawal Replacement Project (1 x 250 MW)															
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.															
Co-ordinates :- North-South Co-ordinate: 600 N', East-West Co-ordinate: 1192 E'										Bore Hole No. 7					
R. L.: Existing ground level 0.0 m										Depth of Bore Hole : 11.00 m					
Location : As per Location Sketch										Depth of Casing : 2.00 m					
Depth of GWT : 4.10 m										Date of Commencement : 06-05-2011 Date of Completion : 08-05-2011					
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value				CR (%)	RQD (%)	Remarks / Other Tests
11.00	2.05	-	III II	Completely weathered greyish hard basalt rock.		CORE	10.00	11.00					50.00	40.00	
	11.00	-	III II												
DS : Disturbed Sample					CR : Core Recovery					K : Permeability Test					
UDS : Undisturbed Sample					RQD : Rock Quality Designation					PT : Packer Permeability Test					
SPT : Standard Penetration Test					PR : Rate of Penetration										
WS : Wash Sample					VST : Vane Shear Test										
Site Engg. Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande		Client Rept.		Bore Termination Depth: 11.00 m							

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.					Borelog As per IS 1892 : 2002		Job No - 11-62 Date: 29/04/011 to 05/06/011 Page No : 1 of 1									
Project :- Bhusawal Replacement Project (1 x 250 MW)																
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.																
Co-ordinates :- North-South Co-ordinate: 820 N', East-West Co-ordinate: 1250 E' Bore Hole No. 8																
R. L.: Existing ground level 0.0 m Depth of Bore Hole : 9.90 m																
Location : As per Location Sketch Depth of Casing : 2.00 m																
Depth of GWT : 4.55 m Date of Commencement : 13-05-2011 Date of Completion : 16-05-2011																
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests
	0.00	-					From	To	15	30	45	60	N			
0.00			-----	Blackish to greyish residual soils.	1	UDS	0.00	0.50								
			-----		1	SPT	0.50	0.95	3	6	8	-	14			
1.00			-----		1	DS	0.95	1.20								
	1.25	-	-----		2	SPT	1.20	1.25	21	-	-	-	R			
2.00				Completely weathered basalt rock.		CORE	1.25	3.00						18.00	Nil	
3.00						CORE	3.00	4.50						28.00	Nil	
4.00						CORE	4.50	6.00						35.00	Nil	
5.00																
						CORE	6.00	7.50						40.00	24.00	
6.00						CORE	7.50	8.50						44.00	31.00	
7.00						CORE	8.50	9.90						37.00	Nil	
8.00																
9.00																
	9.90	-														
DS : Disturbed Sample UDS : Undisturbed Sample SPT : Standard Penetration Test WS : Wash Sample				CR : Core Recovery RQD : Rock Quality Designation PR : Rate of Penetration VST : Vane Shear Test				K : Permeability Test PT : Packer Permeability Test								
Site Engg Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande		Client Rept.		Bore Termination Depth: 9.90 m								

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.					Borelog As per IS 1892 : 2002					Job No: 11-62 Date: 29/04/011 to 05/06/011 Page No: 1 of 1						
Project :- Bhusawal Replacement Project (1 x 250 MW)																
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist Jalgaon - 425 307.																
Co-ordinates :- North-South Co-ordinate: 932 N', East-West Co-ordinate: 1353 E' Bore Hole No. 9																
R.L.: Existing ground level 0.0 m Depth of Bore Hole : 10.50 m																
Location : As per Location Sketch Depth of Casing : 2.00 m																
Date of Commencement : 03-06-2011																
Date of Completion : 05-06-2011																
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests
	0.00	-					From	To	15	30	45	60	N			
0.00			-----	Yellowish to blackish residual soils.	1	UDS	0.00	0.45								
			-----		1	SPT	0.45	0.60	32	-	-	-	R			
			-----		1	DS	0.60	1.00								
1.00	1.05	-	-----		2	SPT	1.00	1.05	21	-	-	-	R			
						Pieces	1.05	1.65						Nil	-	
					3	SPT	1.65	1.69	39	-	-	-	R	Nil	-	
2.00				Yellowish completely weathered basalt rock.	4	CORE	1.69	1.80						Nil	-	
						SPT	1.80	2.00	18	-	-	-	R			
						CORE	2.00	3.90						18.94	Nil	
3.00																
						CORE	3.90	4.60						30.00	Nil	
4.00																
						CORE	4.60	4.90						66.66	63.33	
				A patch of good hard rock.		CORE	4.90	5.40						52.00	52.00	
5.00						CORE	5.40	7.65						28.88	18.22	
6.00																
						CORE	7.65	8.70						27.61	24.76	
7.00																
						CORE	8.70	10.50						35.56	35.56	
8.00																
9.00																
10.00																
10.50																
DS : Disturbed Sample UDS : Undisturbed Sample SPT : Standard Penetration Test WS : Wash Sample					CR : Core Recovery RQD : Rock Quality Designation PR : Rate of Penetration VST : Vane Shear Test					K : Permeability Test PT : Packer Permeability Test						
Site Engg. Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande			Client Rept.		Bore Termination Depth: 10.50 m							

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.					Borelog As per IS 1892 : 2002					Job No: 11-62 Date: 29/04/011 to 05/06/011 Page No. 1 of 1						
Project :- Bhusawal Replacement Project (1 x 250 MW)																
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.																
Co-ordinates :- North-South Co-ordinate: 845 N', East-West Co-ordinate: 1500 E' Bore Hole No. 11																
R. L.: Existing ground level 0.0 m Depth of Bore Hole: 10.30 m																
Location: As per Location Sketch Depth of Casing: 2.00 m																
Depth of GWT: 4.30 m Date of Commencement: 13-05-2011																
Date of Completion: 18-05-2011																
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests
	0.00	-					From	To	15	30	45	60	N			
0.00			----	Residual gravelly clays.	1	UDS	0.00	0.45								
			----		1	SPT	0.45	0.60	10	12	10	-	22			
			----		1	DS	0.60	0.90								
1.00	1.00	-	----		2	SPT	0.90	1.00	27	-	-	-	R			
				Completely weathered basalt rock.	3	CORE	1.00	1.50	32	-	-	-	R	Nil	-	
2.00						SPT	1.50	1.60						14.00	Nil	
						CORE	1.60	3.00								
3.00						CORE	3.00	4.00						22.00	Nil	
4.00						CORE	4.00	5.00						30.00	16.00	
5.00						CORE	5.00	6.00						36.00	Nil	
6.00						CORE	6.00	7.50						41.00	22.40	
7.00					CORE	7.50	9.00						45.00	34.00		
8.00					CORE	9.00	10.30						47.00	14.60		
9.00																
10.00																
	10.30	-														
DS : Disturbed Sample UDS : Undisturbed Sample SPT : Standard Penetration Test WS : Wash Sample					CR : Core Recovery RQD : Rock Quality Designation PR : Rate of Penetration VST : Vane Shear Test					K : Permeability Test PT : Packer Permeability Test						
Site Engg. Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande		Client Rept.		Bore Termination Depth: 10.30 m								

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.					Borelog As per IS 1892 : 2002					Job No : 11-62 Date: 29/04/011 to 05/06/011 Page No. 1 of 1						
Project :- Bhusawal Replacement Project (1 x 250 MW)																
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.																
Co-ordinates :- North-South Co-ordinate: 785 N', East-West Co-ordinate: 1600 E'										Bore Hole No. 12						
R. L.: Existing ground level 0.0 m										Depth of Bore Hole : 9.95 m						
Location : As per Location Sketch										Depth of Casing : 9.95 m						
Depth of GWT : 4.10 m										Date of Commencement : 17-05-2011 Date of Completion : 21-05-2011						
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests
	0.00	-					From	To	15	30	45	60	N			
0.00			-----	Residual gravelly clays.	1	UDS	0.00	0.45								
			-----		1	SPT	0.45	0.90	4	7	9	-	16			
	1.05	-	-----		2	SPT	0.90	1.05	36	-	-	-	R			
1.00				Completely weathered basalt rock.		CORE	1.05	2.40						26.00	Nil	
2.00						CORE	2.40	3.50						32.00	Nil	
3.00						CORE	3.50	5.00						38.50	12.00	
4.00						CORE	5.00	6.50						44.00	Nil	
5.00						CORE	6.50	8.00						47.00	Nil	
6.00						CORE	8.00	9.00						36.00	24.60	
7.00						CORE	9.00	9.95						41.00	Nil	
8.00																
9.00																
	9.95	-														
DS : Disturbed Sample UDS : Undisturbed Sample SPT : Standard Penetration Test WS : Wash Sample					CR : Core Recovery RQD : Rock Quality Designation PR : Rate of Penetration VST : Vane Shear Test					K : Permeability Test PT : Packer Permeability Test						
Site Engg. Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande			Client Rept.			Bore Termination Depth: 9.95 m						

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.						Borelog As per IS 1892 : 2002				Job No. : 11-62 Date: 29/04/011 to 05/06/011 Page No : 1 of 2						
Project :- Bhusawal Replacement Project (1 x 250 MW)																
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.																
Co-ordinates :- North-South Co-ordinate: 710 N', East-West Co-ordinate: 1725 E' Bore Hole No. 13																
R. L.: Existing ground level 0.0 m Depth of Bore Hole : 11.00 m																
Location : As per Location Sketch Depth of Casing : 2.00 m																
Depth of GWT : 4.10 m Date of Commencement : 22-05-2011																
Date of Completion : 26-05-2011																
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests
	0.00	-					From	To	15	30	45	60	N			
0.00				Residual gravelly clays.	1	UDS	0.00	0.35								
					1	SPT	0.35	0.80	5	7	10	-	17			
	0.80	-														
1.00				Completely weathered basalt rock.		CORE	0.80	2.00						21.00	Nil	
2.00						CORE	2.00	3.50						29.00	Nil	
3.00						CORE	3.50	4.50						42.00	Nil	
4.00						CORE	4.50	5.50						32.00	Nil	
5.00						CORE	5.50	7.00						36.00	Nil	
6.00																
7.00						CORE	7.00	8.50						42.00	18.00	
8.00						CORE	8.50	10.00						46.00	23.40	
9.00																
10.00						CORE	10.00	11.00						43.00	27.00	

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.					Borelog As per IS 1892 : 2002					Job No : 11-62 Date: 29/04/011 to 05/06/011 Page No : 2 of 2					
Project :- Bhusawal Replacement Project (1 x 250 MW)															
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.															
Co-ordinates :- North-South Co-ordinate: 710 N', East-West Co-ordinate: 1725 E										Bore Hole No. 13					
R. L.: Existing ground level 0.0 m										Depth of Bore Hole : 11.00 m					
Location : As per Location Sketch										Depth of Casing : 2.00 m					
Depth of GWT : 4.10 m										Date of Commencement : 22-05-2011					
Date of Completion : 26-05-2011															
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value				CR (%)	RQD (%)	Remarks / Other Tests
11.00	0.80	-	/// //	Completely weathered basalt rock.		CORE	10.00	11.00					43.00	27.00	
	11.00	-	/// //												
DS : Disturbed Sample					CR : Core Recovery					K : Permeability Test					
UDS : Undisturbed Sample					RQD : Rock Quality Designation					PT : Packer Permeability Test					
SPT : Standard Penetration Test					PR : Rate of Penetration										
WS : Wash Sample					VST : Vane Shear Test										
Site Engg. Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande		Client Rept.		Bore Termination Depth: 11.00 m							

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.						Borelog As per IS 1892 : 2002				Job No: 11-62 Date: 29/04/011 to 05/06/011 Page No: 1 of 1						
Project :- Bhusawal Replacement Project (1 x 250 MW)																
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.																
Co-ordinates :- North-South Co-ordinate: 788 N', East-West Co-ordinate: 1800 E' Bore Hole No. 14																
R. L.: Existing ground level 0.0 m Depth of Bore Hole : 10.25 m																
Location : As per Location Sketch Depth of Casing : 2.00 m																
Depth of GWT : 4.30 m Date of Commencement : 27-05-2011																
Date of Completion : 31-05-2011																
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests
	0.00	-					From	To	15	30	45	60	N			
0.00			----	Residual gravelly clays.	1	UDS	0.00	0.40								
	0.85	-	----		1	SPT	0.40	0.85	6	8	10	-	18			
			----		2	SPT	0.85	0.85	21	-	-	-	R			
1.00				Completely weathered basalt rock.		CORE	0.85	2.70						14.25	Nil	
2.00						CORE	2.70	3.50						25.00	10.00	
3.00						CORE	3.50	5.40						31.00	14.00	
4.00						CORE	5.40	6.65						52.00	35.00	
5.00						CORE	6.65	7.45						33.00	Nil	
6.00						CORE	7.45	8.25						19.00	Nil	
7.00						CORE	8.25	9.50						24.00	11.00	
8.00						CORE	9.50	10.25						28.00	15.00	
9.00																
10.00																
	10.25	-														
DS : Disturbed Sample CR : Core Recovery K : Permeability Test UDS : Undisturbed Sample RQD : Rock Quality Designation PT : Packer Permeability Test SPT : Standard Penetration Test PR : Rate of Penetration WS : Wash Sample VST : Vane Shear Test																
Site Engg. Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande		Client Rept.		Bore Termination Depth: 10.25 m								

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.					Borelog As per IS 1892 : 2002					Job No: 11-62 Date: 29/04/011 to 05/06/011 Page No: 1 of 1						
Project :- Bhusawal Replacement Project (1 x 250 MW)																
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.																
Co-ordinates :- North-South Co-ordinate: 928 N', East-West Co-ordinate: 1575 E' Bore Hole No. 15																
R.L.: Existing ground level 0.0 m Depth of Bore Hole : 10.10 m																
Location : As per Location Sketch Depth of Casing : 2.00 m																
Depth of GWT : 4.80 m Date of Commencement : 03-06-2011																
Date of Completion : 05-06-2011																
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests
	0.00	-					From	To	15	30	45	60	N			
0.00			----	Blackish to brownish gravelly residual soils .	1	UDS	0.00	0.45								
			----		1	SPT	0.45	0.55	19	-	-	-	R			
			----		1	DS	0.55	0.85								
1.00			----		2	SPT	0.85	1.05	25	-	-	-	R			
			----		2	DS	1.05	1.45								
	1.57	-	----		3	SPT	1.45	1.57	30	-	-	-	R			
2.00				Yellowish with reddish completely weathered basalt rock .		CORE	1.57	3.07						20.66	Nil	
3.00						CORE	3.07	4.70						23.31	Nil	
4.00																
5.00						CORE	4.70	6.20						36.66	22.66	
6.00						CORE	6.20	8.53						25.75	20.17	
7.00																
8.00																
9.00						CORE	8.53	10.10						53.50	47.77	
10.00																
	10.10	-														
DS : Disturbed Sample CR : Core Recovery K : Permeability Test UDS : Undisturbed Sample RQD : Rock Quality Designation PT : Packer Permeability Test SPT : Standard Penetration Test PR : Rate of Penetration WS : Wash Sample VST : Vane Shear Test																
Site Engg. Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande		Client Rept.		Bore Termination Depth: 10.10 m								

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.					Borelog As per IS 1892 : 2002					Job No: 11-62 Date: 29/04/011 to 05/06/011 Page No: 1 of 2						
Project :- Bhusawal Replacement Project (1 x 250 MW)																
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.																
Co-ordinates :- North-South Co-ordinate: 420 N', East-West Co-ordinate: 1665 E'										Bore Hole No. 16						
R.L.: Existing ground level 0.0 m										Depth of Bore Hole : 11.05 m						
Location : As per Location Sketch										Depth of Casing : 2.00 m						
Depth of GWT : 4.70 m										Date of Commencement : 29-05-2011 Date of Completion : 30-05-2011						
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests
	0.00	-					From	To	15	30	45	60	N			
0.00	0.00	-	-----	Yellowish to blackish residual soils.	1	UDS	0.00	0.40								
	0.50	-	-----		1	SPT	0.40	0.50	22	-	-	-	R			
				Small rock core pieces.		CORE	0.50	1.60						Nil	-	
1.00																
				Completely to weathered and fractured greyish soft to hard basalt rock.		CORE	1.60	2.90						26.92	Nil	
2.00																
				Greyish basalt rock.		CORE	2.90	4.15						32.00	Nil	
3.00																
						CORE	4.15	5.65						40.00	6.66	
4.00																
						CORE	5.65	6.95						42.30	Nil	
5.00																
				Basalt hard rock.		CORE	6.95	8.15						50.83	9.16	
6.00																
						CORE	8.15	9.10						63.15	10.52	
7.00																
						CORE	9.10	11.05						17.44	8.72	
8.00																
9.00																
10.00																

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.					Borelog As per IS 1892 : 2002					Job No : 11-62 Date: 29/04/011 to 05/06/011 Page No : 2 of 2					
Project :- Bhusawal Replacement Project (1 x 250 MW)															
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.															
Co-ordinates :- North-South Co-ordinate: 420 N', East-West Co-ordinate: 1665 E'										Bore Hole No. 16					
R. L.: Existing ground level 0.0 m										Depth of Bore Hole : 11.05 m					
Location : As per Location Sketch										Depth of Casing : 2.00 m					
Depth of GWT : 4.70 m										Date of Commencement : 29-05-2011 Date of Completion : 30-05-2011					
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value				CR (%)	RQD (%)	Remarks / Other Tests
11.00	0.50	-		Basalt hard rock		CORE	9.10	11.05					17.44	8.72	
	11.05	-													
DS : Disturbed Sample UDS : Undisturbed Sample SPT : Standard Penetration Test WS : Wash Sample					CR : Core Recovery RQD : Rock Quality Designation PR : Rate of Penetration VST : Vane Shear Test					K : Permeability Test PT : Packer Permeability Test					
Site Engg. Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande		Client Rept.		Bore Termination Depth: 11.05 m							

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.					Borelog As per IS 1892 : 2002					Job No : 11-62 Date: 29/04/011 to 05/06/011 Page No : 1 of 2						
Project :- Bhusawal Replacement Project (1 x 250 MW)																
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.																
Co-ordinates :- North-South Co-ordinate: 420 N', East-West Co-ordinate: 1500 E' Bore Hole No. 17																
R.L.: Existing ground level 0.0 m Depth of Bore Hole: 11.50 m																
Location: As per Location Sketch Depth of Casing: 2.00 m																
Depth of GWT: 4.30 m Date of Commencement: 17-05-2011																
Date of Completion: 19-05-2011																
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests
	0.00	-					From	To	15	30	45	60	N			
	0.00		-----	Blackish to yellowish residual soils.	1	UDS	0.00	0.50								
	1.00	-	-----		1	SPT	0.50	1.00	3	3	6	-	9			
1.00				Completely weathered basalt rock of soft to hard variety disintegrated fractured rock mass reddish to greyish type	2	CORE	1.00	1.90						44.44	Nil	
2.00						SPT	1.90	2.00	19	-	-	-	R	70.00	Nil	
						CORE	2.00	3.00								
3.00						CORE	3.00	3.50						100.0	Nil	
						CORE	3.50	4.00						76.00	22.00	
4.00				Red basalt rock.		CORE	4.00	5.00						50.00	Nil	
5.00					3	SPT	5.00	5.00	22	-	-	-	R	42.00	Nil	
						CORE	5.00	6.00								
6.00				Greyish basalt rock.		CORE	6.00	7.00						52.00	Nil	
7.00				Blackish basalt rock.		CORE	7.00	7.50						56.00	26.00	
				Greyish basalt rock.		CORE	7.50	8.25						52.00	13.33	
8.00																
						CORE	8.25	10.50						20.00	8.89	
9.00																
10.00						CORE	10.50	11.50						40.00	Nil	

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.					Borelog As per IS 1892 : 2002					Job No : 11-62 Date: 29/04/011 to 05/06/011 Page No : 2 of 2					
Project :- Bhusawal Replacement Project (1 x 250 MW)															
Client :- MSPGCL, Chummary Building, Deenagar, Bhusawal, Dist. Jalgaon - 425 307.															
Co-ordinates :- North-South Co-ordinate: 420 N', East-West Co-ordinate: 1500 E'										Bore Hole No. 17					
R. L.: Existing ground level 0.0 m										Depth of Bore Hole : 11.50 m					
Location : As per Location Sketch										Depth of Casing : 2.00 m					
Depth of GWT : 4.30 m										Date of Commencement : 17-05-2011					
										Date of Completion : 19-05-2011					
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value				CR (%)	RQD (%)	Remarks / Other Tests
11.00	1.00	-	\\ \\	Greyish basalt rock		CORE	10.50	11.50					40.00	Nil	
	11.50	-	\\ \\												
DS : Disturbed Sample					CR : Core Recovery					K : Permeability Test					
UDS : Undisturbed Sample					RQD : Rock Quality Designation					PT : Packer Permeability Test					
SPT : Standard Penetration Test					PR : Rate of Penetration										
WS : Wash Sample					VST : Vane Shear Test										
Site Engg. Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande		Client Rept.		Bore Termination Depth: 11.50 m							

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.					Borelog As per IS 1892 : 2002					Job No : 11-62 Date: 29/04/011 to 05/06/011 Page No : 1 of 1						
Project :- Bhusawal Replacement Project (1 x 250 MW)																
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307																
Co-ordinates :- North-South Co-ordinate: 300 N', East-West Co-ordinate: 1500 E'										Bore Hole No. 18						
R. L.: Existing ground level 0.0 m										Depth of Bore Hole : 9.45 m						
Location : As per Location Sketch										Depth of Casing : 2.00 m						
Depth of GWT : 4.70 m										Date of Commencement : 30-05-2011 Date of Completion : 02-06-2011						
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests
	0.00	-					From	To	15	30	45	60	N			
	0.00			Blackish soft to yellowish stiff consistency soils.	1	UDS	0.15	0.65								
					1	SPT	0.65	0.90	15	18	-	-	R			
	1.00				1	DS	0.90	1.60								
					2	SPT	1.60	1.90	25	35	17	-	R			
	1.90	-														
	2.00			Weathered basalt rock.		CORE	1.90	2.20						40.00	Nil	
						CORE	2.20	2.60						25.00	Nil	
						CORE	2.60	2.90						100.0	Nil	
	3.00					CORE	2.90	3.00						100.0	Nil	
						CORE	3.00	3.80						25.00	Nil	
						CORE	3.80	4.00						60.00	Nil	
	4.00			Blackish hard rock.		CORE	4.00	5.20						15.00	Nil	
						CORE										
						CORE										
	5.00					CORE	5.20	6.50						15.38	8.46	
						CORE										
						CORE										
	6.00					CORE										
						CORE										
						CORE										
	7.00			Greyish basalt rock.	3	SPT	6.50	6.60	22	-	-	-	R	30.00	24.50	
						CORE	6.60	8.60								
						CORE										
						CORE										
	8.00					CORE										
						CORE										
						CORE										
	9.00					CORE	8.60	9.45						88.24	70.59	
						CORE										
						CORE										
	9.45	-				CORE										
DS : Disturbed Sample UDS : Undisturbed Sample SPT : Standard Penetration Test WS : Wash Sample					CR : Core Recovery RQD : Rock Quality Designation PR : Rate of Penetration VST : Vane Shear Test					K : Permeability Test PT : Packer Permeability Test						
Site Engg. Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande			Client Rept.		Bore Termination Depth: 9.45 m							

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RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.										Borelog As per IS 1892 : 2002					Job No. 11-62 Date: 29/04/011 to 05/06/011 Page No. 1 of 1				
Project :- Bhusawal Replacement Project (1 x 250 MW)																			
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.																			
Co-ordinates :- North-South Co-ordinate: 92 N', East-West Co-ordinate: 1497 E' Bore Hole No. 20																			
R. L.: Existing ground level 0.0 m Depth of Bore Hole: 10.15 m																			
Location : As per Location Sketch Depth of Casing: 2.00 m																			
Depth of GWT: 4.20 m Date of Commencement: 29-05-2011																			
Date of Completion: 31-05-2011																			
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests			
	0.00	-					From	To	15	30	45	60	N						
0.00			-----	Yellowish stiff to hard consistency soils.	1	DS	0.00	0.55											
	0.60	-	-----		1	SPT	0.55	0.60	19	-	-	-	R						
1.00			\\ \\	Yellowish completely weathered disintegrated rock.	2	CORE	0.60	1.00					R	Nil	-				
			\\ \\			SPT	1.00	1.10	26	-	-	-	R	Nil	-				
			\\ \\			CORE	1.10	2.15						Nil	-				
2.00			\\ \\	Greyish hard rock.		CORE	2.15	3.40						23.20	Nil				
			\\ \\			CORE	3.40	4.90						23.33	7.33				
3.00			\\ \\			CORE	4.90	6.50						40.66	16.35				
			\\ \\			CORE	6.50	8.05						18.71	18.71				
4.00			\\ \\			CORE	8.05	10.15						29.05	21.90				
5.00			\\ \\																
6.00			\\ \\																
7.00			\\ \\																
8.00			\\ \\																
	10.15	-	\\ \\																
DS : Disturbed Sample					CR : Core Recovery					K : Penneability Test									
UDS : Undisturbed Sample					RQD : Rock Quality Designation					PT : Packer Permeability Test									
SPT : Standard Penetration Test					PR : Rate of Penetration														
WS : Wash Sample					VST : Vane Shear Test														
Site Engg. Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande		Client Rept.		Bore Termination Depth: 10.15 m											

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.					Borelog As per IS 1892 : 2002					Job No : 11-62 Date: 29/04/011 to 05/06/011 Page No. 1 of 1						
Project :- Bhusawal Replacement Project (1 x 250 MW)																
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.																
Co-ordinates :- North-South Co-ordinate: 58 N', East-West Co-ordinate: 1700 E' Bore Hole No. 21																
R. L.: Existing ground level 0.0 m Depth of Bore Hole: 10.60 m																
Location : As per Location Sketch Depth of Casing : 2.00 m																
Depth of GWT : 4.90 m Date of Commencement : 29-05-2011																
Date of Completion : 30-05-2011																
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests
	0.00	-					From	To	15	30	45	60	N			
0.00			-----	Yellowish blackish stiff to hard consistency soils.	I	UDS	0.00	0.50								
	1.00	-	-----		I	SPT DS	0.50	0.60	23	-	-	-	R			
1.00				Completely weathered disintegrated fractured greyish to black basalt rock.		CORE	1.00	2.10						28.18	Nil	
	2.00					CORE	2.10	3.10						30.00	Nil	
	3.00					CORE	3.10	4.60						Nil	Nil	
	4.00															
	5.00					CORE	4.60	6.10						32.66	Nil	
	6.00					CORE	6.10	7.60						38.00	6.66	
	7.00															
	8.00					CORE	7.60	9.60						25.50	16.50	
	9.00															
	10.00			Moderately weathered basalt rock.		CORE	9.60	10.60						60.00	60.00	
	10.60	-														
DS : Disturbed Sample UDS : Undisturbed Sample SPT : Standard Penetration Test WS : Wash Sample					CR : Core Recovery RQD : Rock Quality Designation PR : Rate of Penetration VST : Vane Shear Test					K : Permeability Test PT : Packer Permeability Test						
Site Engg. Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande		Client Rept		Bore Termination Depth: 10.60 m								

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RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.					Borelog As per IS 1892 : 2002					Job No : 11-62 Date: 29/04/11 to 05/06/11 Page No : 1 of 1						
Project :- Bhusawal Replacement Project (1 x 250 MW)																
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.																
Co-ordinates :- North-South Co-ordinate: 545 N', East-West Co-ordinate: 1150 E' Bore Hole No. 23																
R. L.: Existing ground level 0.0 m Depth of Bore Hole : 10.00 m																
Location : As per Location Sketch Depth of Casing : 2.00 m																
Depth of GWT : 4.30 m Date of Commencement : 09-05-2011 Date of Completion : 11-05-2011																
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests
	0.00	-					From	To	15	30	45	60	N			
0.00			----	Blackish to yellowish residual soils.	1	UDS	0.00	0.45								
			----		1	SPT	0.45	0.90	7	9	11	-	20			
			----		1	UDS	0.90	1.20								
1.00	1.25	-	----		2	SPT	1.20	1.25	27	-	-	-	R			
				Completely weathered basalt rock disintegrated and fractured.		CORE Pieces	1.25	2.00						Nil	-	
2.00						CORE	2.00	3.10						40.90	Nil	
3.00						CORE	3.10	4.00						66.66	Nil	
4.00						CORE	4.00	5.00						43.00	Nil	
5.00				Highly weathered basalt rock with alternate bands of completely weathered rocks.		CORE	5.00	6.00						50.00	48.00	
6.00						CORE	6.00	7.00						47.00	Nil	
7.00				Alternate bands of Highly to completely weathered basalt rock.		CORE	7.00	8.00						52.00	34.00	
8.00						CORE	8.00	9.00						Nil	Nil	
9.00						CORE	9.00	10.00						49.00	44.89	
10.00																
	10.00	-														
DS : Disturbed Sample UDS : Undisturbed Sample SPT : Standard Penetration Test WS : Wash Sample					CR : Core Recovery RQD : Rock Quality Designation PR : Rate of Penetration VST : Vane Shear Test					K : Permeability Test PT : Packer Permeability Test						
Site Engg. Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande			Client Rept.		Bore Termination Depth: 10.00 m							

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.					Borelog As per IS 1892 : 2002					Job No : 11-62 Date. 29/04/011 to 05/06/011 Page No : 1 of 1							
Project :- Bhusawal Replacement Project (1 x 250 MW)																	
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.																	
Co-ordinates :- North-South Co-ordinate: 568 N', East-West Co-ordinate: 1220 E' Bore Hole No. 24																	
R. L.: Existing ground level 0.0 m Depth of Bore Hole : 10.25 m																	
Location : As per Location Sketch Depth of Casing : 2.00 m																	
Depth of GWT : 4.90 m Date of Commencement : 08-05-2011																	
Date of Completion : 10-05-2011																	
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests	
	0.00	-					From	To	15	30	45	60	N				
0.00			----	Brownish residual soils of soft consistency	1	UDS	0.00	0.50									
	0.95	-	----		1	SPT	0.50	0.95	6	6	8	-	14				
1.00				Greyish basalt rock.		Pieces	0.95	1.35						Nil	-		
						CORE	1.35	2.00							75.38	Nil	
2.00																	
					2	SPT	2.00	2.10	25	-	-	-	R				
						CORE	2.10	3.00							30.00	Nil	
3.00																	
						CORE	3.00	4.00							38.00	Nil	
4.00						CORE	4.00	4.50							64.00	Nil	
						CORE	4.50	5.50							40.00	31.00	
5.00																	
					CORE	5.50	7.65							32.55	27.44		
6.00																	
7.00																	
					CORE	7.65	8.50							Nil	Nil		
8.00																	
9.00				Highly weathered basalt rocks.		CORE	8.50	10.25						30.86	30.86		
10.00																	
	10.25	-															
DS : Disturbed Sample					CR : Core Recovery					K : Permeability Test							
UDS : Undisturbed Sample					RQD : Rock Quality Designation					PT : Packer Permeability Test							
SPT : Standard Penetration Test					PR : Rate of Penetration												
WS : Wash Sample					VST : Vane Shear Test												
Site Engg. Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande		Client Rept.		Bore Termination Depth: 10.25 m									

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.						Borelog As per IS 1892 : 2002				Job No: 11-62 Date: 29/04/011 to 05/06/011 Page No. 1 of 1						
Project :- Bhusawal Replacement Project (1 x 250 MW)																
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.																
Co-ordinates :- North-South Co-ordinate: 568 N', East-West Co-ordinate: 1080 E' Bore Hole No. 25																
R.L.: Existing ground level 0.0 m Depth of Bore Hole: 10.20 m																
Location: As per Location Sketch Depth of Casing: 2.00 m																
Depth of GWT: 4.10 m Date of Commencement: 30-04-2011																
Date of Completion: 02-05-2011																
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests
	0.00	-					From	To	15	30	45	60	N			
0.00			-----	Brownish clay .	1	DS	0.00	0.10								
			-----		1	UDS	0.10	0.55								
			-----		1	SPT	0.55	1.00	4	9	18	-	27			
1.00			-----	Brownish sandy clay	2	DS	1.00	1.20								
	1.50	-	-----		2	SPT	1.20	1.50	15	20	30	27	50			
				Completely weathered basalt rock.		CORE	1.50	2.00						60.00	Nil	
2.00						CORE	2.00	4.00						24.00	Nil	
3.00																
4.00						CORE	4.00	5.00						35.00	Nil	
5.00						SPT	5.00	5.11	23	-	-	-	R	19.13	Nil	
				Greyish basalt rock .	3	CORE	5.11	7.20								
6.00																
7.00						CORE	7.20	8.00						58.75	12.50	
8.00						CORE	8.00	9.20						Nil	Nil	
9.00						CORE	9.20	10.20						45.00	10.00	
10.00																
	10.20	-														
DS : Disturbed Sample						CR : Core Recovery				K : Permeability Test						
UDS : Undisturbed Sample						RQD : Rock Quality Designation				PT : Packer Permeability Test						
SPT : Standard Penetration Test						PR : Rate of Penetration										
WS : Wash Sample						VST : Vane Shear Test										
Site Engg. Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande		Client Rept.		Bore Termination Depth: 10.20 m								

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.					Borelog As per IS 1892 : 2002					Job No 11-62 Date: 29/04/011 to 05/06/011 Page No : 1 of 1						
Project :- Bhusawal Replacement Project (1 x 250 MW)																
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307																
Co-ordinates :- North-South Co-ordinate: 520 N', East-West Co-ordinate: 1080 E' Bore Hole No. 26																
R.L. : Existing ground level 0.0 m Depth of Bore Hole : 10.50 m																
Location : As per Location Sketch Depth of Casing : 2.00 m																
Depth of GWT : 4.50 m Date of Commencement : 29-04-2011																
Date of Completion : 02-05-2011																
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests
	0.00	-					From	To	15	30	45	60	N			
0.00			----	Blackish soil to residual grayish Sandy Clays .	1	UDS	0.00	0.45								
			----		1	SPT	0.45	0.90	5	7	14	-	21			
			----		1	DS	0.90	1.40								
1.00			----		2	SPT	1.40	1.50	22	-	-	-	R			
	1.50	-	----													
				Brownish Completely weathered rock .		CORE	1.50	2.05						Nil	-	
2.00					3	SPT	2.05	2.10	39	-	-	-	R			
				Greyish hard rock .		CORE	2.10	3.00						25.00	Nil	
3.00				Greyish basalt rock .		CORE	3.00	3.50						20.00	Nil	
						CORE	3.50	5.00						30.00	Nil	
4.00																
5.00						CORE	5.00	7.00						25.00	Nil	
6.00																
7.00						CORE	7.00	8.40						27.14	Nil	
8.00						CORE	8.40	10.00						30.63	30.63	
9.00																
10.00						CORE	10.00	10.50						42.00	20.00	
	10.50	-														
DS : Disturbed Sample UDS : Undisturbed Sample SPT : Standard Penetration Test WS : Wash Sample					CR : Core Recovery RQD : Rock Quality Designation PR : Rate of Penetration VST : Vane Shear Test					K : Permeability Test PT : Packer Permeability Test						
Site Engg Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande			Client Rept.		Bore Termination Depth: 10.50 m							

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.						Borelog As per IS 1892 : 2002				Job No : 11-62 Date: 29/04/011 to 05/06/011 Page No : 1 of 1						
Project :- Bhusawal Replacement Project (1 x 250 MW)																
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.																
Co-ordinates :- North-South Co-ordinate: 600 N', East-West Co-ordinate: 1118 E'																
Bore Hole No. 27																
R.L.: Existing ground level 0.0 m																
Depth of Bore Hole : 8.50 m																
Location : As per Location Sketch																
Depth of Casing : 2.00 m																
Date of Commencement : 07-05-2011																
Date of Completion : 09-05-2011																
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests
	0.00	-					From	To	15	30	45	60	N			
0.00			----	Blackish Grayish Residual soils .	1	UDS	0.00	0.50								
	1.00	-	----		1	SPT	0.50	0.90	4	6	9	-	15			
1.00				Greyish completely weathered basalt rock .		CORE	1.00	1.90						40.00	Nil	
	2.00				2	SPT	1.90	2.00	33	-	-	-	R	32.00	Nil	
						CORE	2.00	3.00								
3.00						CORE	3.00	4.00						30.00	Nil	
	4.00				3	SPT	4.00	4.00	23	-	-	-	R	36.00	Nil	
						CORE	4.00	5.00								
5.00						CORE	5.00	6.00						40.00	Nil	
	6.00			Blackish basalt rock .		CORE	6.00	7.00						38.00	Nil	
						CORE	7.00	7.50						64.00	Nil	
7.00						CORE	7.50	8.50						40.00	39.00	
8.00																
	8.50	-														
DS : Disturbed Sample				CR : Core Recovery				K : Permeability Test								
UDS : Undisturbed Sample				RQD : Rock Quality Designation				PT : Packer Permeability Test								
SPT : Standard Penetration Test				PR : Rate of Penetration												
WS : Wash Sample				VST : Vane Shear Test												
Site Engg. Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande		Client Rept.		Bore Termination Depth: 8.50 m								

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.					Borelog As per IS 1892 : 2002					Job No : 11-62 Date: 29/04/011 to 05/06/011 Page No : 1 of 1						
Project :- Bhusawal Replacement Project (1 x 250 MW)																
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.																
Co-ordinates :- North-South Co-ordinate: 750 N', East-West Co-ordinate: 1060 E' Bore Hole No. 28																
R.L.: Existing ground level 0.0 m Depth of Bore Hole : 10.00 m																
Location : As per Location Sketch Depth of Casing : 2.00 m																
Depth of GWT : 4.10 m Date of Commencement : 24-05-2011																
Date of Completion : 29-05-2011																
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests
	0.00	-					From	To	15	30	45	60	N			
	0.00		-----	Blackish to greyish residual soils.	1	UDS	0.00	0.45								
			-----		1	SPT	0.45	0.90	6	8	10	-	18			
	1.35	-	-----		1	DS	0.90	1.35								
1.00				Completely weathered Basalt rock.		CORE	1.35	2.05						48.00	Nil	
2.00					2	CORE	2.05	3.25						55.00	Nil	
						SPT	3.25	3.25	21	-	-	-	R			
3.00						CORE	3.25	4.50						29.00	Nil	
4.00						CORE	4.50	5.50						43.00	Nil	
						CORE	5.50	6.60						37.00	Nil	
5.00																
						CORE	6.60	7.75						25.00	12.00	
6.00						CORE	7.75	8.40						53.00	41.00	
						CORE	8.40	9.40						35.00	Nil	
7.00						CORE	9.40	10.00						22.00	Nil	
8.00																
9.00																
10.00																
	10.00	-														
DS : Disturbed Sample CR : Core Recovery K : Permeability Test UDS : Undisturbed Sample RQD : Rock Quality Designation PT : Packer Permeability Test SPT : Standard Penetration Test PR : Rate of Penetration WS : Wash Sample VST : Vane Shear Test																
Site Engg. Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande			Client Rept.		Bore Termination Depth: 10.00 m							

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.					Borelog As per IS 1892 : 2002					Job No : 11-62 Date: 29/04/011 to 05/06/011 Page No. 1 of 1						
Project :- Bhusawal Replacement Project (1 x 250 MW)																
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist Jalgaon - 425 307.																
Co-ordinates :- North-South Co-ordinate: 668 N', East-West Co-ordinate: 1340 E'										Bore Hole No. 29						
R. L.: Existing ground level 0.0 m										Depth of Bore Hole : 9.00 m						
Location : As per Location Sketch										Depth of Casing : 2.00 m						
Depth of GWT : 5.10 m										Date of Commencement : 17-05-2011 Date of Completion : 19-05-2011						
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests
	0.00	-					From	To	15	30	45	60	N			
0.00				Blackish soil.	1	UDS	0.00	0.45								
					1	SPT	0.45	0.90	5	8	13	-	21			
1.00					2	UDS	0.90	1.35								
					1	DS	1.35	2.00								
2.00	2.00	-			2	SPT	2.00	2.00	12	-	-	-	R			
						CORE	2.00	3.00						Nil	-	
3.00				Greyish basalt rock .		CORE	3.00	4.00						38.00	Nil	
4.00						CORE	4.00	5.00						40.00	Nil	
5.00						CORE	5.00	6.00						70.00	Nil	
6.00				Blakish weathered rock .		CORE	6.00	7.00						53.00	Nil	
7.00						CORE	7.00	8.00						50.00	Nil	
8.00				Greyish basalt rock .		CORE	8.00	9.00						45.00	37.00	
9.00																
	9.00	-														
DS : Disturbed Sample					CR : Core Recovery					K : Permeability Test						
UDS : Undisturbed Sample					RQD : Rock Quality Designation					PT : Packer Permeability Test						
SPT : Standard Penetration Test					PR : Rate of Penetration											
WS : Wash Sample					VST : Vane Shear Test											
Site Engg. Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande			Client Rept.		Bore Termination Depth: 9.00 m							

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.					Borelog As per IS 1892 : 2002					Job No : 11-62 Date: 29/04/011 to 05/06/011 Page No : 1 of 1					
Project :- Bhusawal Replacement Project (1 x 250 MW)															
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.															
Co-ordinates :- North-South Co-ordinate: 155 N', East-West Co-ordinate: 1526 E' Bore Hole No. 30															
R.L.: Existing ground level 0.0 m Depth of Bore Hole : 7.75 m															
Location : As per Location Sketch Depth of Casing : 2.00 m															
Depth of GWT : 5.30 m Date of Commencement : 21-05-2011															
Date of Completion : 25-05-2011															
Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)	SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests
	0.00	-					From To	15	30	45	60	N			
0.00			----	Blackish to greyish residual soils.	1	UDS	0.00 0.50								
	0.95	-	----		1	SPT	0.50 0.95	3	5	6	-	11			
1.00				Greyish basalt rock.		CORE	0.95 2.00						34.28	Nil	
				Completely weathered basalt rocks											
2.00					2	SPT	2.00 2.00	22	-	-	-	R	47.00	Nil	
						CORE	2.00 3.00								
3.00						CORE	3.00 4.00						29.00	Nil	
4.00				Blackish basalt rock.		CORE	4.00 5.00						34.00	Nil	
5.00						CORE	5.00 6.00						48.00	28.00	
6.00						CORE	6.00 7.75						28.57	11.42	
7.00															
	7.75	-													
DS : Disturbed Sample					CR : Core Recovery					K : Permeability Test					
UDS : Undisturbed Sample					RQD : Rock Quality Designation					PT : Packer Permeability Test					
SPT : Standard Penetration Test					PR : Rate of Penetration										
WS : Wash Sample					VST : Vane Shear Test										
Site Engg. Mahesh		Drawn By Reena		Checked By Sandip S. Deshpande			Client Rept.		Bore Termination Depth: 7.75 m						

RENUKA ENGINEERS, SHOP NO. 1, MEERA MOHAN, OPP. KRANTI TOWER, SECTOR NO. 3, SHREE NAGAR, THANE - 400 604.						Borelog As per IS 1892 : 2002				Job No. : 11-62 Date: 29/04/011 to 05/06/011 Page No. : 1 of 1			
Project :- Bhusawal Replacement Project (1 x 250 MW)													
Client :- MSPGCL, Chummary Building, Deepnagar, Bhusawal, Dist. Jalgaon - 425 307.													
Co-ordinates :- North-South Co-ordinate: 200 N , East-West Co-ordinate: 1526 E													
R. L.: Existing ground level 0.0 m						Bore Hole No. 31							
Location: As per Location Sketch						Depth of Bore Hole : 10.30 m							
Depth of GWT : 5.20 m						Depth of Casing : 2.00 m Date of Commencement : 21-05-2011 Date of Completion : 25-05-2011							

Scale	Depth (m)	R.L. (m)	Log	Description	Sample No.	Type	Depth (m)		SPT 'N' Value					CR (%)	RQD (%)	Remarks / Other Tests
							From	To	15	30	45	60	N			
0.00	0.00															
	0.95			Blackish to greyish residual soils.	1	UDS	0.00	0.50								
					1	SPT	0.50	0.95	3	4	9		13			
1.00				Greyish completely weathered basalt rock		CORE	0.95	1.95						30.00	Nil	
2.00					2	SPT	1.95	2.00	22	-	-	-	R	27.00	Nil	
						CORE	2.00	3.00								
3.00						CORE	3.00	4.00						32.00	Nil	
4.00						CORE	4.00	5.00						33.00	Nil	
5.00						CORE	5.00	6.00						45.00	25.00	
6.00						CORE	6.00	7.00						40.00	24.00	
7.00						CORE	7.00	8.50						44.00	6.66	
8.00																
9.00						CORE	8.50	10.30						20.00	12.22	
10.00																
	10.30															

DS : Disturbed Sample UDS : Undisturbed Sample SPT : Standard Penetration Test WS : Wash Sample	CR : Core Recovery RQD : Rock Quality Designation PR : Rate of Penetration VST : Vane Shear Test	K : Permeability Test PT : Packer Permeability Test

Site Engg. Mahesh	Drawn By Reena	Checked By Sandip S. Deshpande	Client Rept.	Bore Termination Depth: 10.30 m

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ANNEXURE – II
ELECTRICAL RESISTIVITY TEST
(ERT)

BACKGROUND:

Electrical Resistivity Survey was carried out in the premises of **Maharashtra State Power Generation Corporation Limited**, at site **Bhusaval Project 1x660 MW Bhusaval (M.S)** in order to assess the geological strategy. Vertical Electrical Sounding (VES) were carried total 08 location using Wenner array for an electrode spread (AB/2) of 10 mtr deep in order to ascertain sub-surface geology.

PRINCIPLE:

In Wenner array observation are made to obtain information on the variation of the physical field in the vertical section at a given location (sounding). The variation in the physical field is interpreted in terms of subsurface in homogeneities, which include underground nature and structure of rock layer, variation in lithology. Quantity and quality of water, the electrical properties of most rock / soil are primarily dependent on the amount of moisture in the rock / soil. Saturated rock / soil has lower resistivity the unsaturated and dry rock / soil. The higher porosity of the saturated rock, the lower its resistivity. The basis of making an electrical sounding is that the further away from a current source the measurement of the potential the deeper the probing will be.

GEOLOGICAL FEATURE:

The land observed 3 layer cases.

- a) Heavy burden, b) Thick black clay-soil (black cotton soil), c) Hard rock.
- a) Heavy burden upto approximately 1.00mtr to 2.0 mtr below ground level.
- b) Thick black clay-soil (black cotton soil) seems from 2 to 4.5 mtr approx below burden level.

- c) Hard rock (basaltic) seems in between 4.5 mtr approx below thick soil level and further deep.
- d) Static water level from 5to 6 metres below ground level. (By well inventory)

Nature of rock: Basalt rock (Igneous)

Classification: Rocks are aggregates of minerals. Geologists divide rocks into three groups: igneous, metamorphic, and sedimentary. Igneous rocks crystallize from magma also called basalt.

Basalt is an extrusive mafic volcanic rock. It is commonly erupted as passive lava flows due to its low viscosity (resulting from high magmatic temperatures and low silica contents). A dominant component of oceanic crust, basalt is the most abundant volcanic rock.

Rainfall and climate:

The area studied moderate humid climate with the minimum and maximum temperature of the area lies between 21° c (winter) to 45°c (summer). The annual rainfall recorded from 1500 to 2000 mm (source by National Informatics Centre).

For RENUKA ENGINEERS

Dr. S. S. Deshpande

Electrical Resistivity Test

Field data

Client: MSPGCL

Date: 07/06/2011

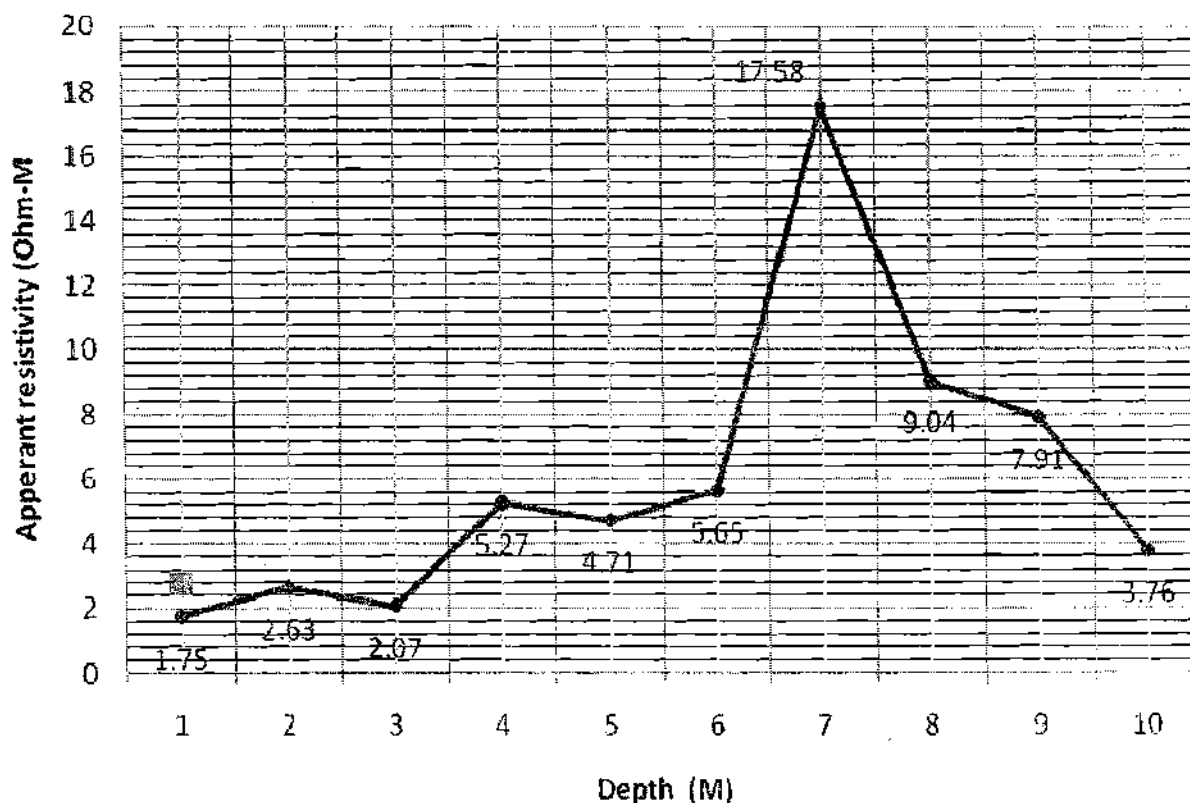
Site: BHUSAVAL (M.S)

Location # -01

Pin spacing (m)	Resistance (Ohm-m)	$K = 2\pi \times a$	Apparent Resistivity (RHO)
01	0.28	6.28	1.75
02	0.21	12.56	2.63
03	0.11	18.84	2.07
04	0.21	25.12	5.27
05	0.15	31.40	4.71
06	0.15	37.68	5.65
07	0.40	43.96	17.58
08	0.18	50.24	9.04
09	0.14	56.52	7.91
10	0.06	62.80	3.76

Client: MSPGCL - BHUSAVAL

Location # 01



Electrical Resistivity Test

Field data

Client: MSPGCL

Date: 07/06/2011

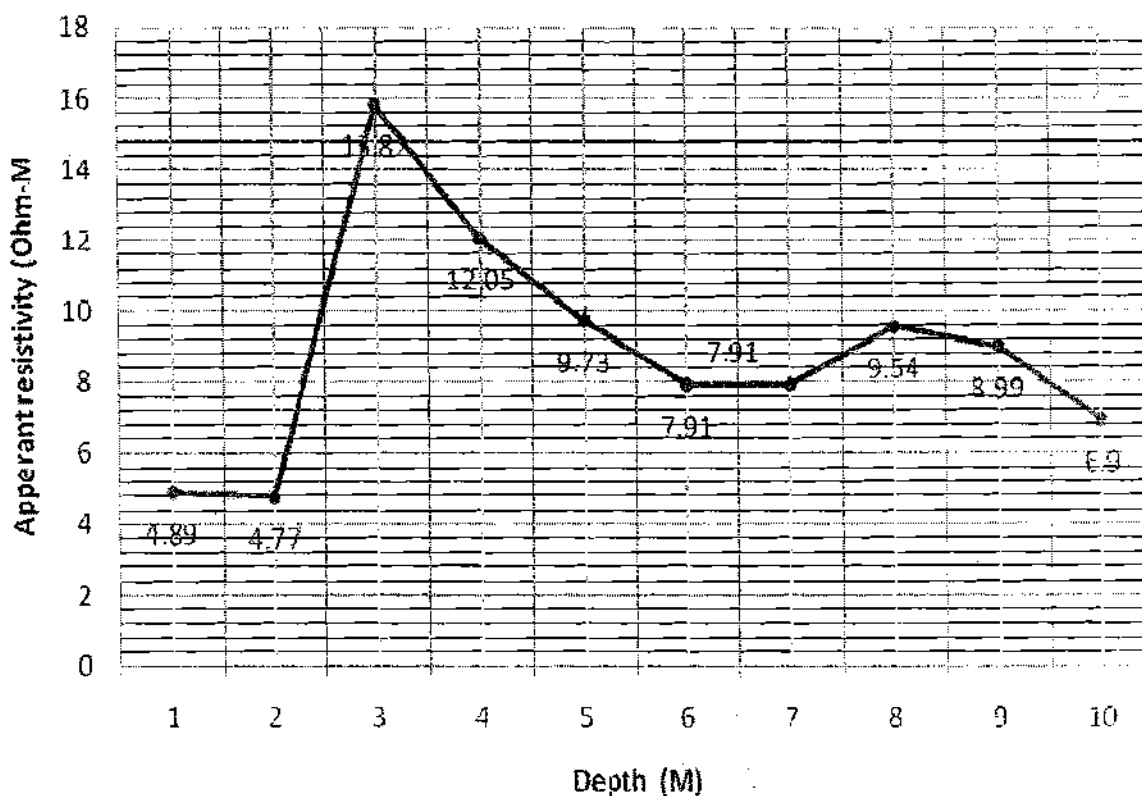
Site: BHUSAVAL (M.S)

Location # -02

Pin spacing (m)	Resistance (Ohm-m)	$K = 2\pi \times a$	Apparent Resistivity (RHO)
01	0.78	6.28	4.89
02	0.38	12.56	4.77
03	0.84	18.84	15.82
04	0.48	25.12	12.05
05	0.31	31.40	9.73
06	0.21	37.68	7.91
07	0.18	43.96	7.91
08	0.19	50.24	9.54
09	0.16	56.52	8.99
10	0.11	62.80	6.90

Client: MSPGCL - BHUSAVAL

Location # 02



Electrical Resistivity Test

Field data

Client: MSPGCL

Date: 07/06/2011

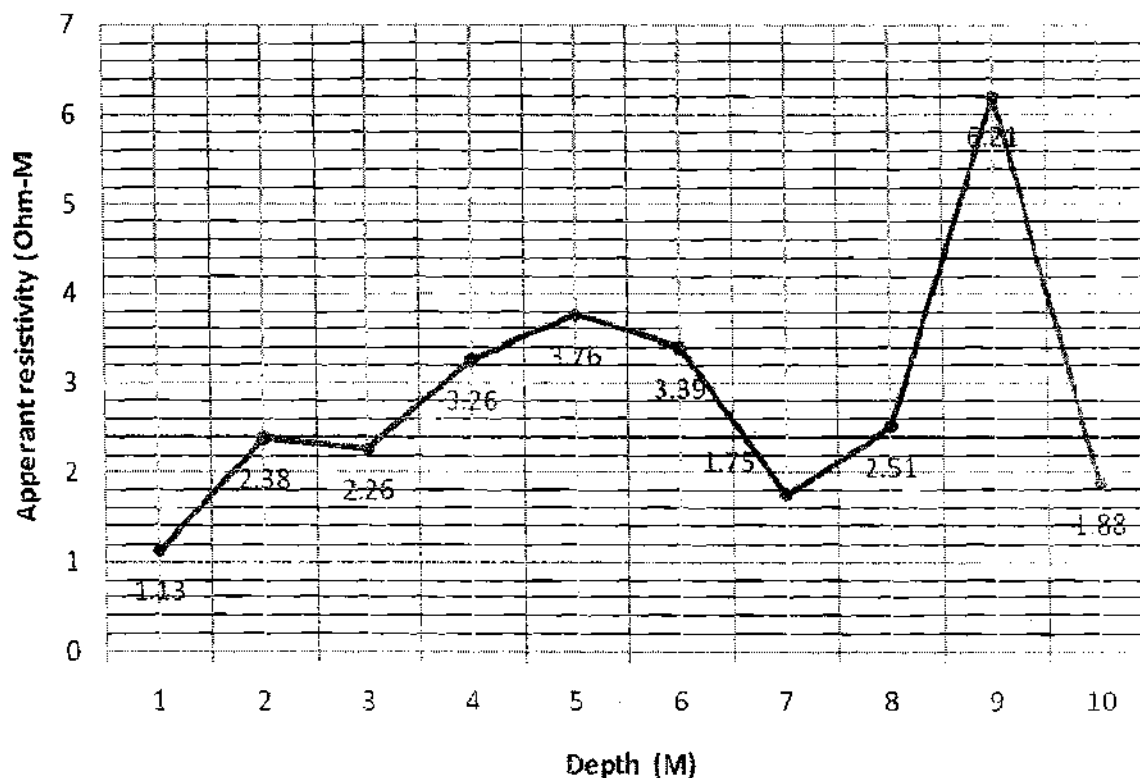
Site: BHUSAVAL (M.S)

Location # -03

Pin spacing (m)	Resistance (Ohm-m)	$K = 2\pi \times a$	Apparent Resistivity (RHO)
01	0.18	6.28	1.13
02	0.19	12.56	2.38
03	0.12	18.84	2.26
04	0.13	25.12	3.26
05	0.12	31.40	3.76
06	0.09	37.68	3.39
07	0.04	43.96	1.75
08	0.05	50.24	2.51
09	0.11	56.52	6.21
10	0.03	62.80	1.88

Client: MSPGCL - BHUSAVAL

Location # 03



Electrical Resistivity Test

Field data

Client: MSPGCL

Date: 07/06/2011

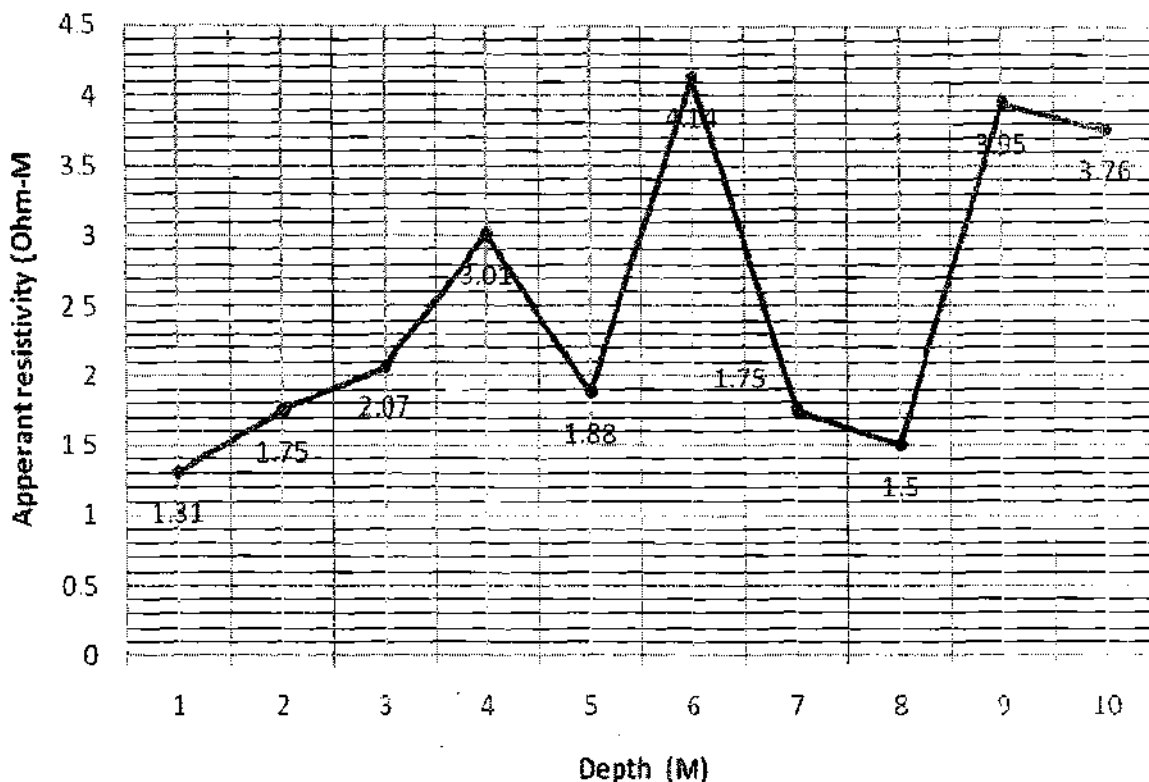
Site: BHUSAVAL (M.S)

Location # -04

Pin spacing (m)	Resistance (Ohm-m)	$K = 2\pi \times a$	Apparent Resistivity (RHO)
01	0.21	6.28	1.31
02	0.14	12.56	1.75
03	0.11	18.84	2.07
04	0.12	25.12	3.01
05	0.06	31.40	1.88
06	0.11	37.68	4.14
07	0.04	43.96	1.75
08	0.03	50.24	1.50
09	0.07	56.52	3.95
10	0.06	62.80	3.76

Client: MSPGCL - BHUSAVAL

Location # 04



Electrical Resistivity Test

Field data

Client: MSPGCL

Date: 07/06/2011

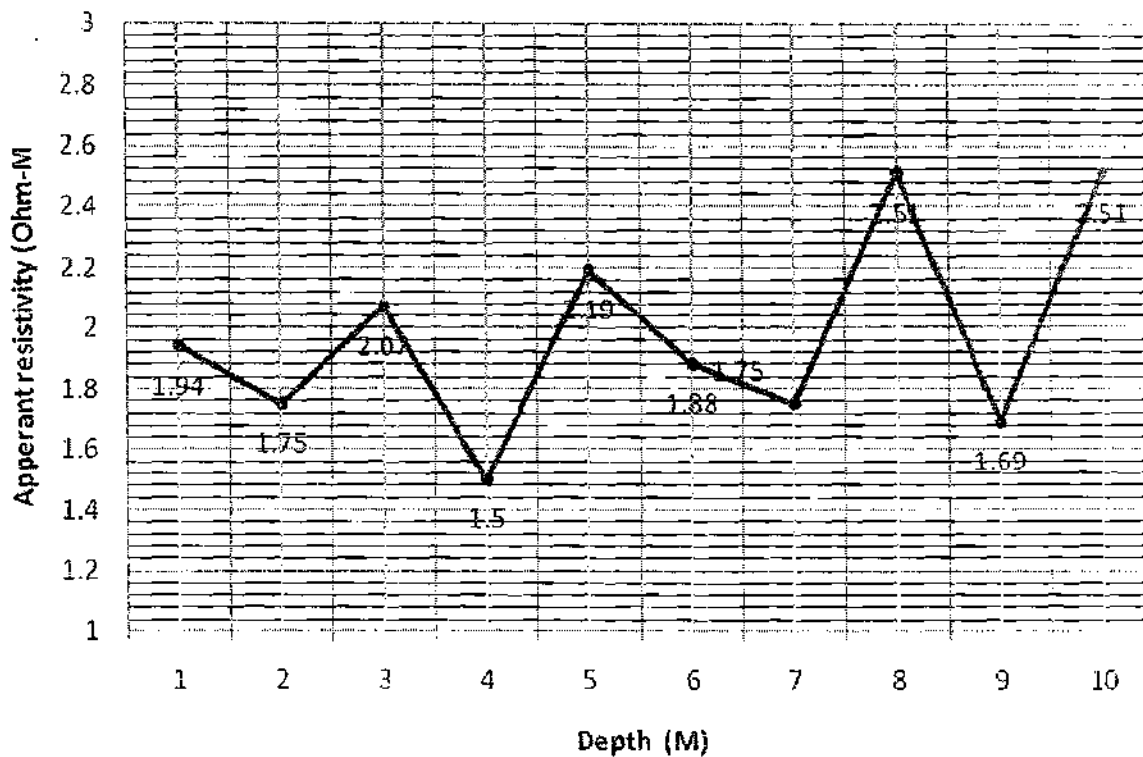
Site: BHUSAVAL (M.S)

Location # -05

Pin spacing (m)	Resistance (Ohm-m)	$K = 2\pi \times a$	Apparent Resistivity (RHO)
01	0.31	6.28	1.94
02	0.14	12.56	1.75
03	0.11	18.84	2.07
04	0.06	25.12	1.50
05	0.07	31.40	2.19
06	0.05	37.68	1.88
07	0.04	43.96	1.75
08	0.05	50.24	2.51
09	0.03	56.52	1.69
10	0.04	62.80	2.51

Client: MSPGCL - BHUSAVAL

Location # 05



Electrical Resistivity Test

Field data

Client: MSPGCL

Date: 07/06/2011

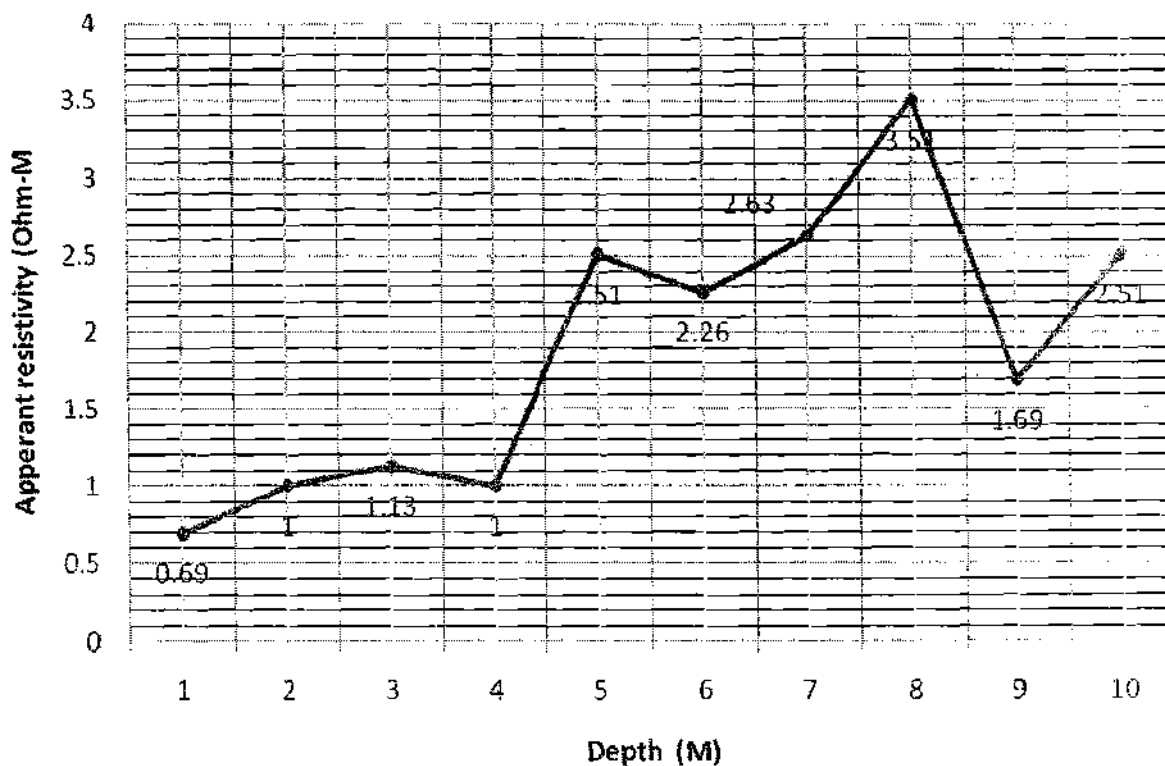
Site: BHUSAVAL (M.S)

Location # -06

Pin spacing (m)	Resistance (Ohm-m)	$K = 2\pi \times a$	Apparent Resistivity (RHO)
01	0.11	6.28	0.69
02	0.08	12.56	1.00
03	0.06	18.84	1.13
04	0.04	25.12	1.00
05	0.08	31.40	2.51
06	0.06	37.68	2.26
07	0.06	43.96	2.63
08	0.07	50.24	3.51
09	0.03	56.52	1.69
10	0.04	62.80	2.51

Client: MSPGCL - BHUSAVAL

Location # 06



Electrical Resistivity Test

Field data

Client: MSPGCL

Date: 07/06/2011

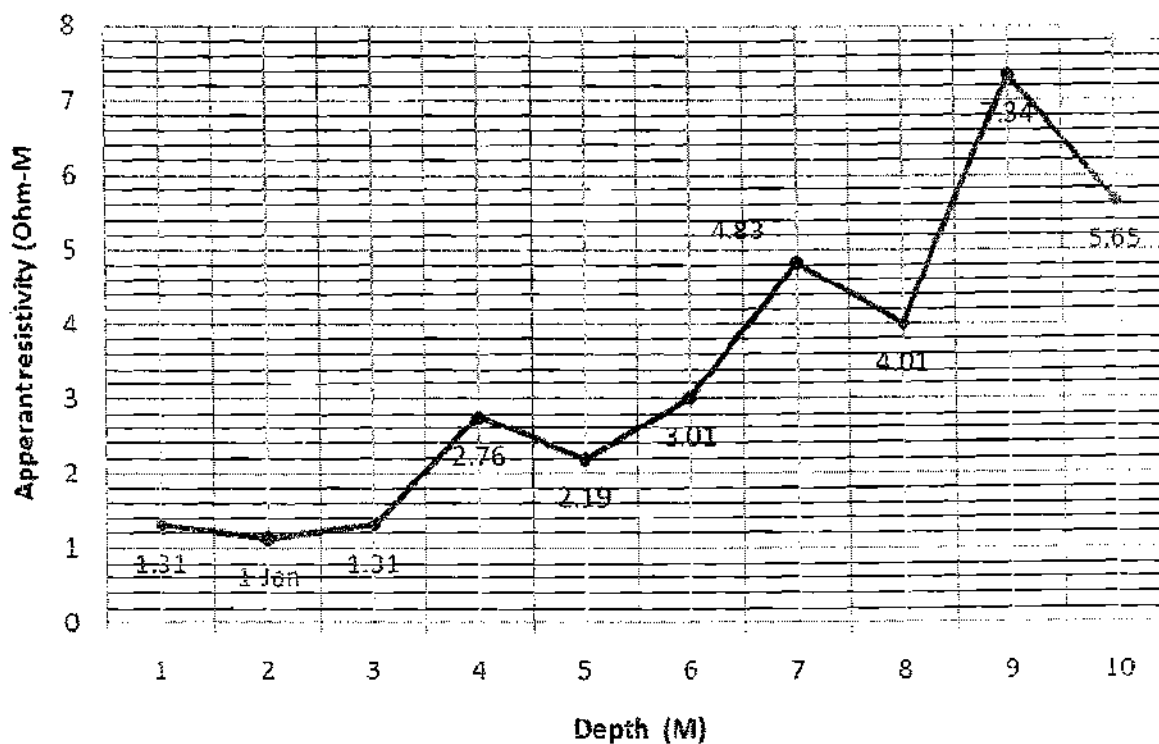
Site: BHUSAVAL (M.S)

Location # -07

Pin spacing (m)	Resistance (Ohm-m)	$K = 2\pi \times a$	Apparent Resistivity (RHO)
01	0.21	6.28	1.31
02	0.09	12.56	1.13
03	0.07	18.84	1.31
04	0.11	25.12	2.76
05	0.07	31.40	2.19
06	0.08	37.68	3.01
07	0.11	43.96	4.83
08	0.08	50.24	4.01
09	0.13	56.52	7.34
10	0.09	62.80	5.65

Client: MSPGCL - BHUSAVAL

Location # 07



Electrical Resistivity Test

Field data

Client: MSPGCL

Date: 07/06/2011

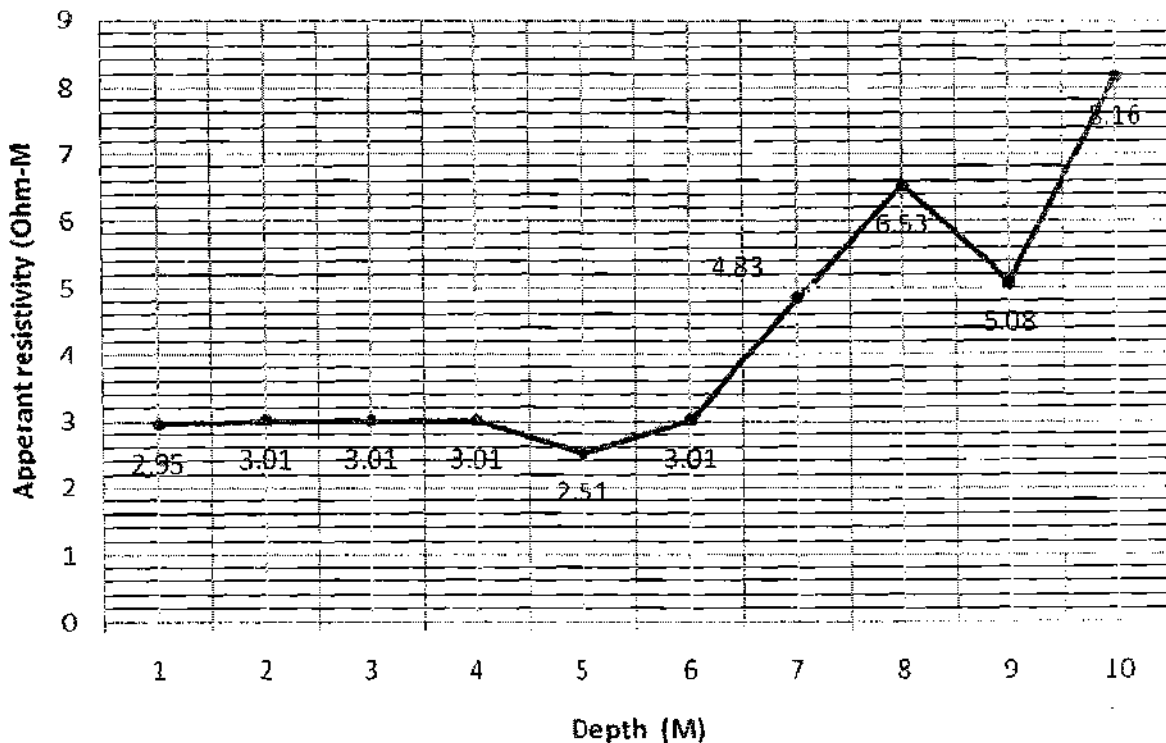
Site: BHUSAVAL (M.S)

Location # -08

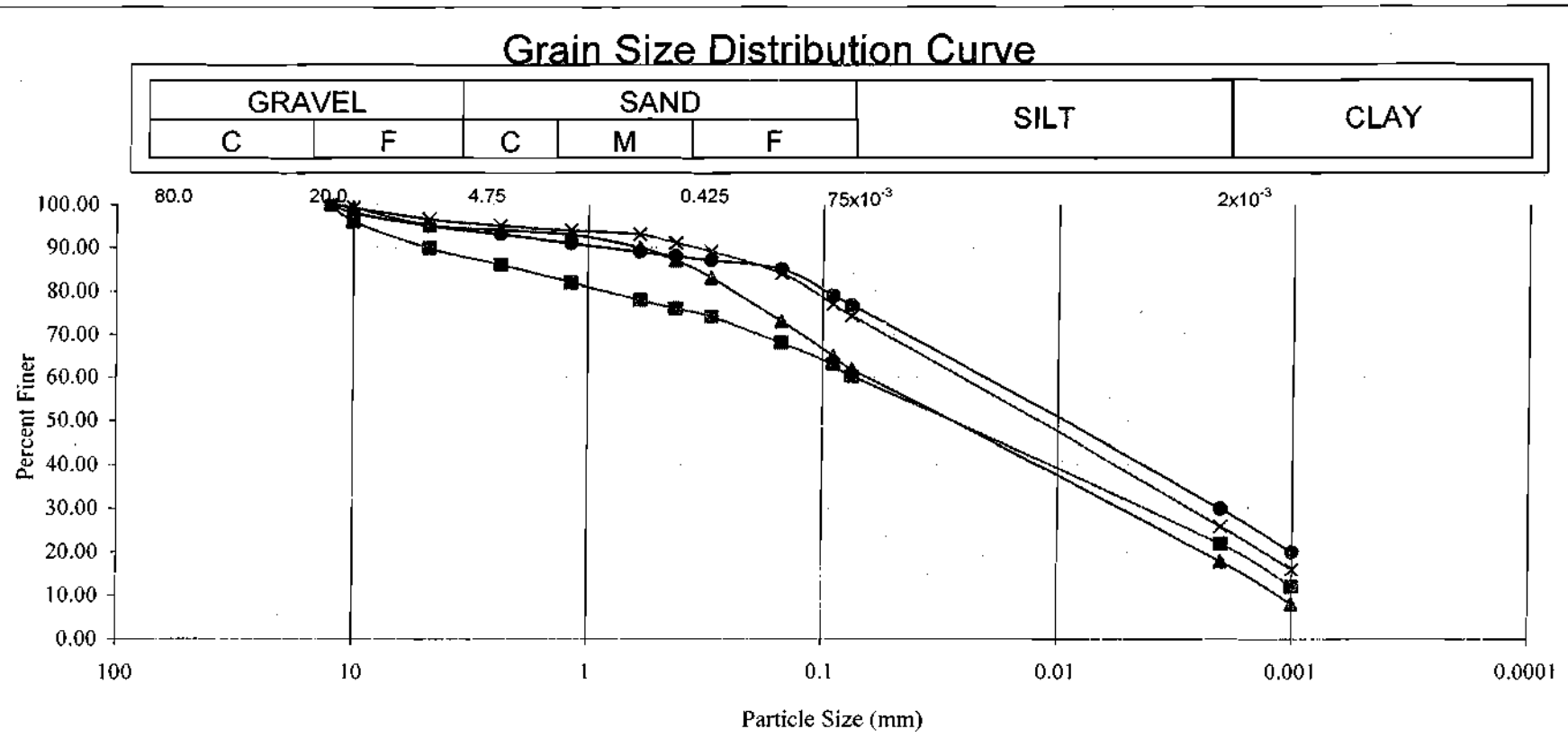
Pin spacing (m)	Resistance (Ohm-m)	$K = 2\pi \times a$	Apparent Resistivity (RHO)
01	0.47	6.28	2.95
02	0.24	12.56	3.01
03	0.16	18.84	3.01
04	0.12	25.12	3.01
05	0.08	31.40	2.51
06	0.07	37.68	3.01
07	0.11	43.96	4.83
08	0.13	50.24	6.53
09	0.09	56.52	5.08
10	0.13	62.80	8.16

Client: MSPGCL - BHUSAVAL

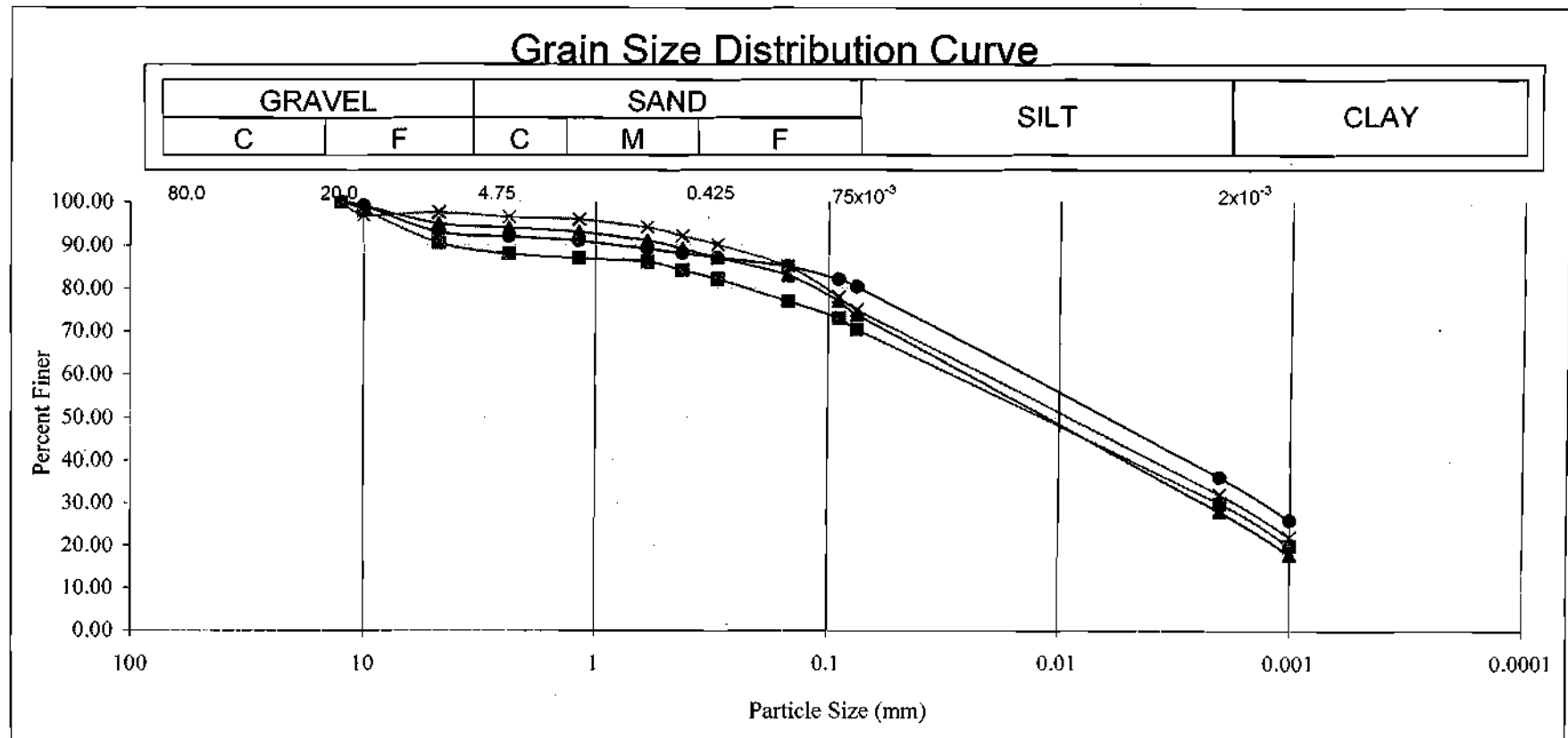
Location # 08



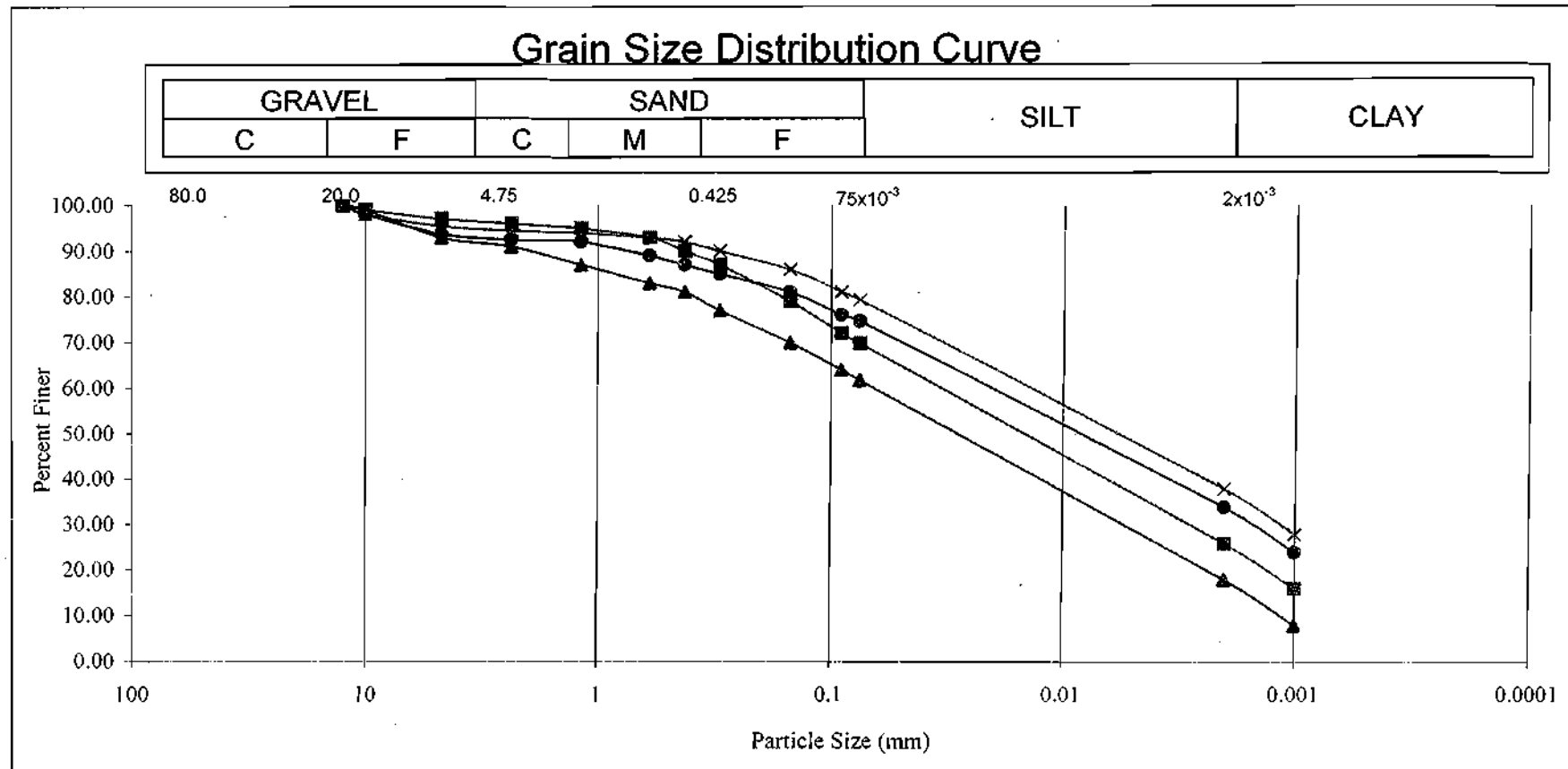
GRAPHS



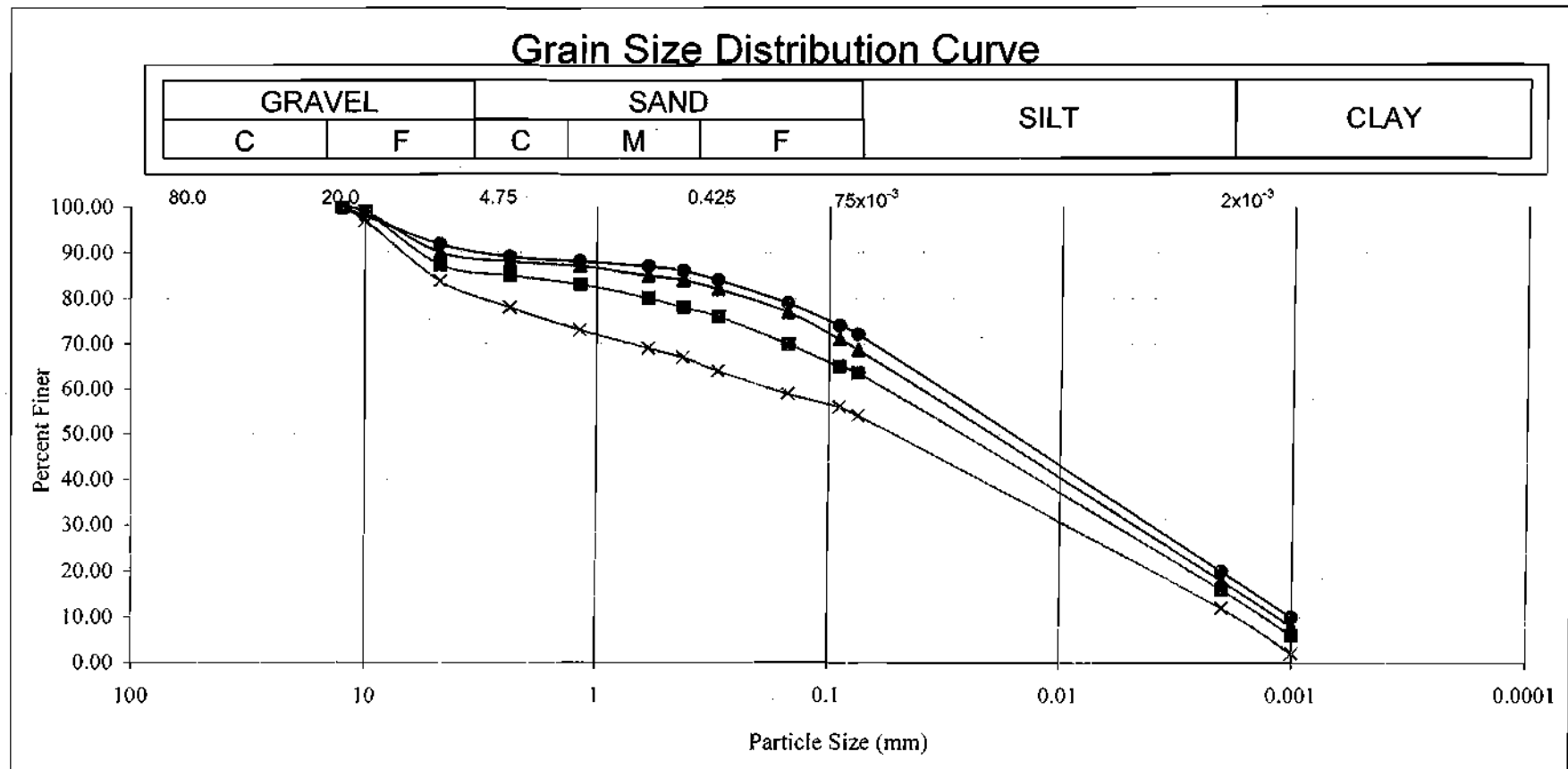
Symbol	Sample No.	Bore Hole No.	Depth in m.	Type of Sample	Gravel %	Sand %	Silt %	Clay %	Liquid Limit	Plastic Limit	Plasticity Index
●	1	1	0.00-0.45	UDS1	5.00	18.20	76.80		55.00	26.00	29.00
■	2	2	0.00-0.50	UDS1	10.20	29.50	60.30		48.00	25.00	23.00
▲	3	3	0.00-0.50	UDS1	4.90	33.20	61.90		49.00	24.00	25.00
×	4	4	0.45-0.90	UDS1	3.50	22.20	74.30		56.00	27.00	29.00



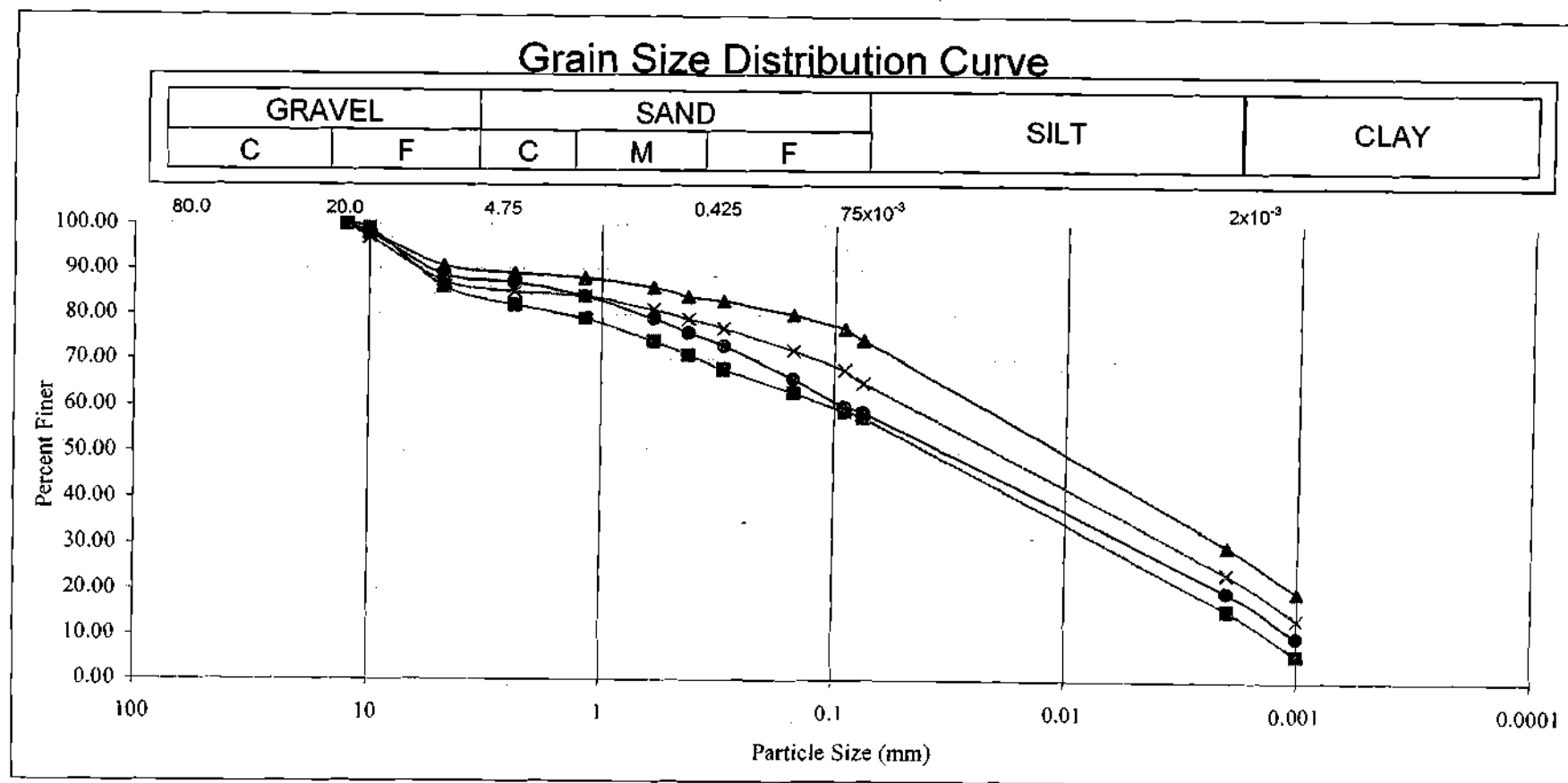
Symbol	Sample No.	Bore Hole No.	Depth in m.	Type of Sample	Gravel %	Sand %	Silt Clay %	Liquid Limit	Plastic Limit	Plasticity Index
	5	5	0.00-0.45	UDS1	7.00	12.70	80.30	59.00	28.00	31.00
	6	6	0.50-0.95	UDS1	9.50	20.20	70.30	50.00	26.00	24.00
	7	7	0.00-0.45	UDS1	5.00	21.20	73.80	52.00	27.00	25.00
	8	8	0.00-0.50	UDS1	2.50	22.60	74.90	51.00	26.00	25.00



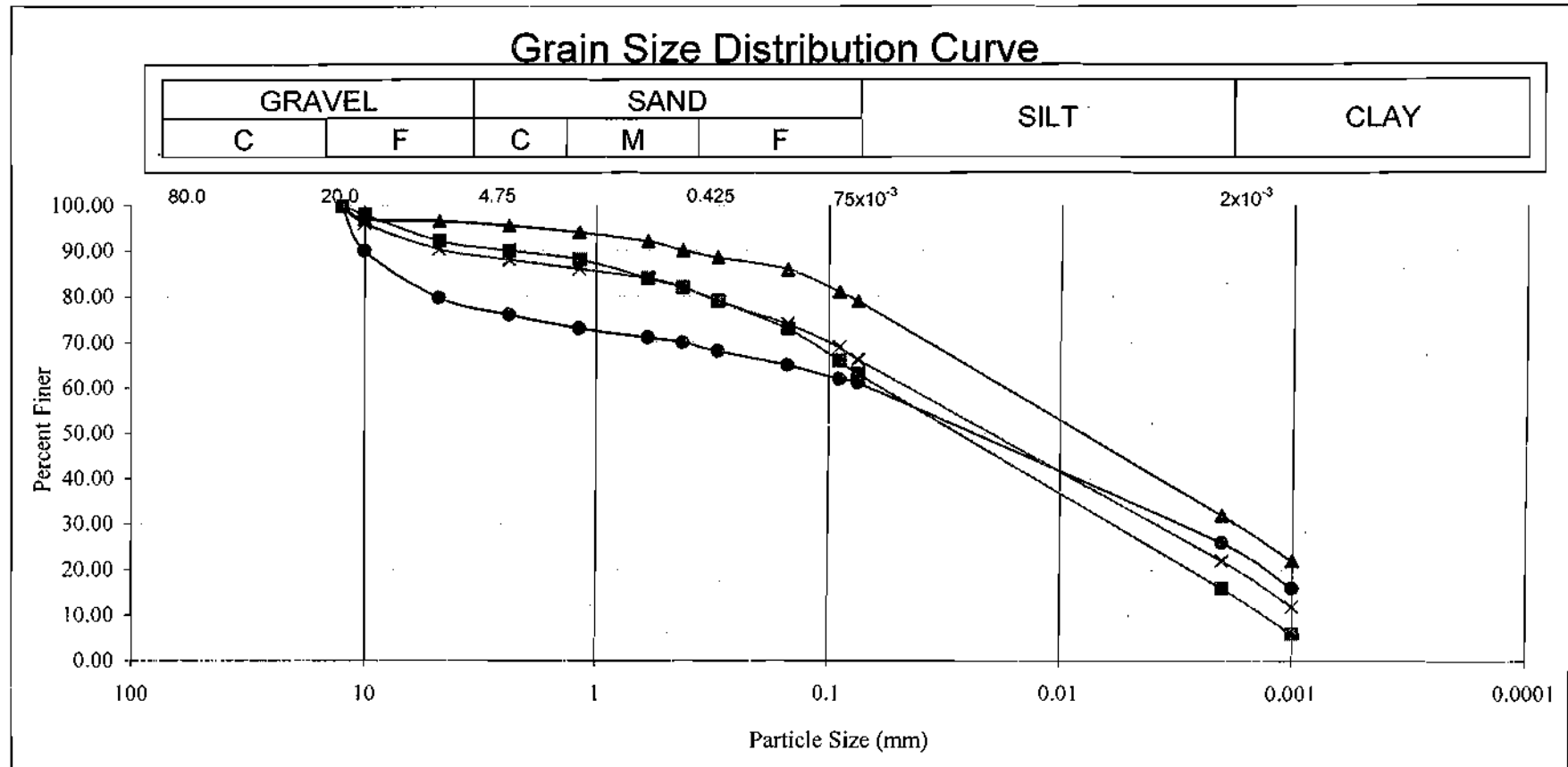
Symbol	Sample No.	Bore Hole No.	Depth in m.	Type of Sample	Gravel %	Sand %	Silt %	Clay %	Liquid Limit	Plastic Limit	Plasticity Index
●	9	9	0.00-0.45	UDS1	6.20	19.20	74.60	53.00	27.00	26.00	26.00
■	10	10	0.00-0.45	UDS1	2.90	27.30	69.80	50.00	26.00	24.00	24.00
▲	11	11	0.00-0.45	UDS1	7.00	31.20	61.80	47.00	24.00	23.00	23.00
×	12	12	0.00-0.45	UDS1	4.50	16.20	79.30	53.00	27.00	26.00	26.00



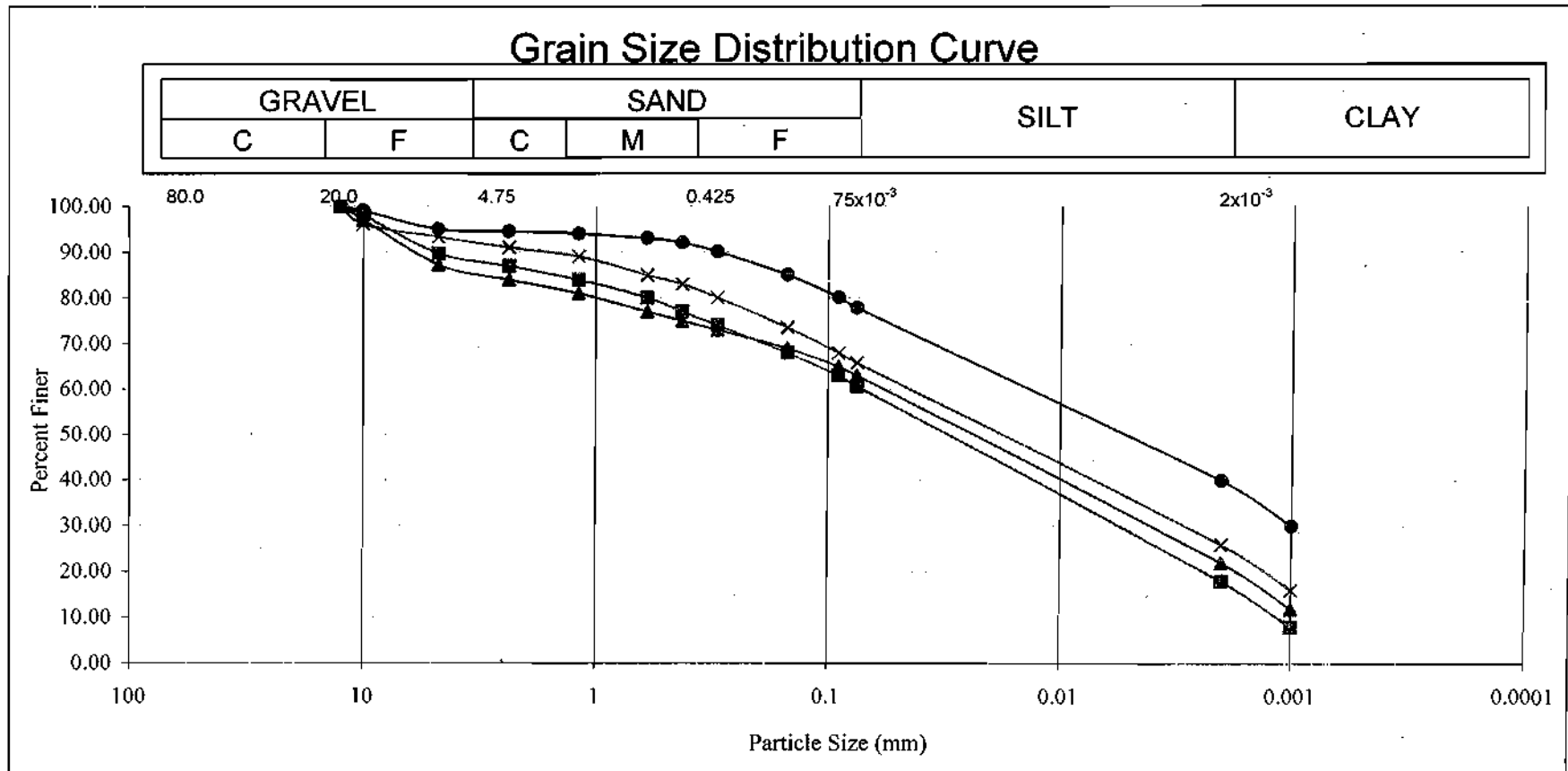
Symbol	Sample No.	Bore Hole No.	Depth in m.	Type of Sample	Gravel %	Sand %	Silt %	Clay %	Liquid Limit	Plastic Limit	Plasticity Index
●	13	13	0.00-0.35	UDS1	8.20	19.70	72.10	51.00	26.00	25.00	25.00
■	14	14	0.00-0.20	UDS1	12.70	23.80	63.50	49.00	25.00	24.00	24.00
▲	15	15	0.00-0.45	UDS1	10.00	21.35	68.65	42.00	25.00	17.00	17.00
×	16	16	0.00-0.40	UDS1	16.20	29.70	54.10	43.00	22.00	21.00	21.00



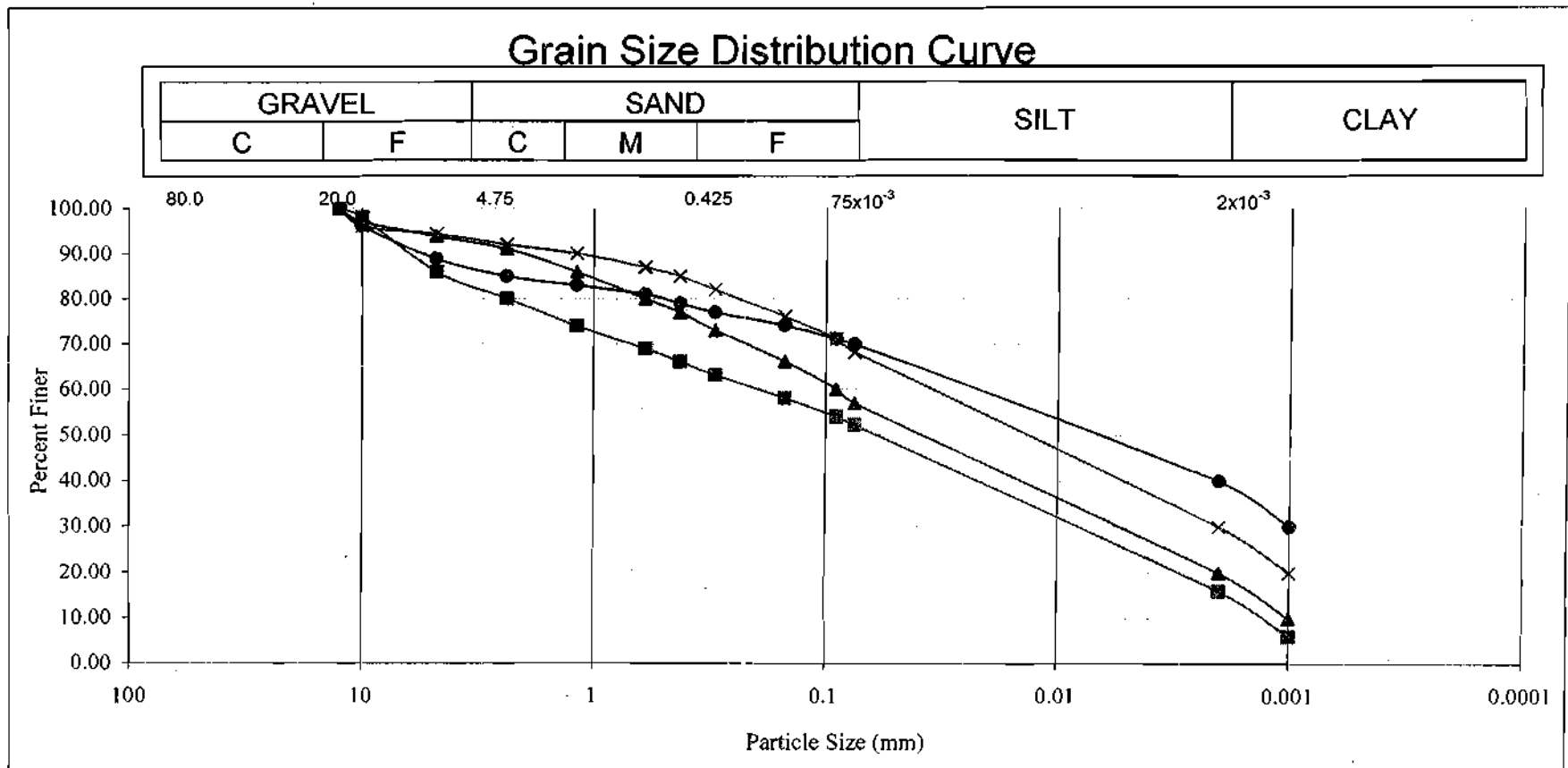
Symbol	Sample No.	Bore Hole No.	Depth in m.	Type of Sample	Gravel %	Sand %	Silt %	Clay	Liquid Limit	Plastic Limit	Plasticity Index
●	17	17	0.00-0.50	UDS1	11.30	30.00	58.70		44.00	23.00	21.00
■	18	18	0.00-0.65	UDS1	13.90	28.50	57.60		43.00	22.00	21.00
▲	19	19	0.00-0.50	UDS1	9.30	16.30	74.40		53.00	27.00	26.00
×	20	21	0.00-0.50	UDS1	12.70	22.10	65.20		49.00	25.00	24.00



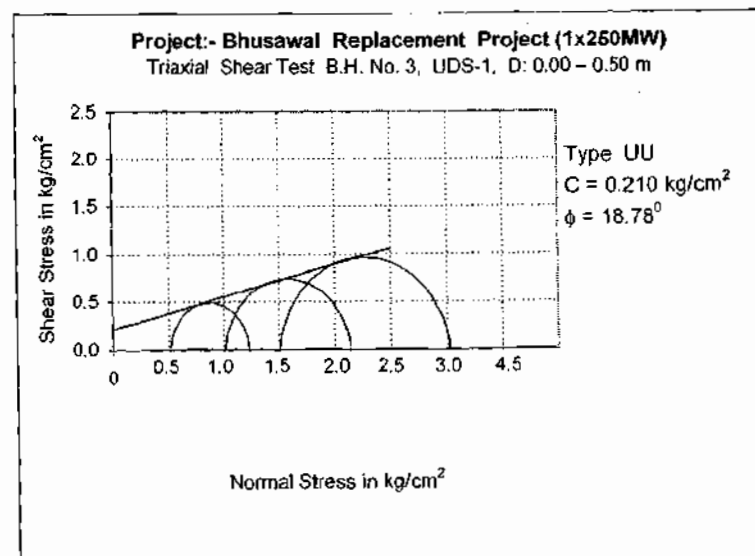
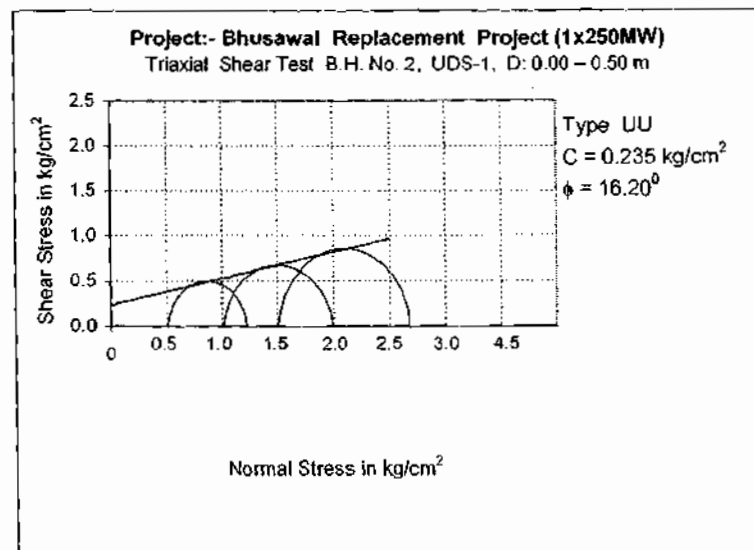
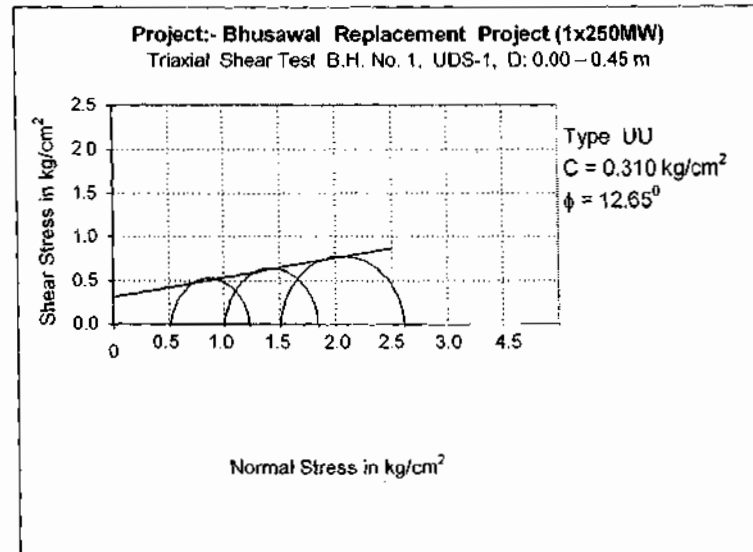
Symbol	Sample No.	Bore Hole No.	Depth in m.	Type of Sample	Gravel %	Sand %	Silt %	Clay	Liquid Limit	Plastic Limit	Plasticity Index
●	21	23	0.00-0.45	UDS1	20.20	18.70	61.10		45.00	23.00	22.00
■	22	23	0.90-1.70	UDS2	7.80	29.20	63.00		47.00	24.00	23.00
▲	23	24	0.00-0.50	UDS1	3.50	17.50	79.00		56.00	27.00	29.00
×	24	25	0.10-0.55	UDS1	9.70	24.10	66.20		49.00	25.00	24.00

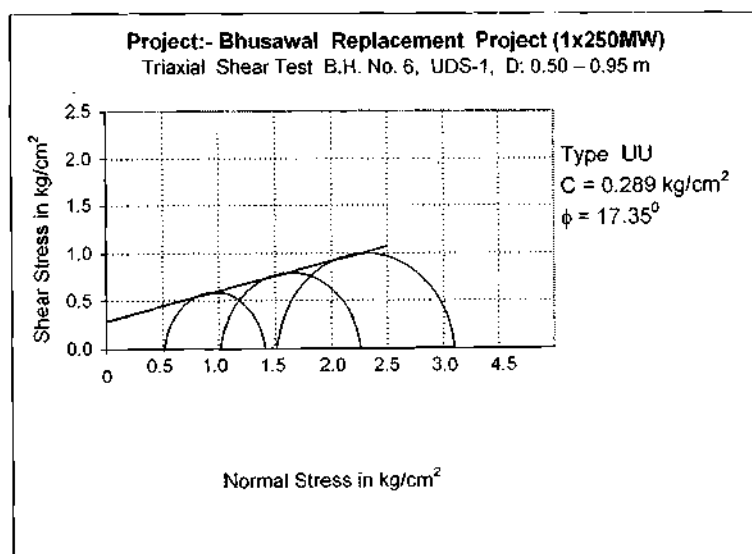
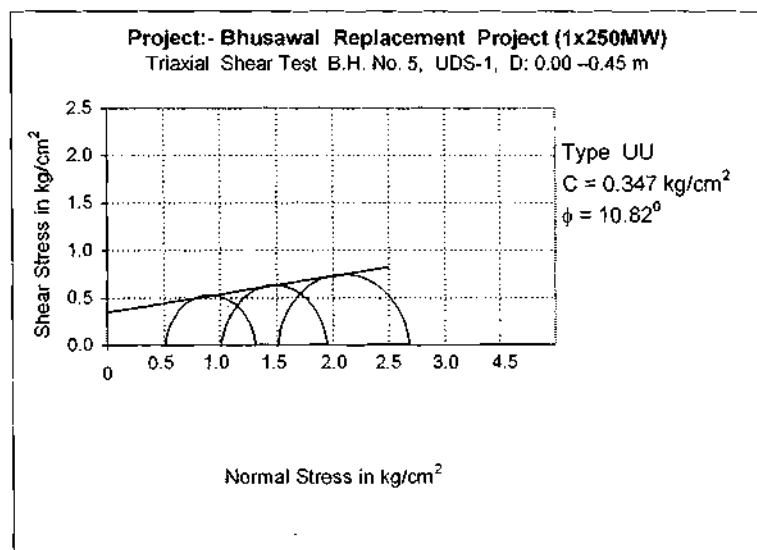
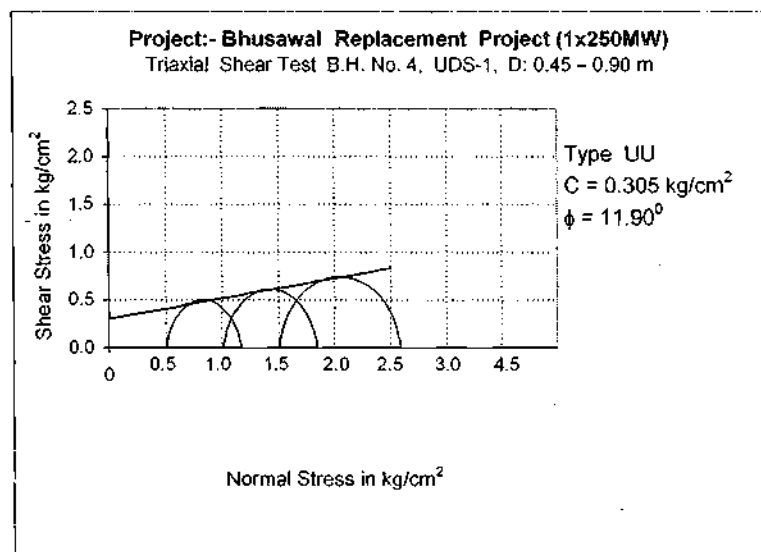


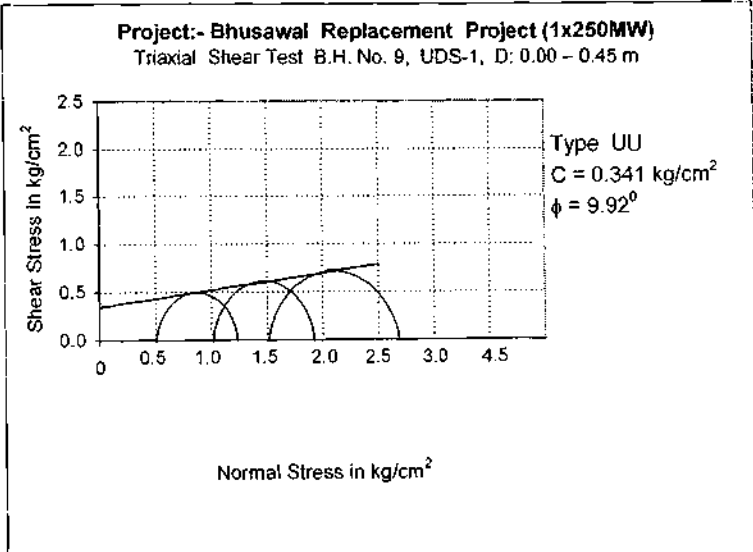
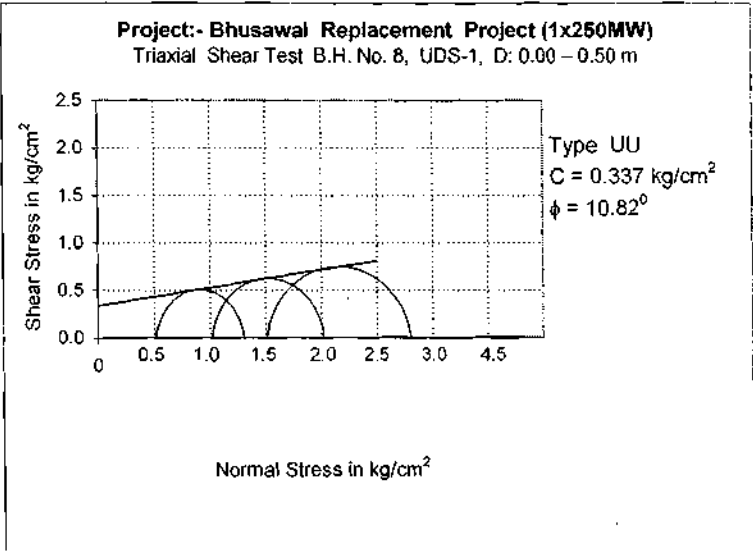
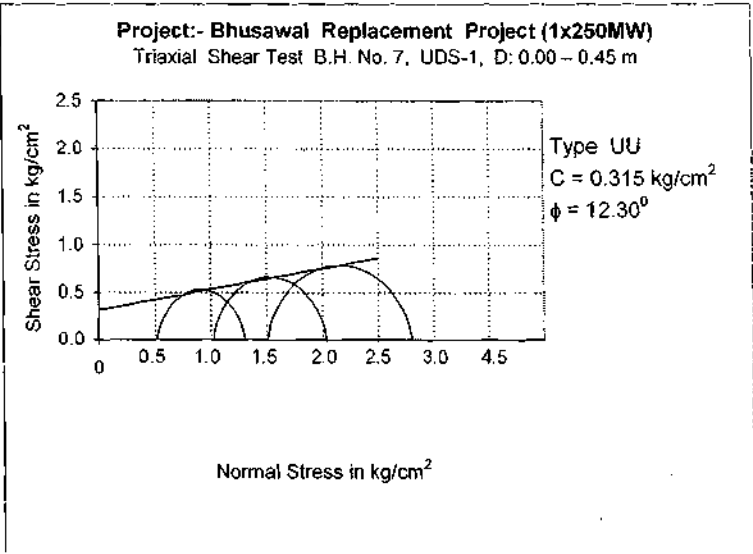
Symbol	Sample No.	Bore Hole No.	Depth in m.	Type of Sample	Gravel %	Sand %	Silt %	Clay %	Liquid Limit	Plastic Limit	Plasticity Index
●	25	26	0.00-0.45	UDS1	5.00	17.20	77.80		45.00	23.00	22.00
■	26	27	0.00-0.50	UDS1	10.30	29.00	60.70		47.00	24.00	23.00
▲	27	28	0.00-0.45	UDS1	12.70	24.20	63.10		56.00	27.00	29.00
×	28	29	0.00-0.45	UDS1	6.70	27.50	65.80		49.00	25.00	24.00

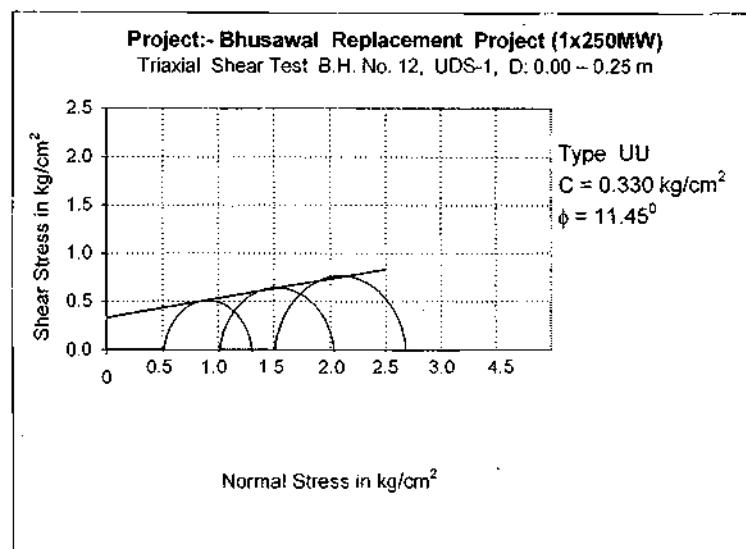
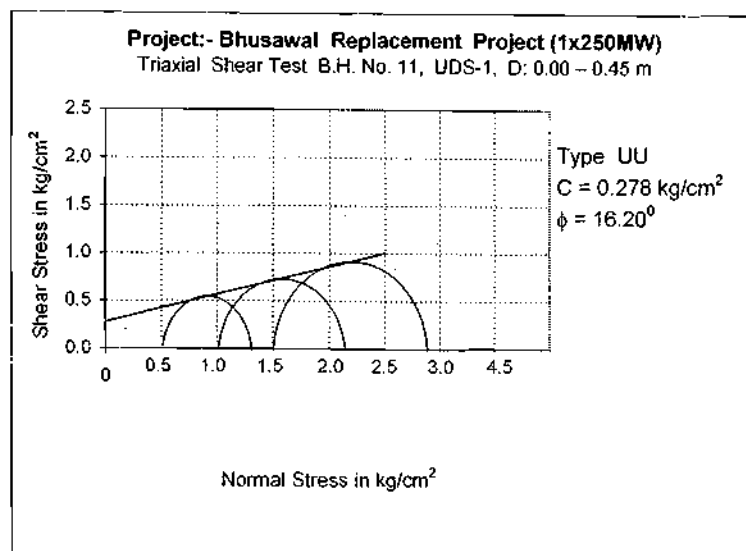
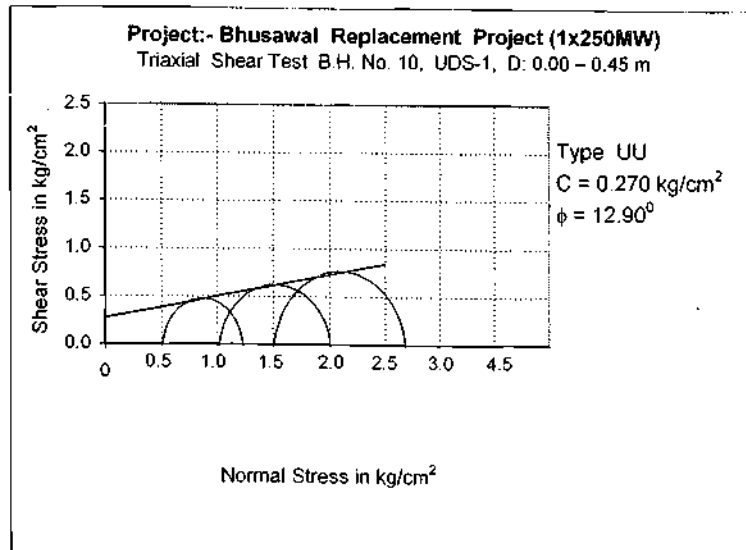


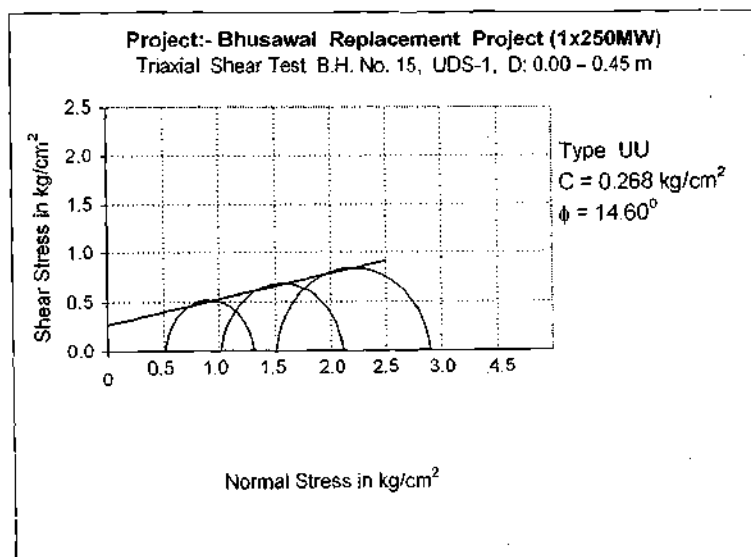
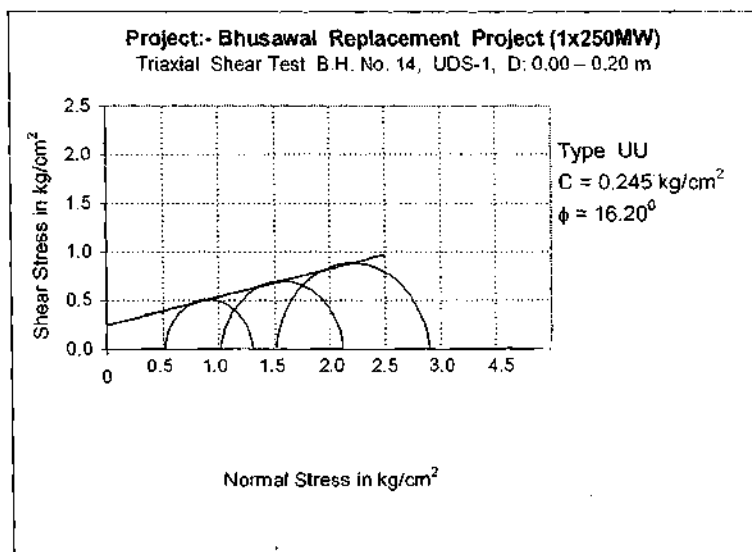
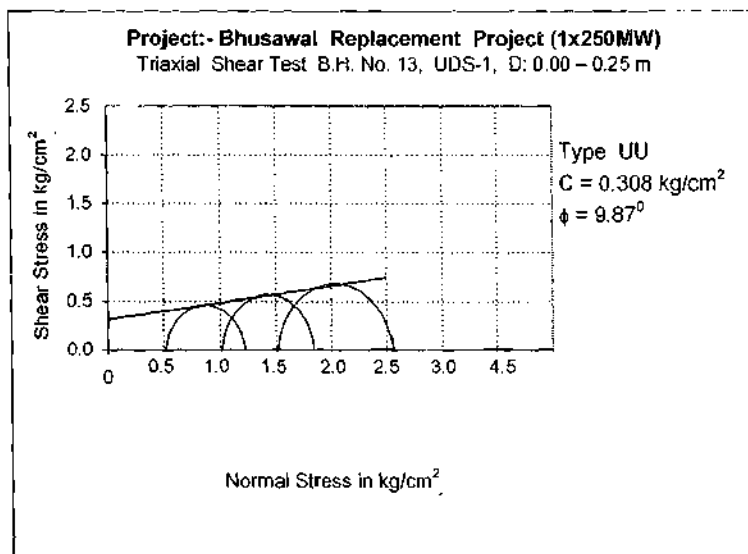
Symbol	Sample No.	Bore Hole No.	Depth in m.	Type of Sample	Gravel %	Sand %	Silt %	Clay %	Liquid Limit	Plastic Limit	Plasticity Index
●	29	29	0.90-1.35	UDS2	11.20	18.90	69.90		52.00	25.00	27.00
■	30	30	0.00-0.50	UDS1	14.10	33.70	52.20		41.00	22.00	19.00
▲	31	31	0.00-0.50	UDS1	6.20	36.90	56.90		47.00	23.00	24.00
×	32	32	0.00-0.50	UDS1	5.70	26.20	68.10		49.00	24.00	25.00

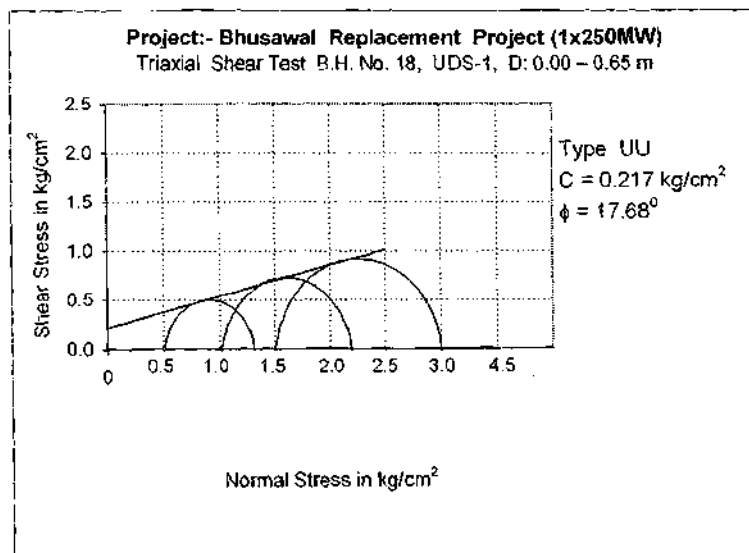
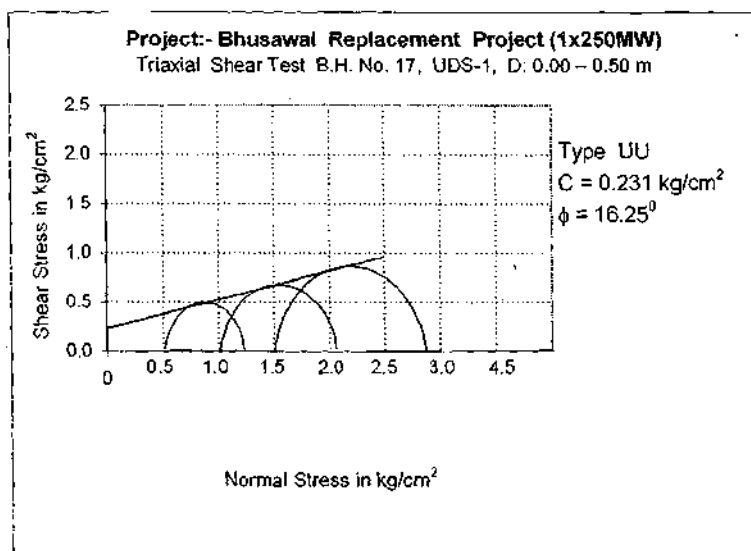
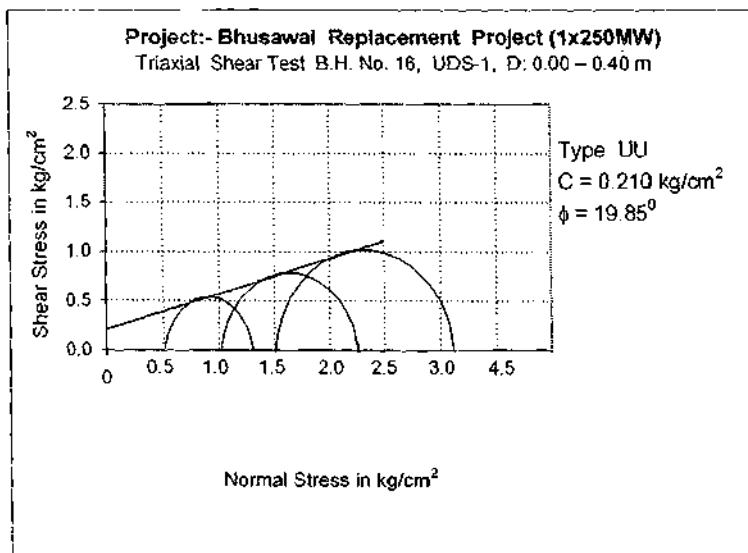


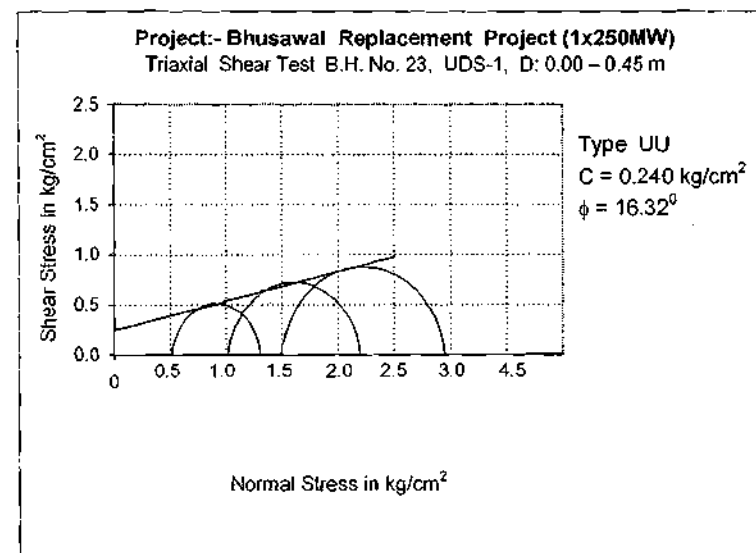
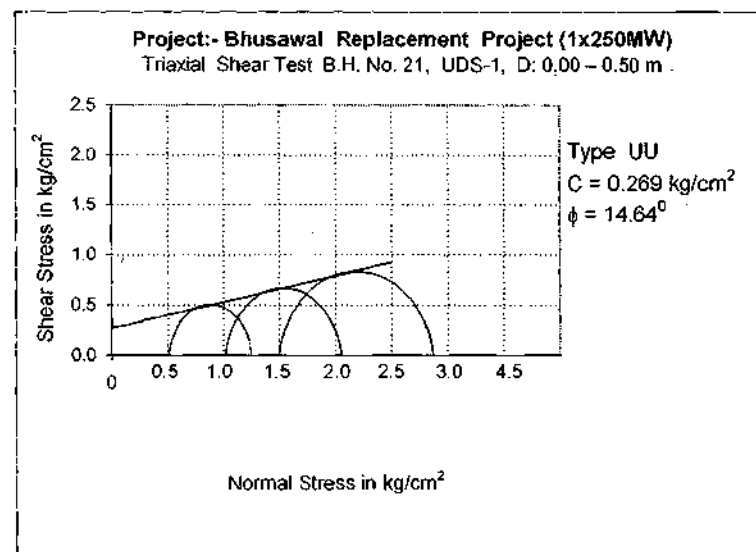
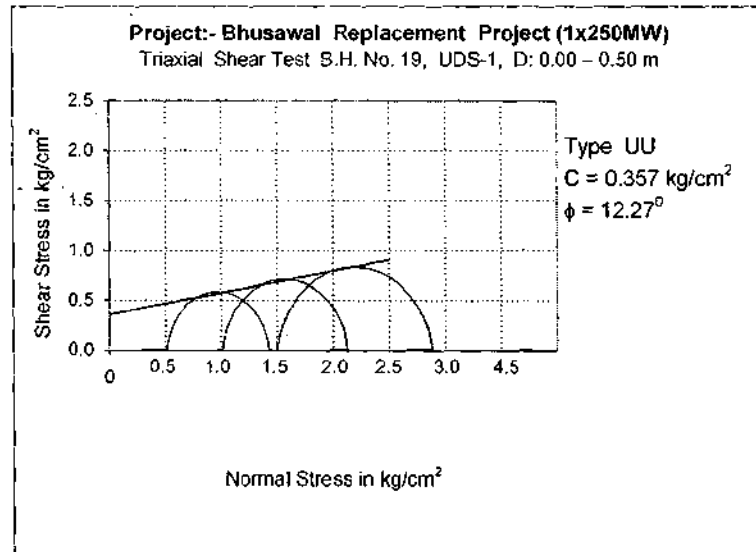


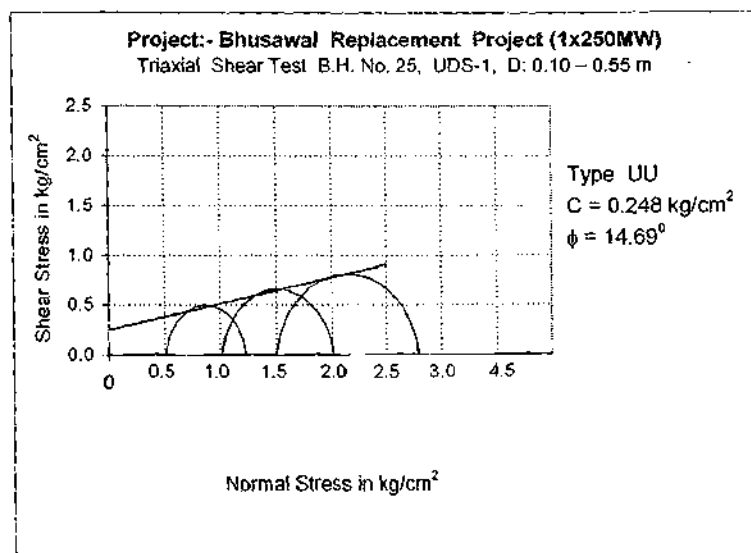
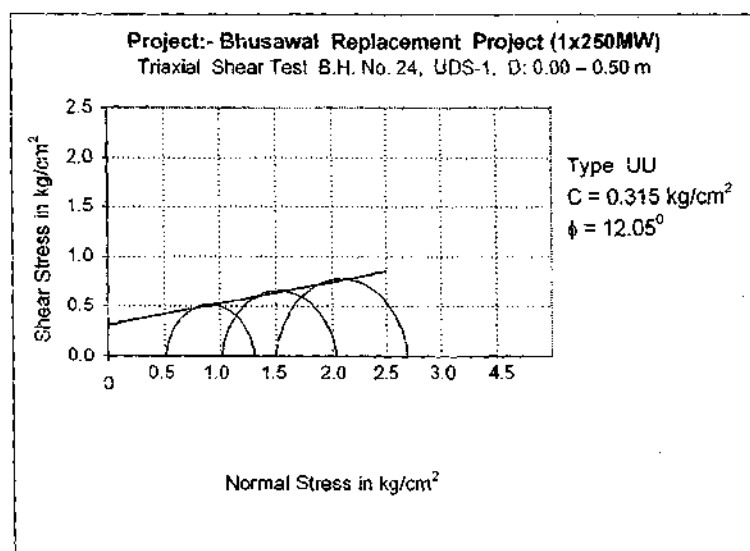
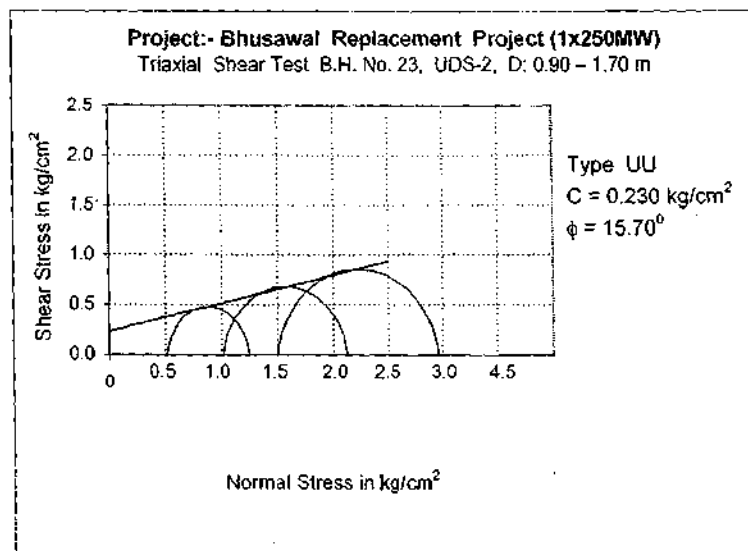


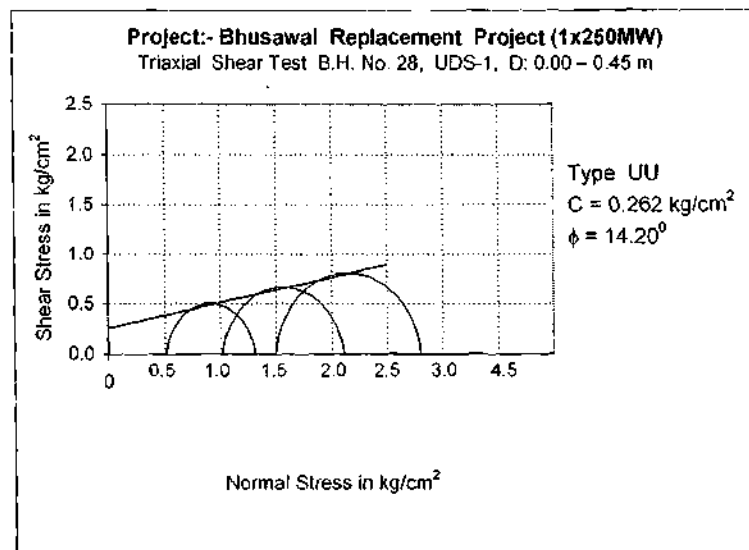
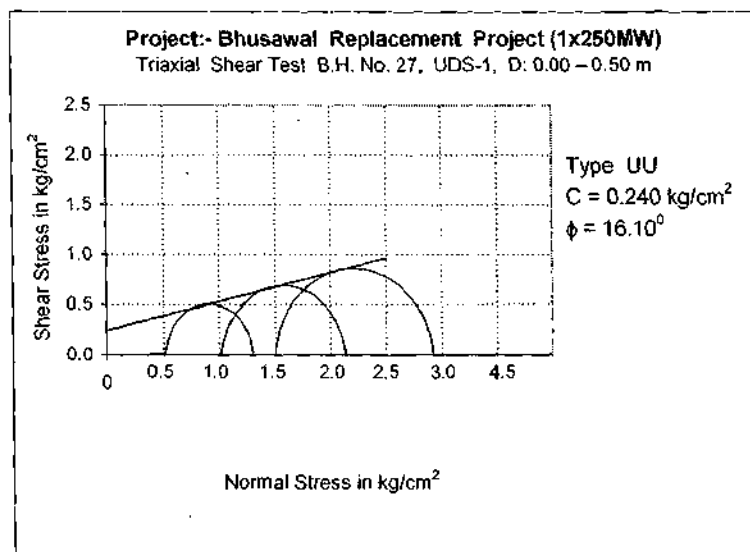
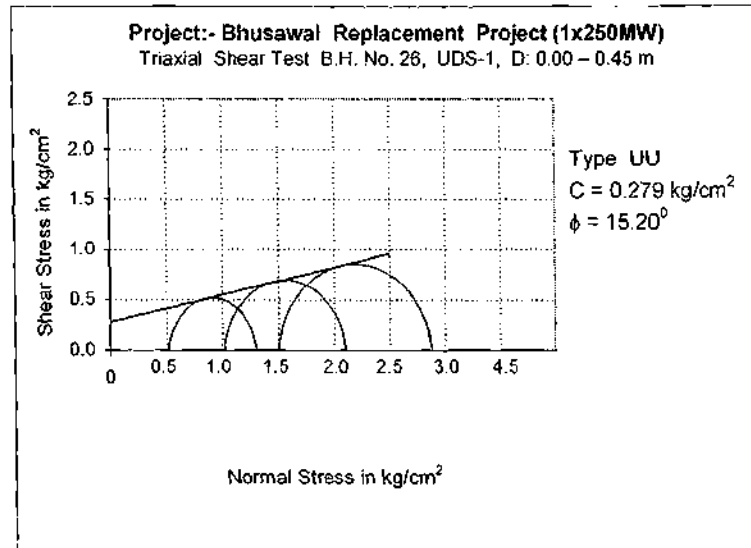


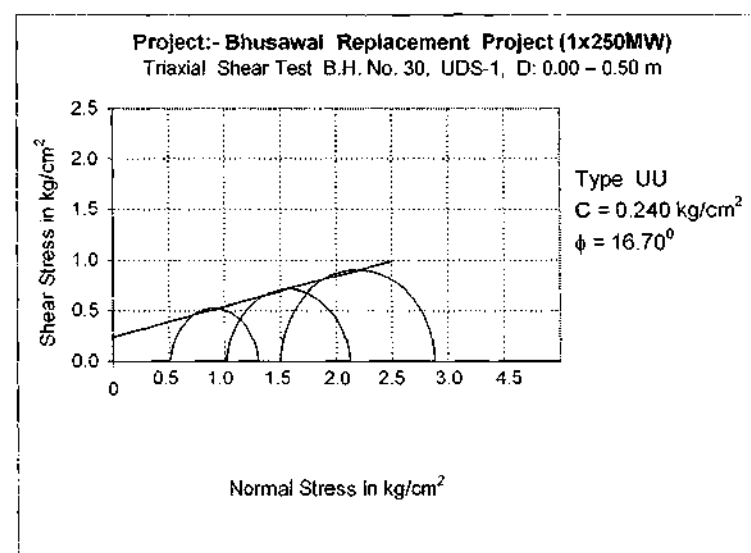
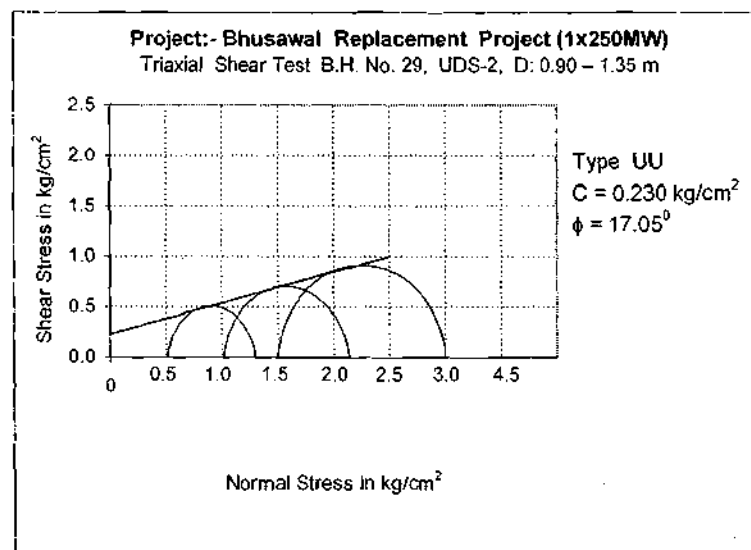
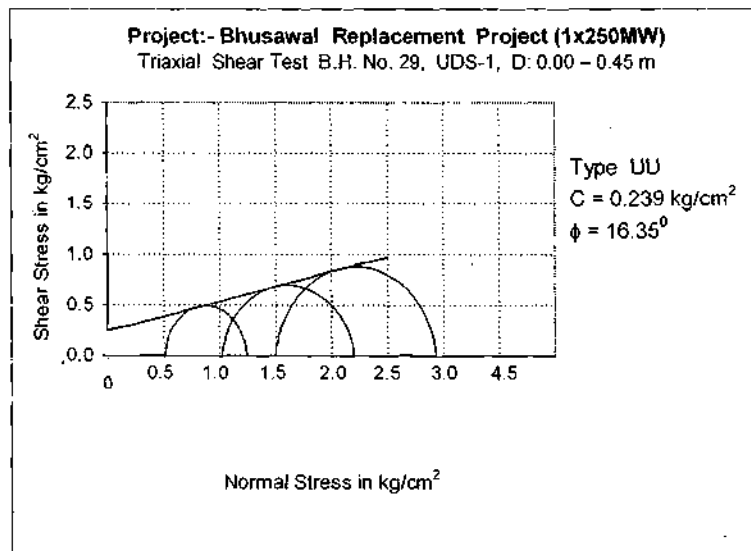


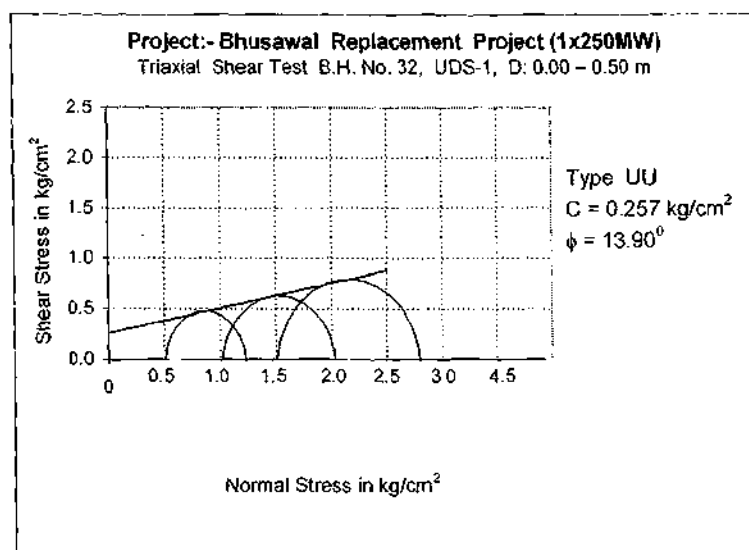
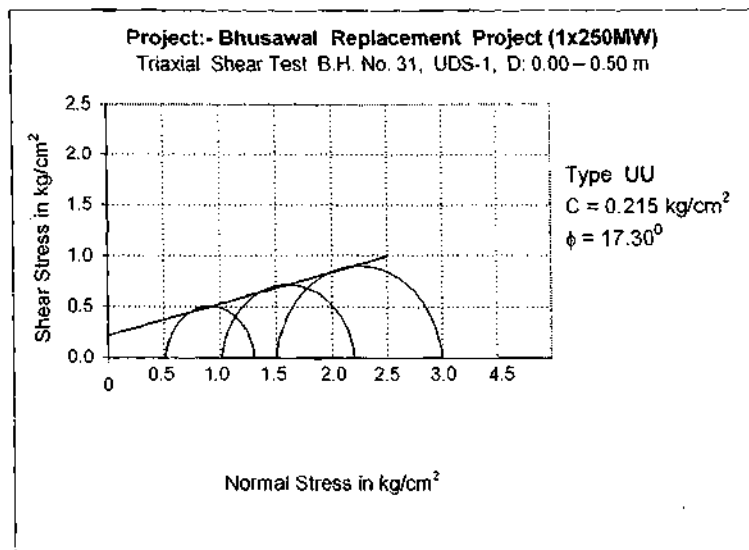


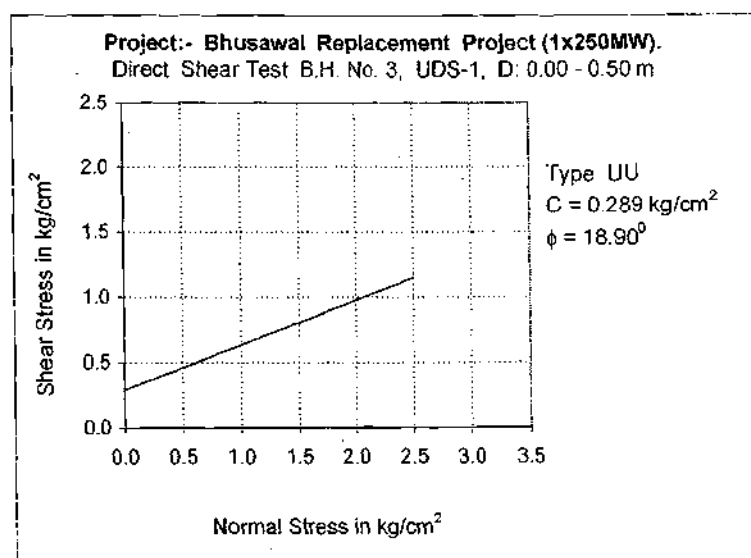
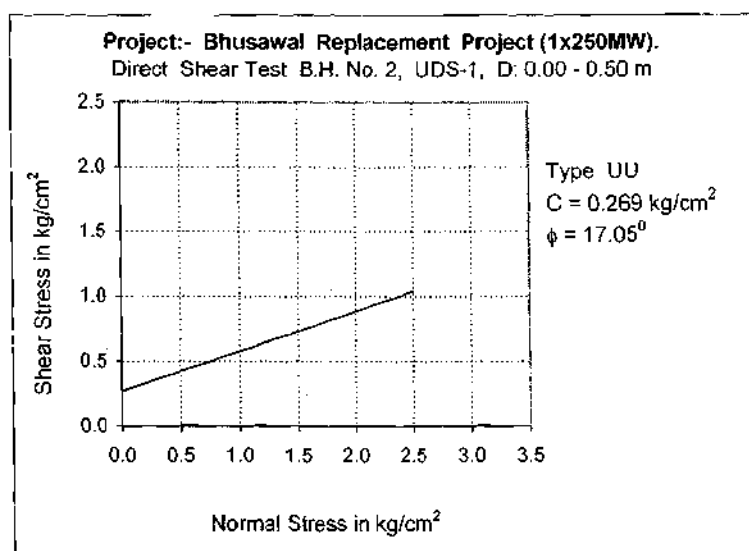
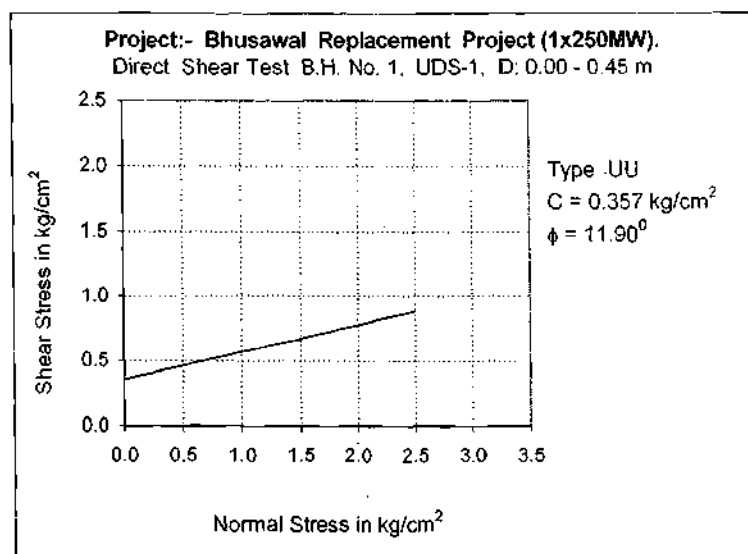


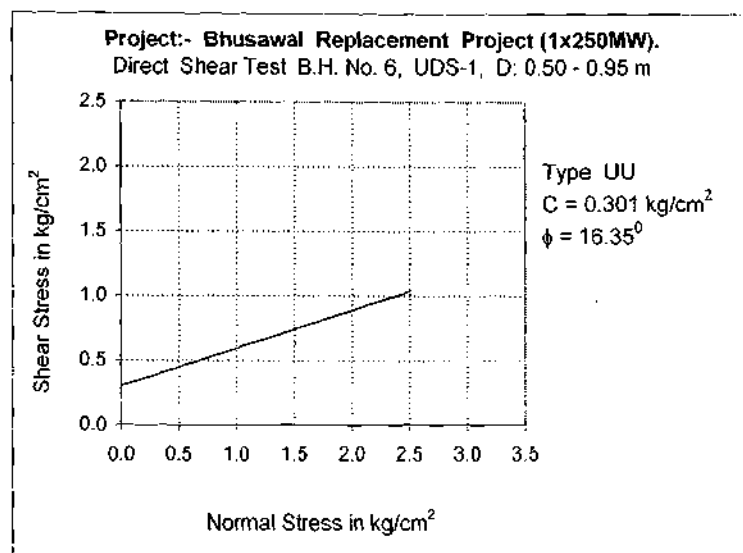
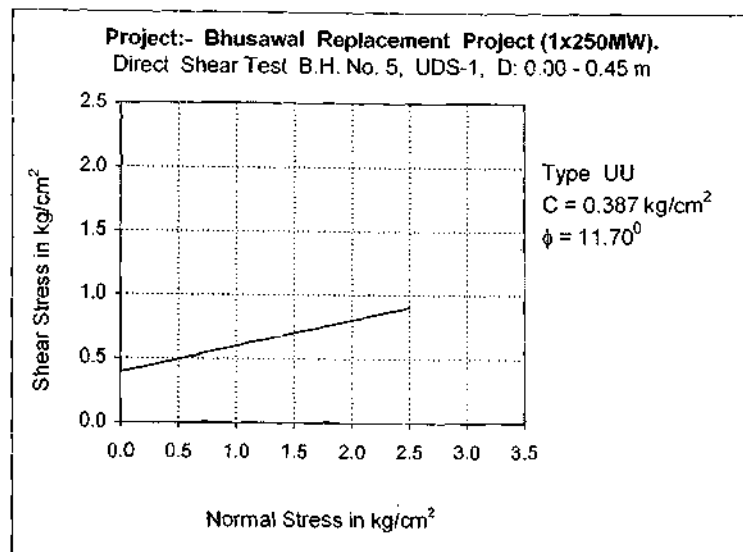
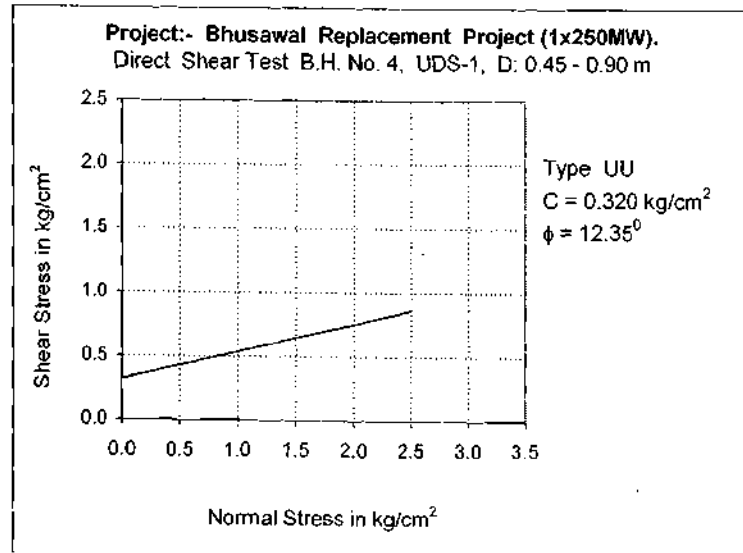


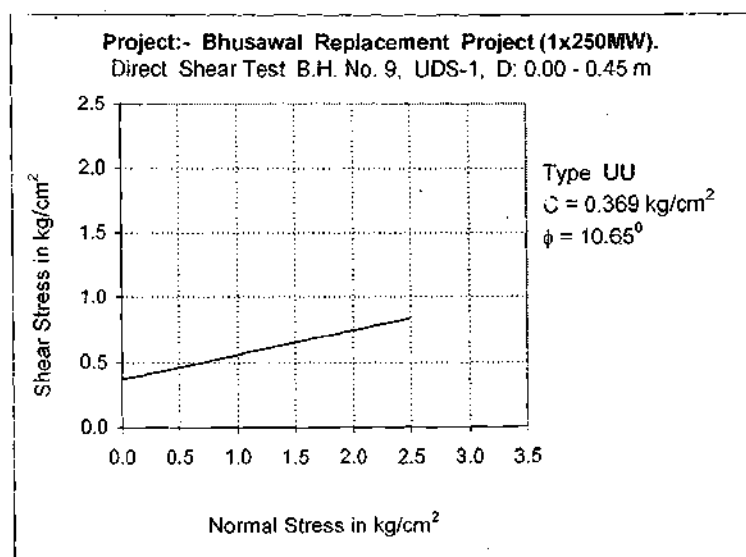
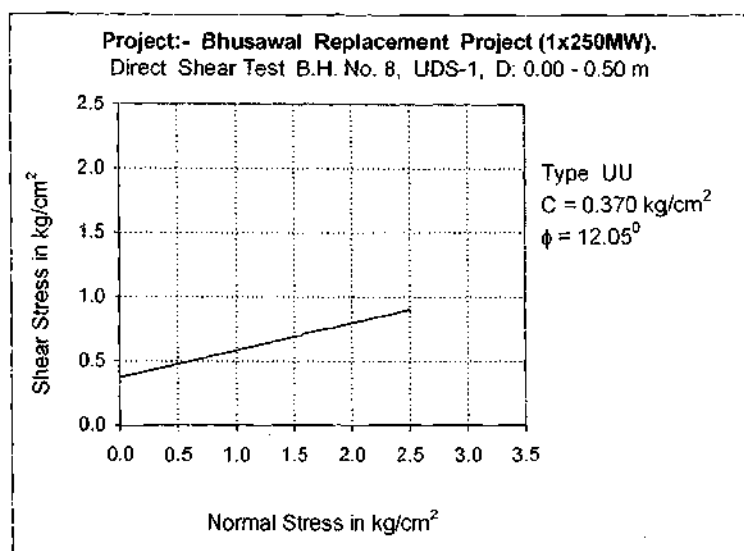
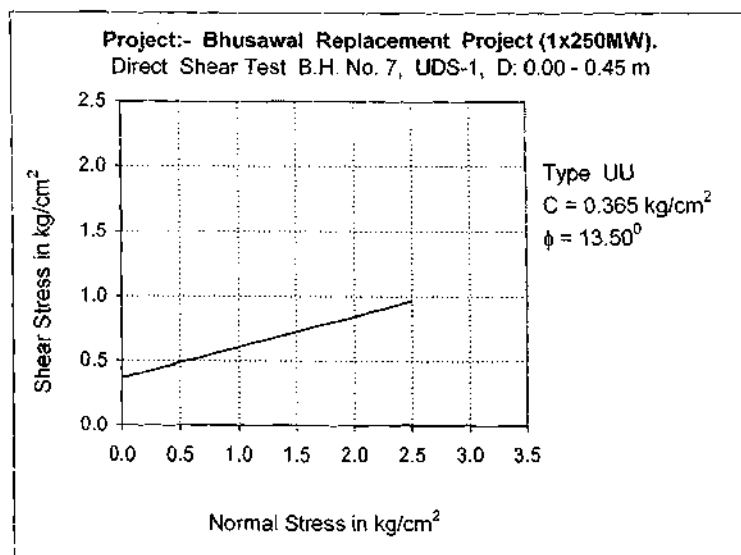


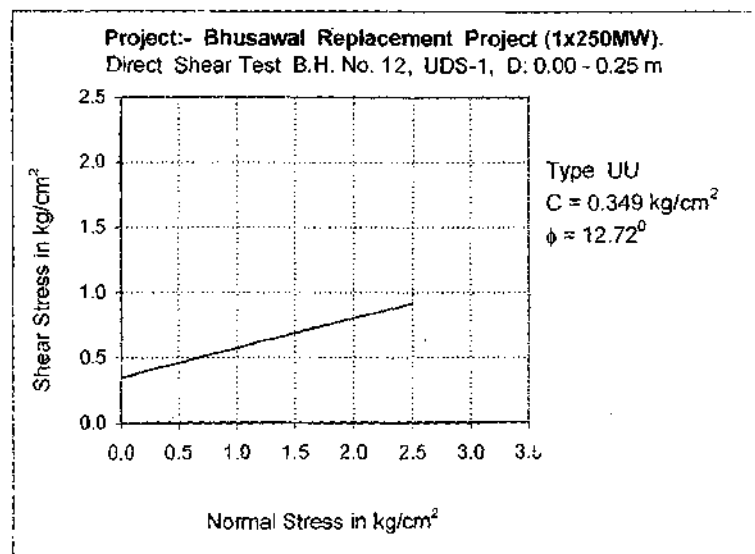
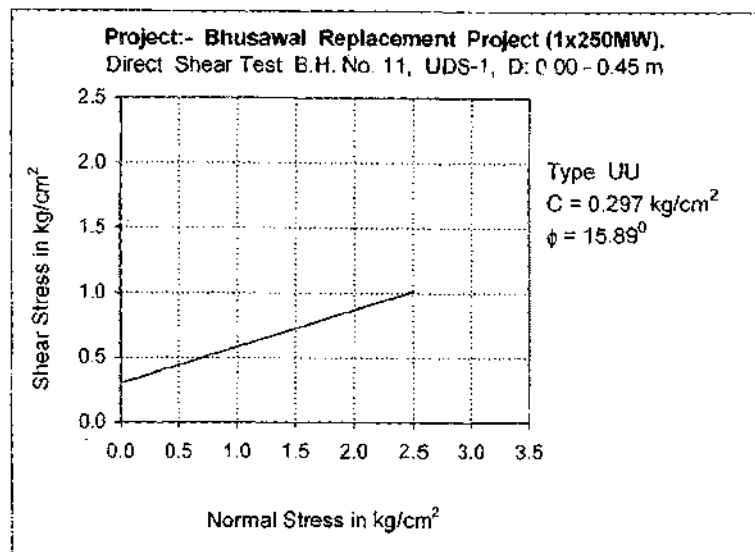
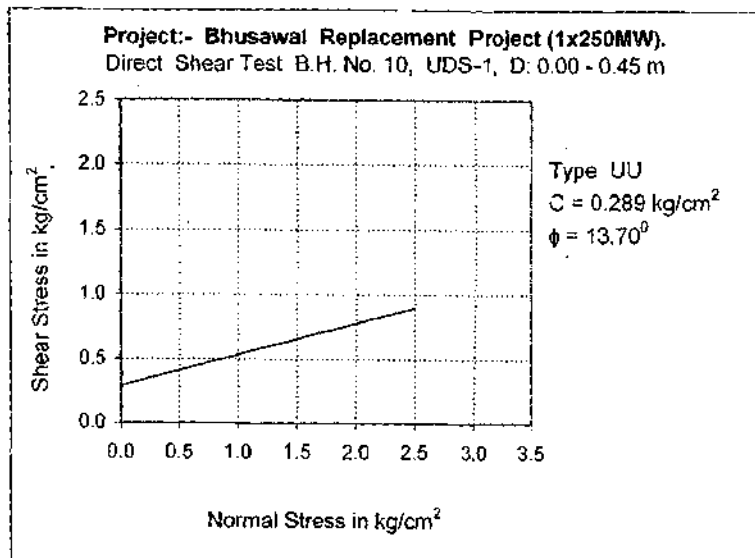


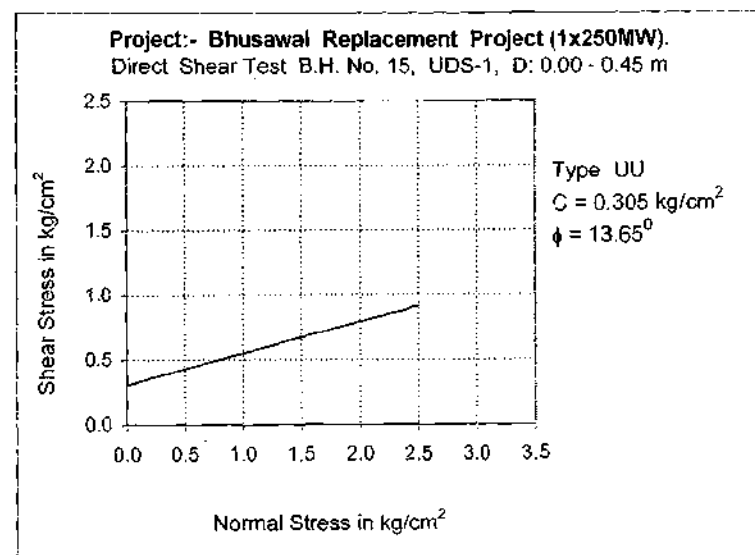
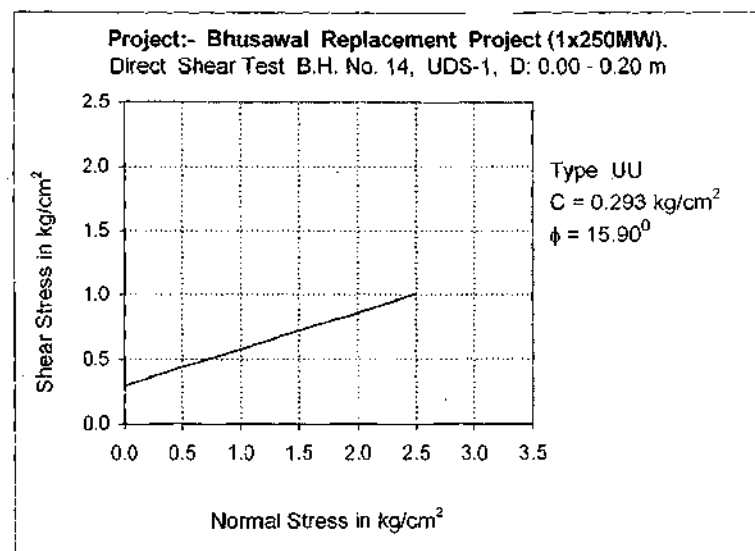
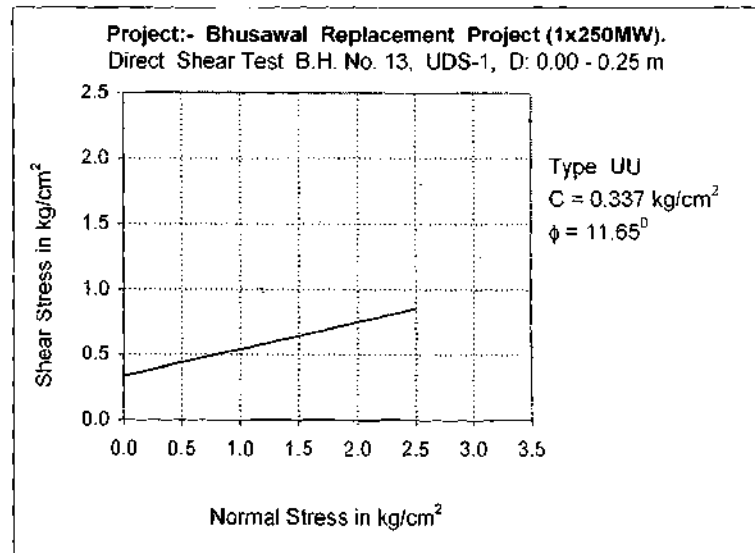


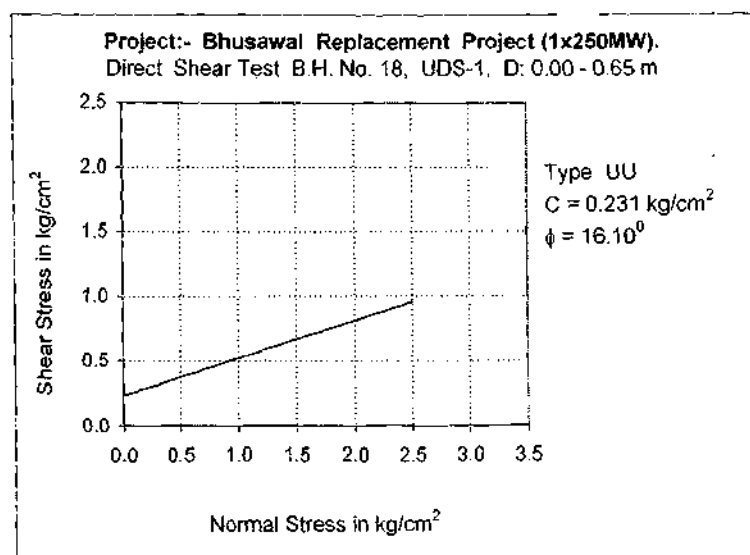
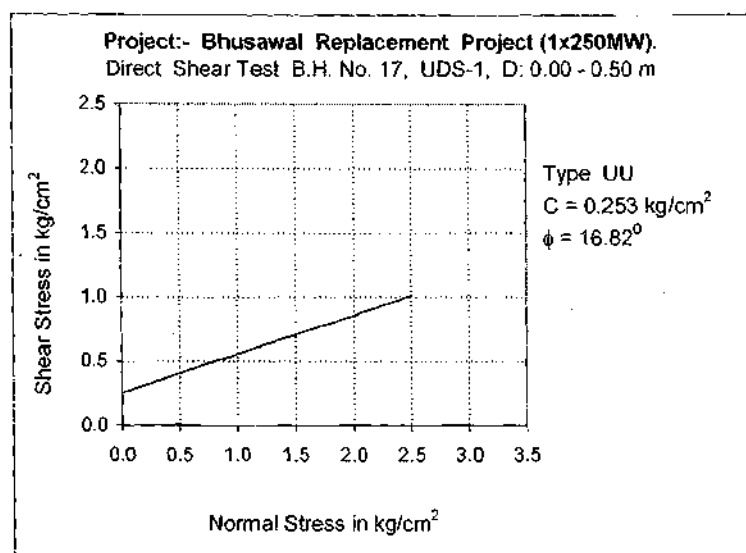
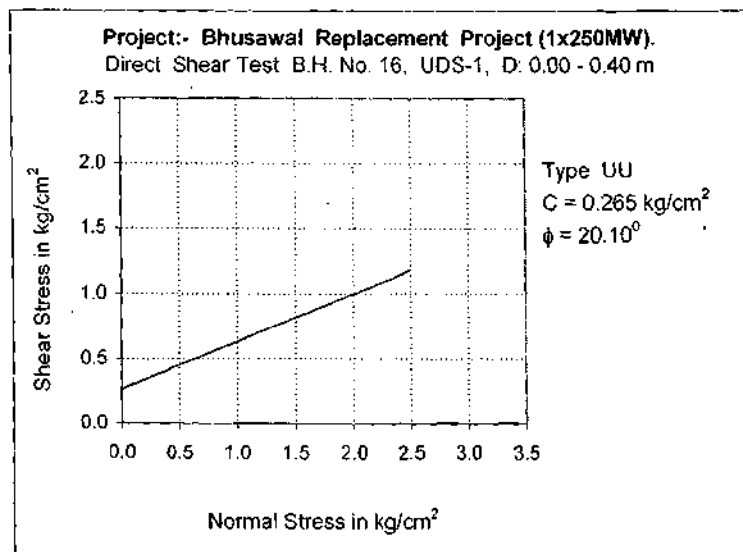


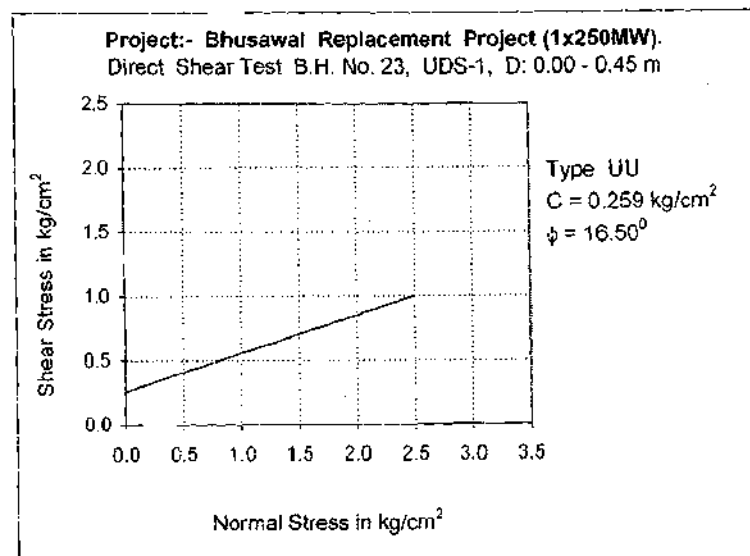
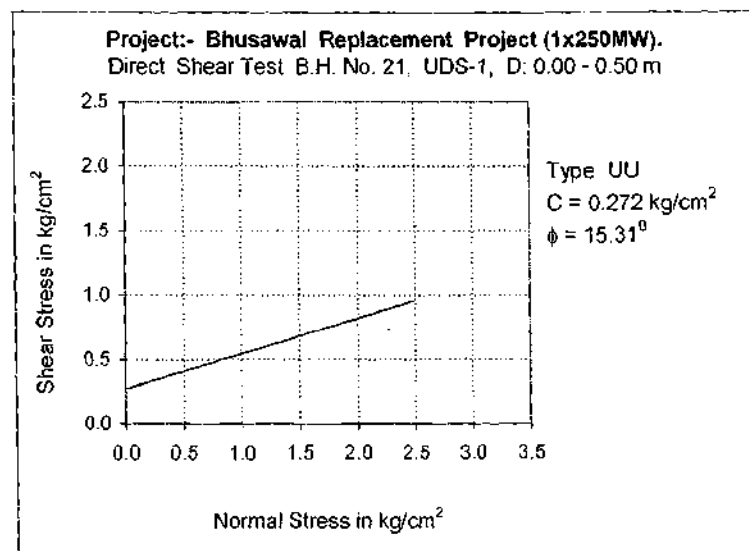
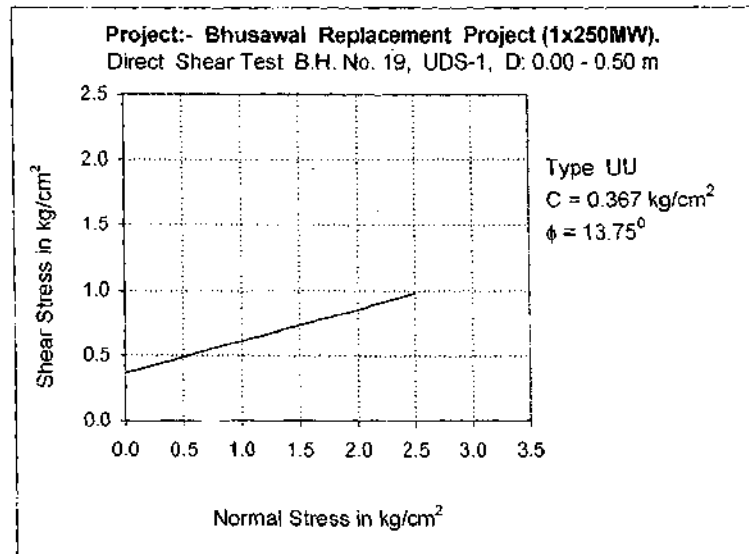


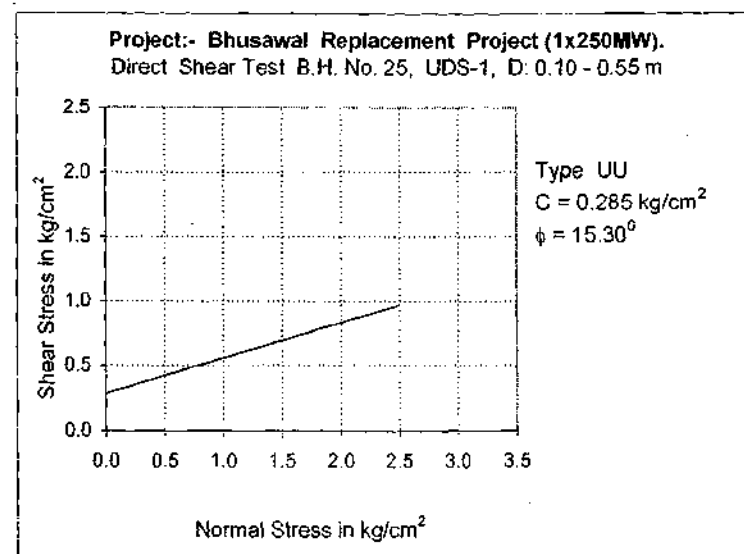
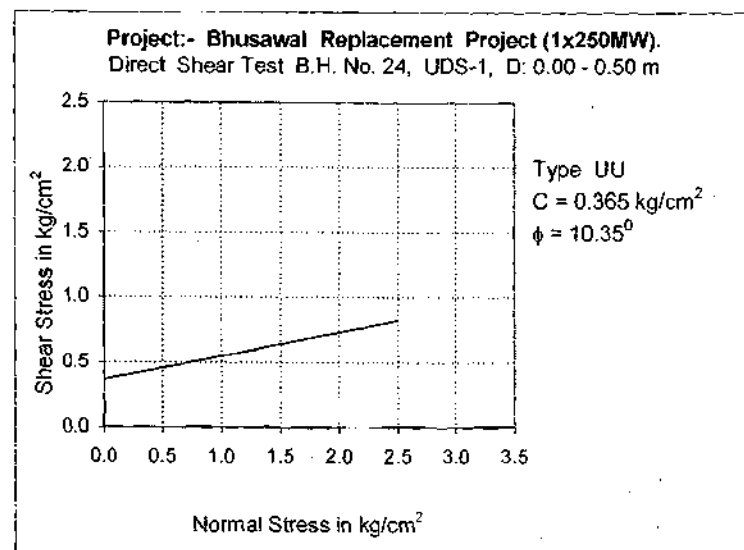
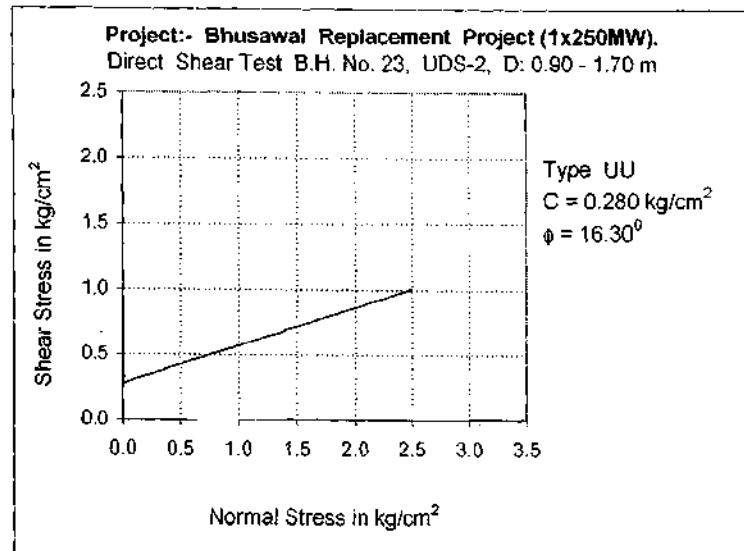


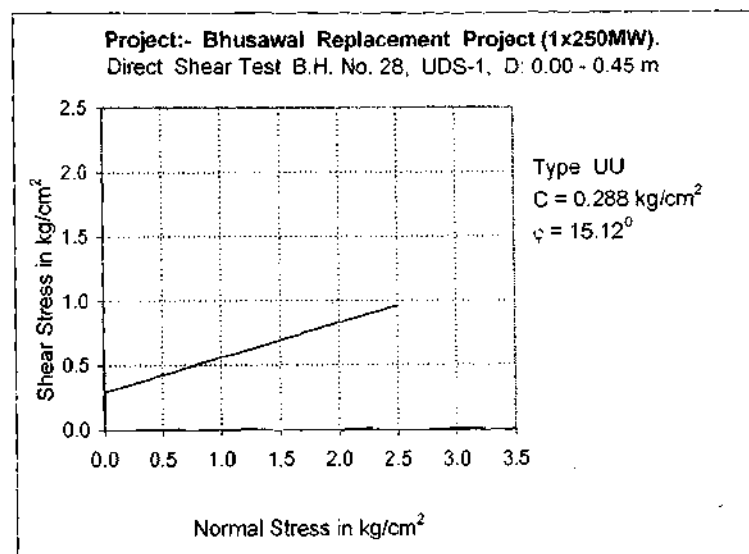
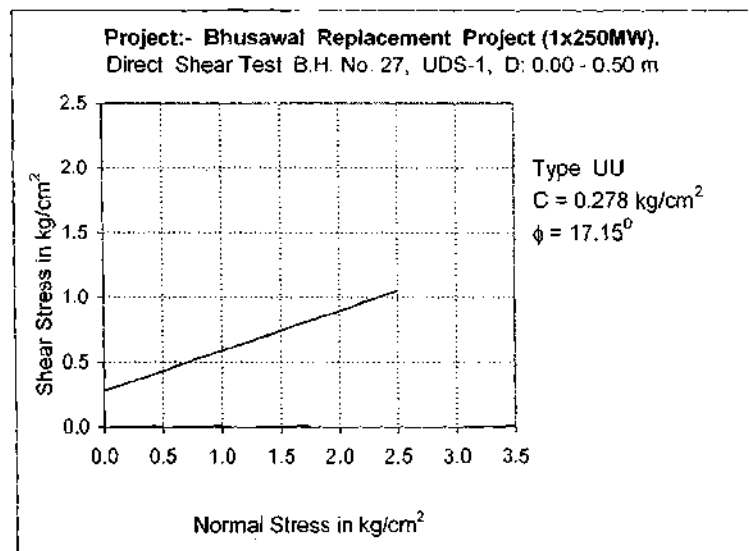
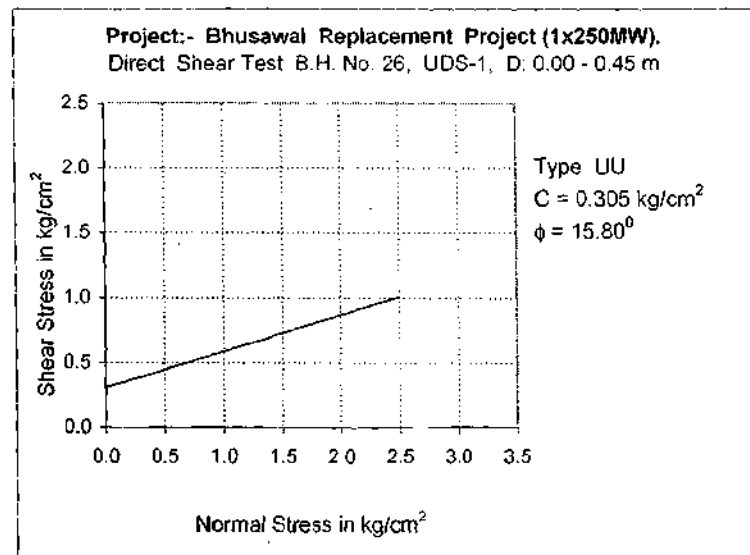


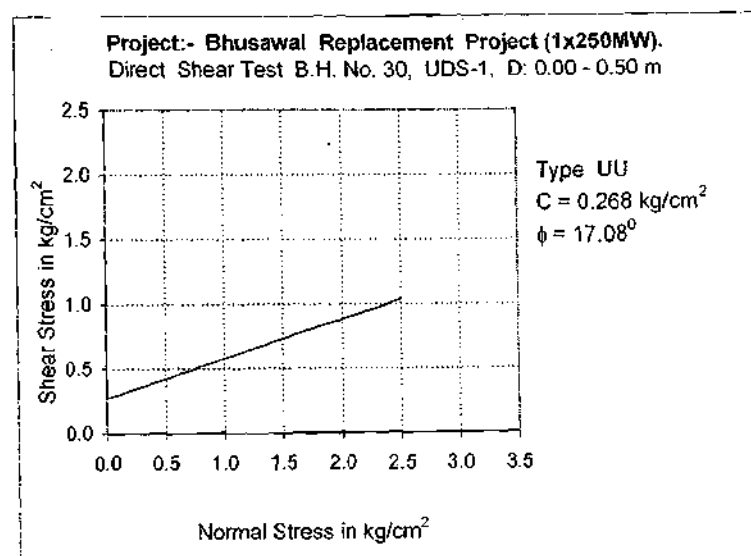
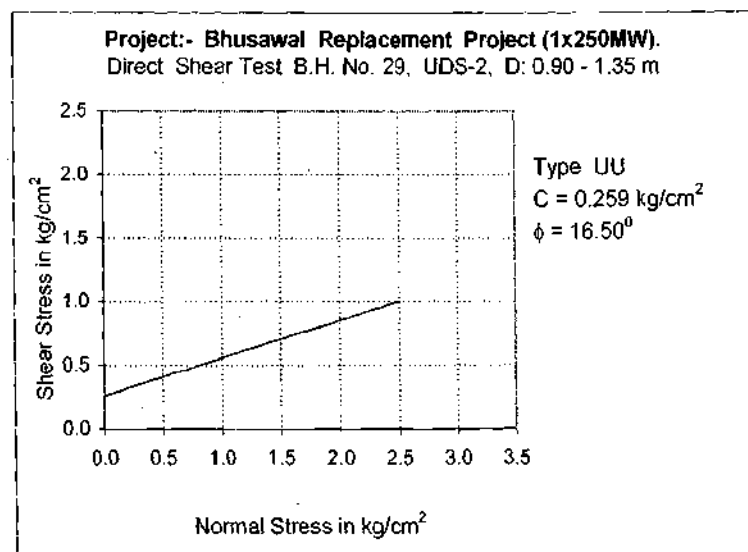
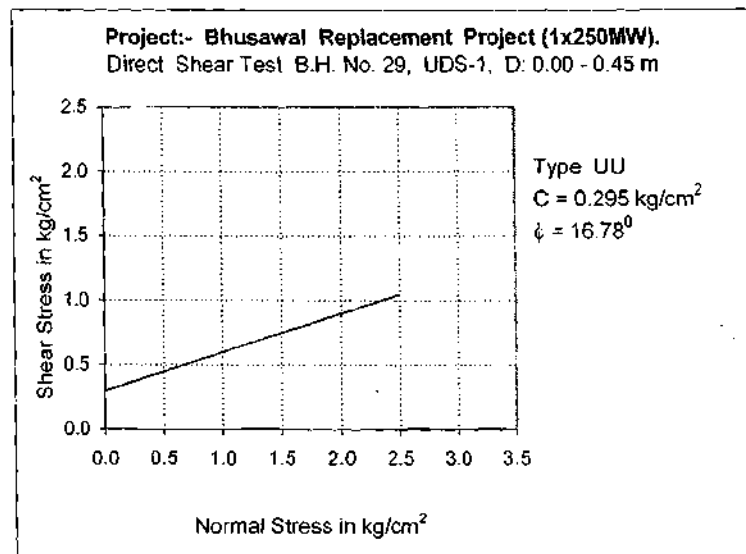


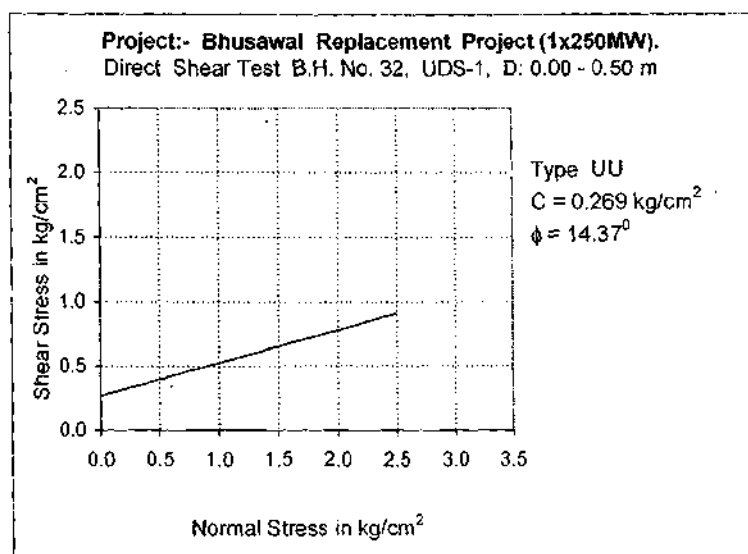
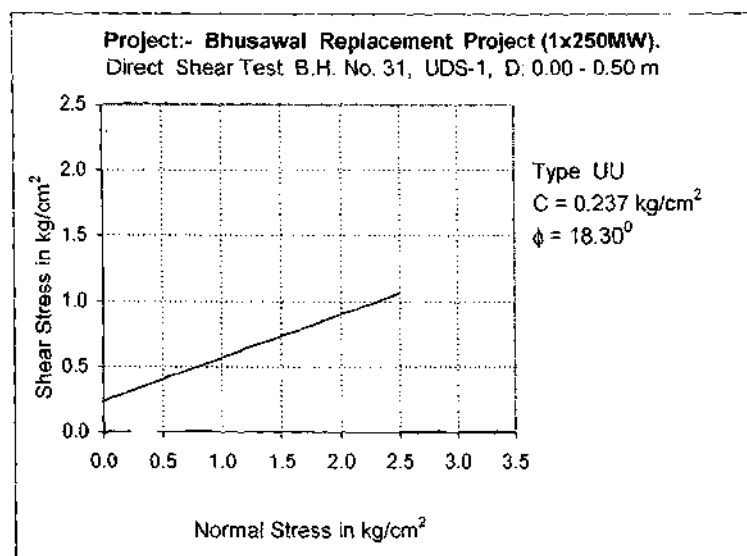


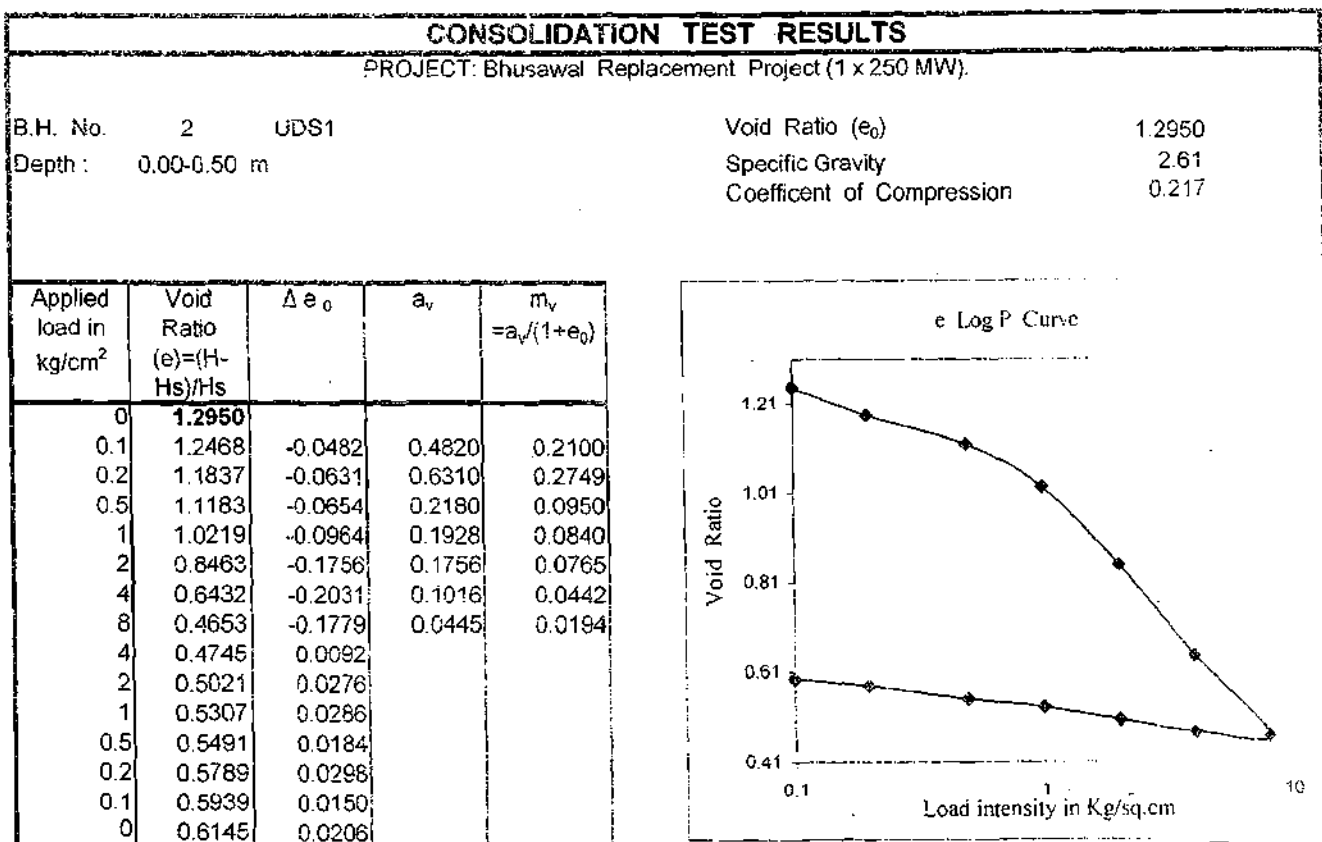
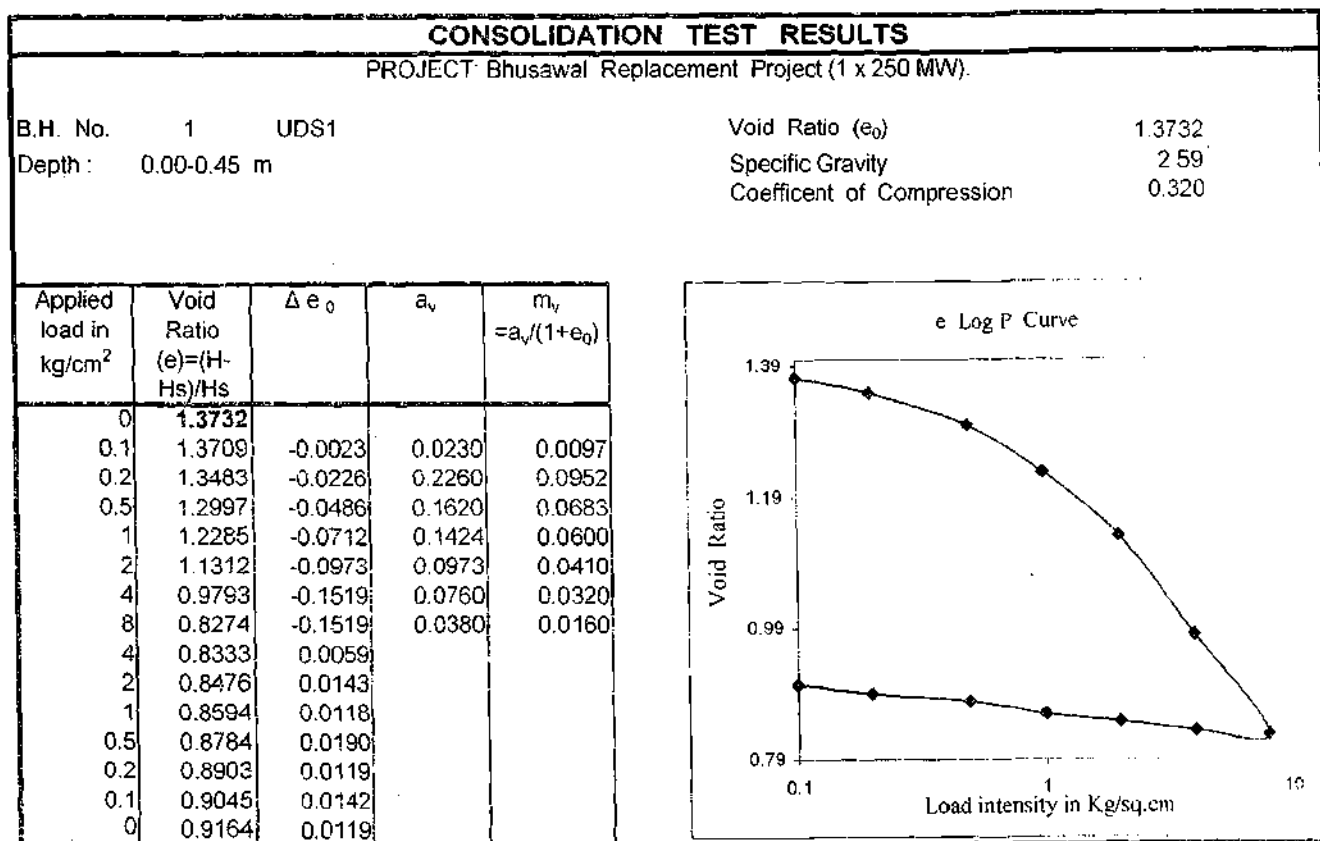












CONSOLIDATION TEST RESULTS

PROJECT: Bhusawal Replacement Project (1 x 250 MW).

B.H. No. 3 UDS1

Depth: 0.00-0.50 m

Void Ratio (e_0)

1.1826

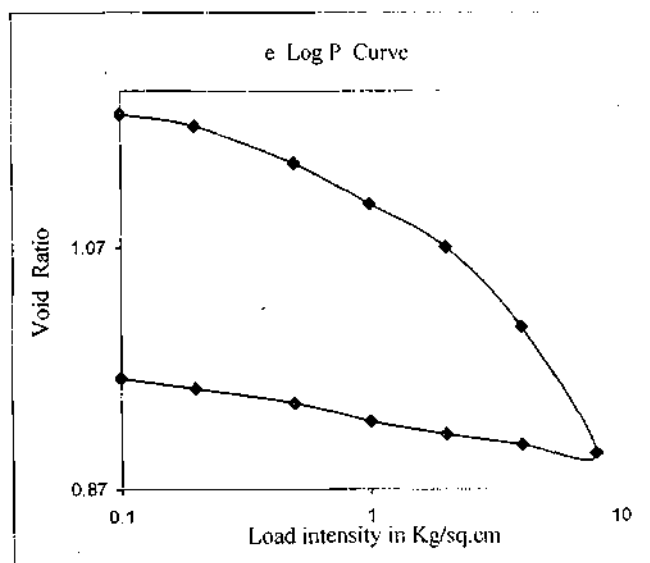
Specific Gravity

2.65

Coefficient of Compression

0.191

Applied load in kg/cm ²	Void Ratio (e)=(H-Hs)/Hs	Δe_0	a_v	m_v = $a_v/(1+e_0)$
0	1.1826			
0.1	1.1805	-0.0021	0.0210	0.0096
0.2	1.1706	-0.0099	0.0990	0.0454
0.5	1.1401	-0.0305	0.1017	0.0466
1	1.1063	-0.0338	0.0676	0.0310
2	1.0700	-0.0363	0.0363	0.0166
4	1.0037	-0.0663	0.0332	0.0152
8	0.8989	-0.1048	0.0262	0.0120
4	0.9065	0.0076		
2	0.9153	0.0088		
1	0.9262	0.0109		
0.5	0.9415	0.0153		
0.2	0.9535	0.0120		
0.1	0.9622	0.0087		
0	0.9775	0.0153		

**CONSOLIDATION TEST RESULTS**

PROJECT: Bhusawal Replacement Project (1 x 250 MW).

B.H. No. 4 UDS1

Depth: 0.45-0.90 m

Void Ratio (e_0)

1.2165

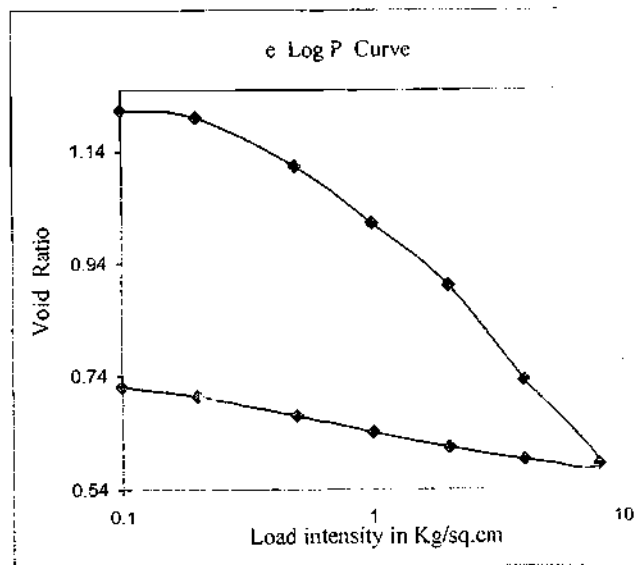
Specific Gravity

2.63

Coefficient of Compression

0.267

Applied load in kg/cm ²	Void Ratio (e)=(H-Hs)/Hs	Δe_0	a_v	m_v = $a_v/(1+e_0)$
0	1.2165			
0.1	1.2131	-0.0034	0.0340	0.0153
0.2	1.1998	-0.0133	0.1330	0.0600
0.5	1.1134	-0.0864	0.2880	0.1299
1	1.0114	-0.1020	0.2040	0.0920
2	0.9006	-0.1108	0.1108	0.0500
4	0.7322	-0.1684	0.0842	0.0380
8	0.5837	-0.1485	0.0371	0.0167
4	0.5914	0.0077		
2	0.6125	0.0211		
1	0.6391	0.0266		
0.5	0.6690	0.0299		
0.2	0.7033	0.0343		
0.1	0.7200	0.0167		
0	0.7377	0.0177		



CONSOLIDATION TEST RESULTS

PROJECT: Bhusawal Replacement Project (1 x 250 MW).

B.H. No. 5 UDS1

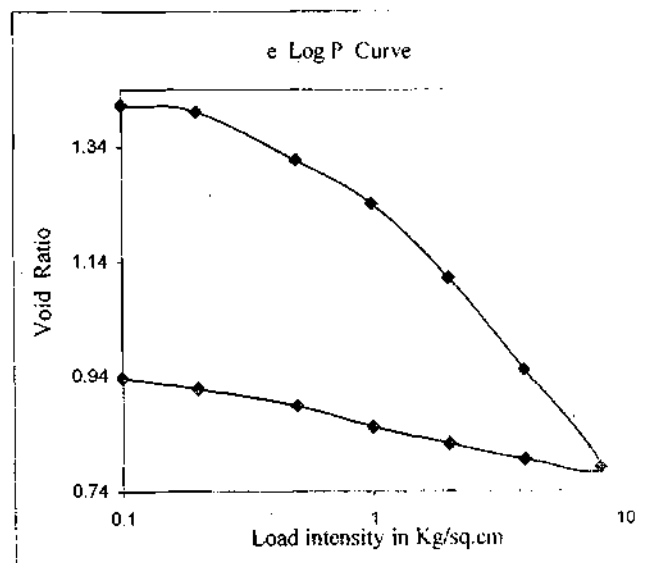
Depth: 0.00-0.45 m

Void Ratio (e_0) 1.4155

Specific Gravity 2.67

Coefficient of Compression 0.297

Applied load in kg/cm ²	Void Ratio (e)=(H-Hs)/Hs	Δe_0	a_v	$m_v = a_v/(1+e_0)$
0	1.4155			
0.1	1.4130	-0.0025	0.0250	0.0103
0.2	1.4010	-0.0120	0.1200	0.0497
0.5	1.3170	-0.0840	0.2800	0.1159
1	1.2403	-0.0767	0.1534	0.0635
2	1.1111	-0.1292	0.1292	0.0535
4	0.9505	-0.1606	0.0803	0.0332
8	0.7814	-0.1691	0.0423	0.0175
4	0.7947	0.0133		
2	0.8213	0.0266		
1	0.8514	0.0301		
0.5	0.8877	0.0363		
0.2	0.9179	0.0302		
0.1	0.9360	0.0181		
0	0.9577	0.0217		

**CONSOLIDATION TEST RESULTS**

PROJECT: Bhusawal Replacement Project (1 x 250 MW).

B.H. No. 6 UDS1

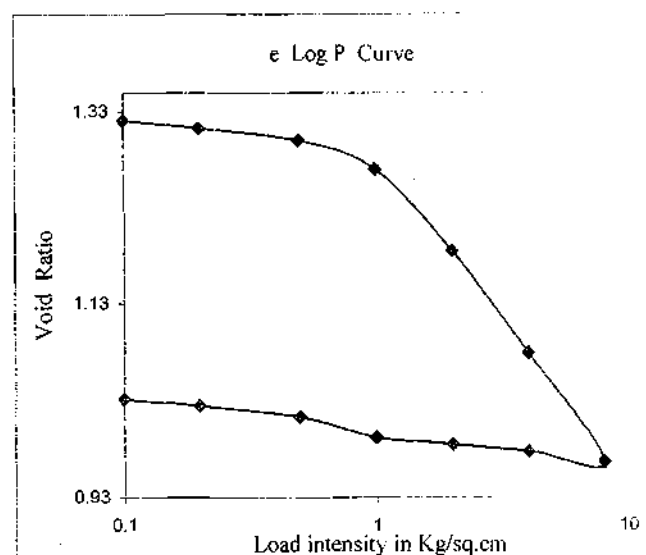
Depth: 0.50-0.95 m

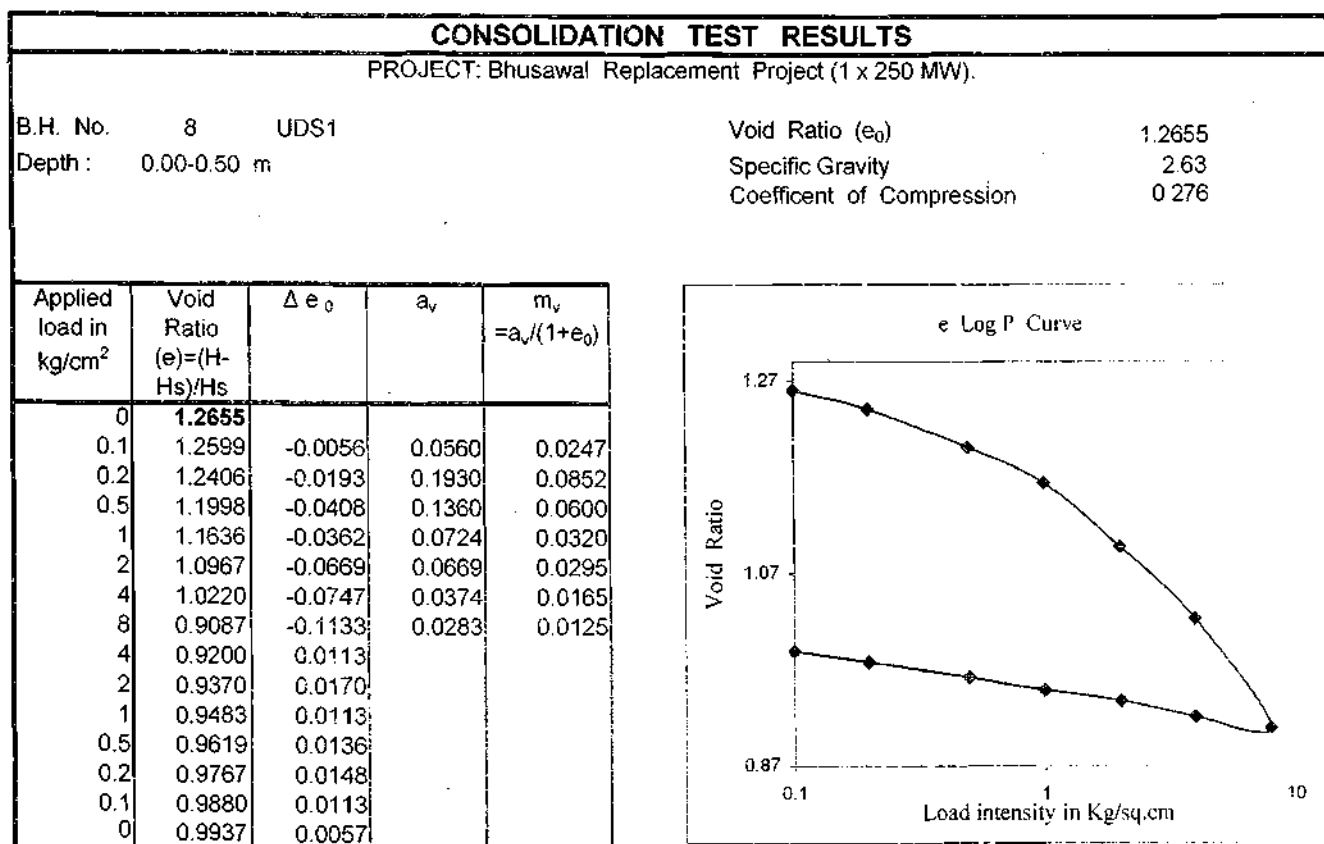
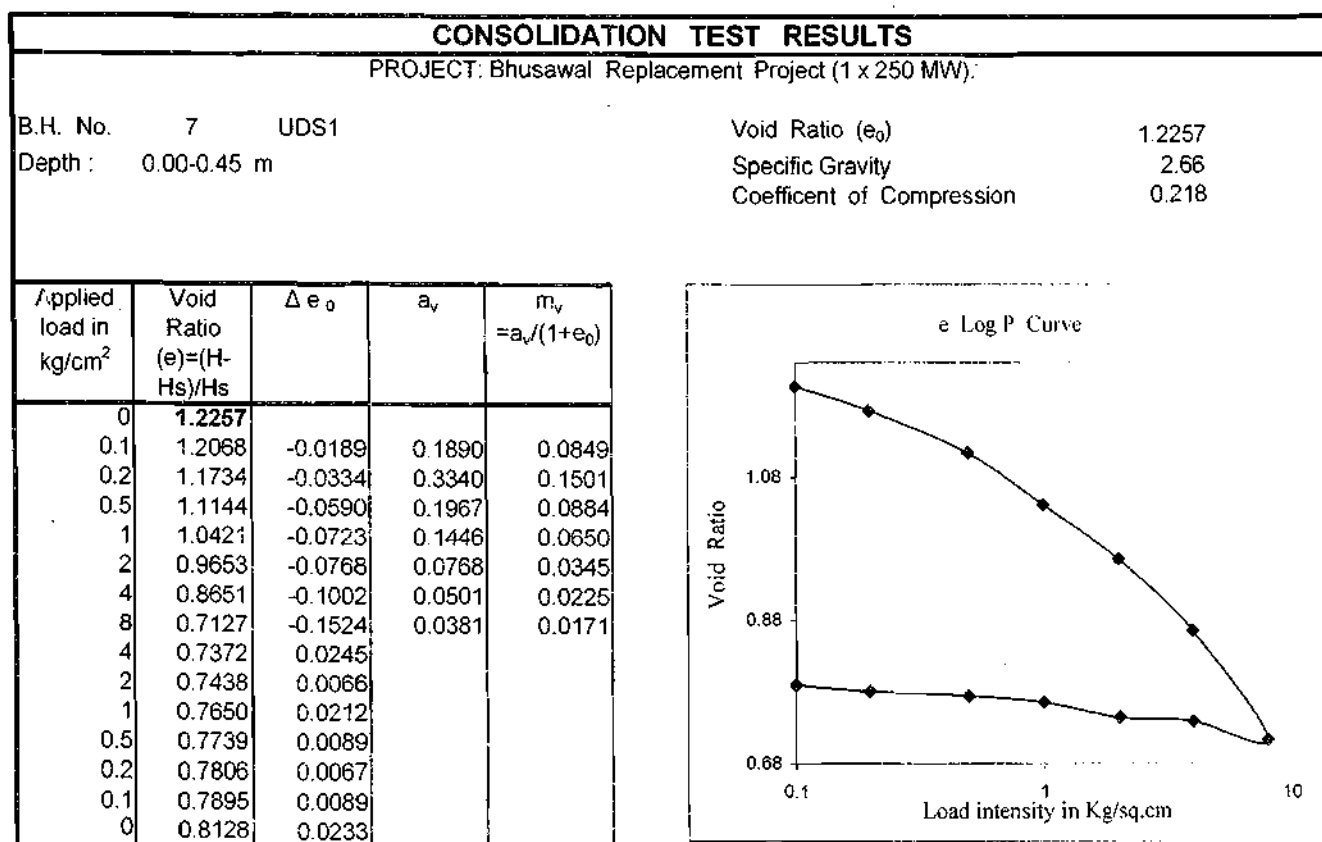
Void Ratio (e_0) 1.3220

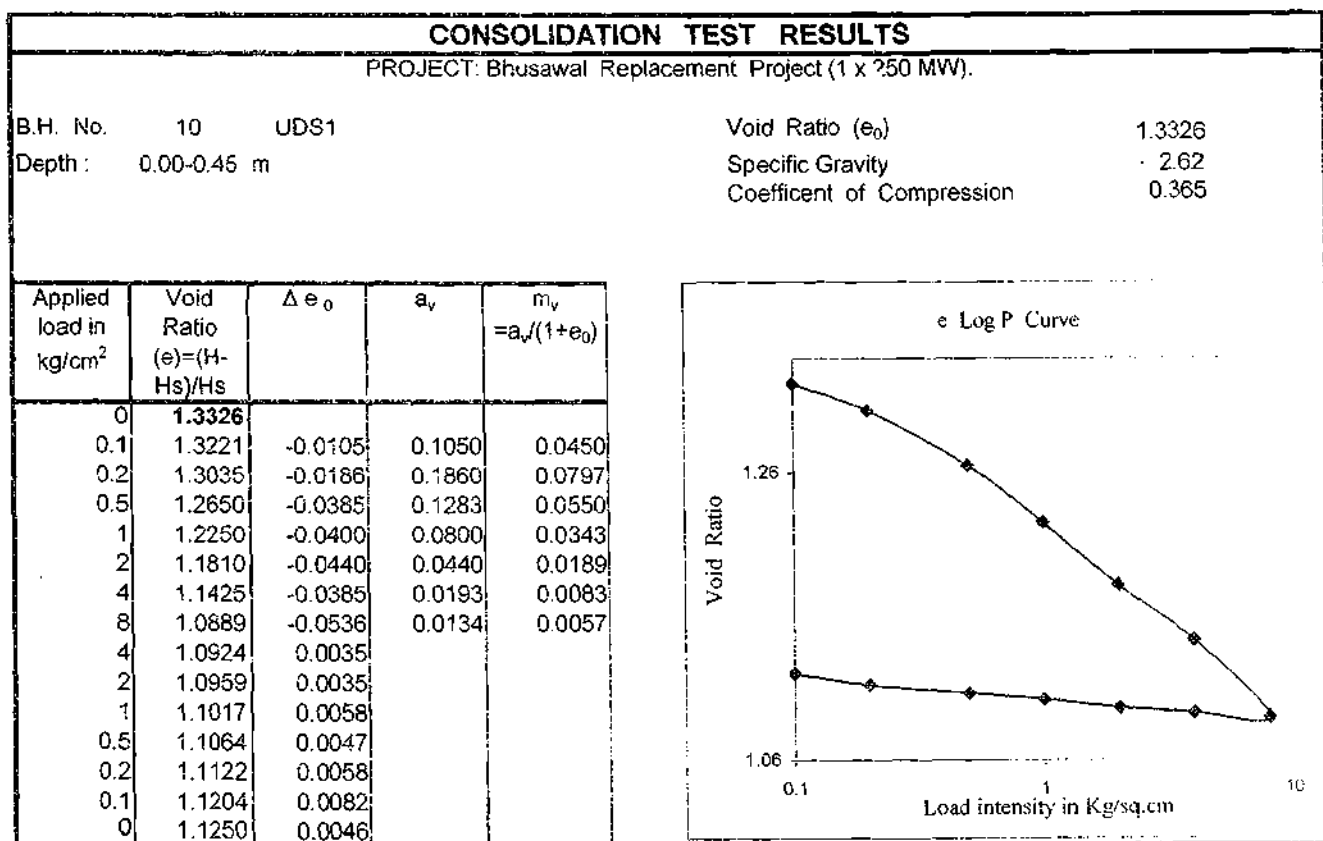
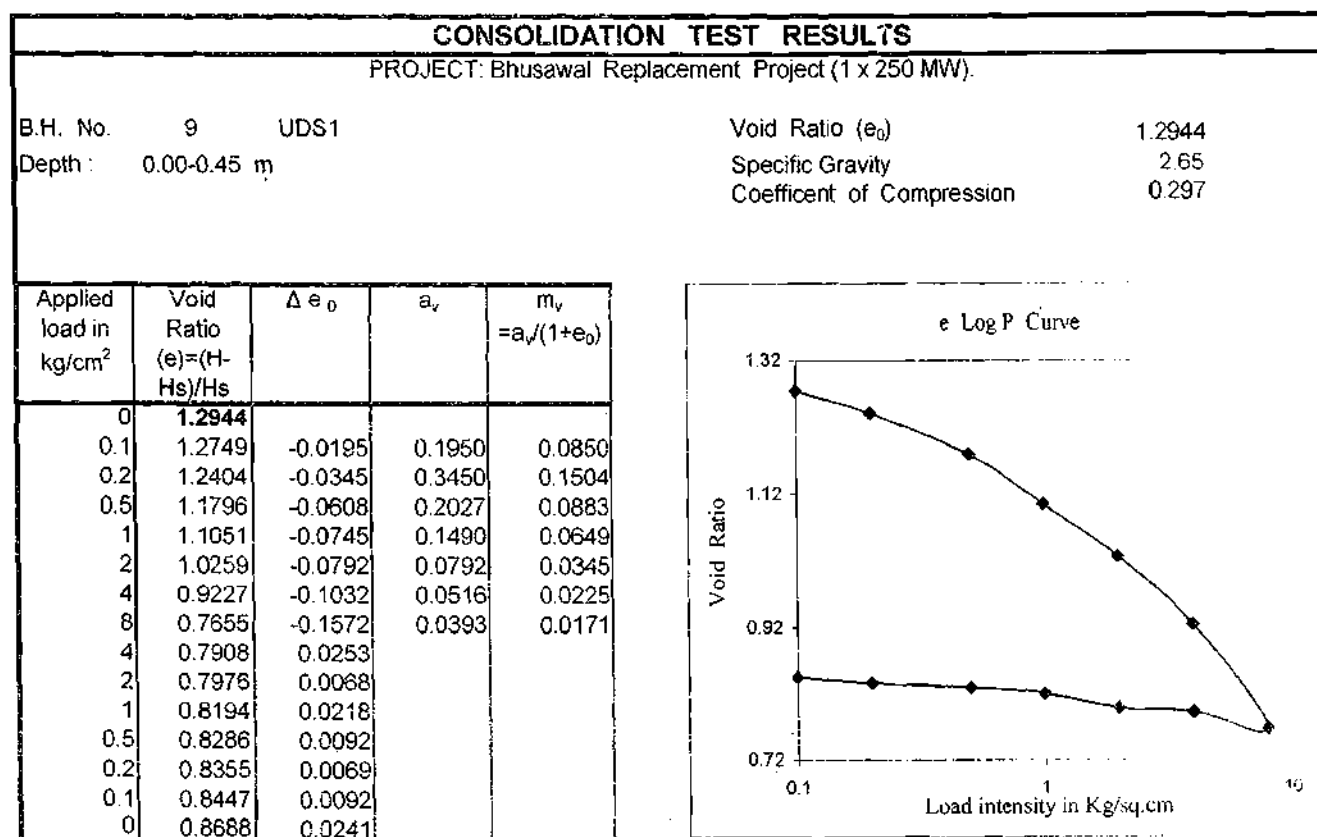
Specific Gravity 2.63

Coefficient of Compression 0.365

Applied load in kg/cm ²	Void Ratio (e)=(H-Hs)/Hs	Δe_0	a_v	$m_v = a_v/(1+e_0)$
0	1.3220			
0.1	1.3208	-0.0012	0.0120	0.0052
0.2	1.3128	-0.0080	0.0800	0.0345
0.5	1.3000	-0.0128	0.0427	0.0184
1	1.2698	-0.0302	0.0604	0.0260
2	1.1839	-0.0859	0.0859	0.0370
4	1.0782	-0.1057	0.0529	0.0228
8	0.9656	-0.1126	0.0282	0.0121
4	0.9761	0.0105		
2	0.9831	0.0070		
1	0.9912	0.0081		
0.5	1.0116	0.0204		
0.2	1.0237	0.0121		
0.1	1.0306	0.0069		
0	1.0480	0.0174		







CONSOLIDATION TEST RESULTS

PROJECT: Bhusawal Replacement Project (1 x 250 MW).

B.H. No. 11 UDS1

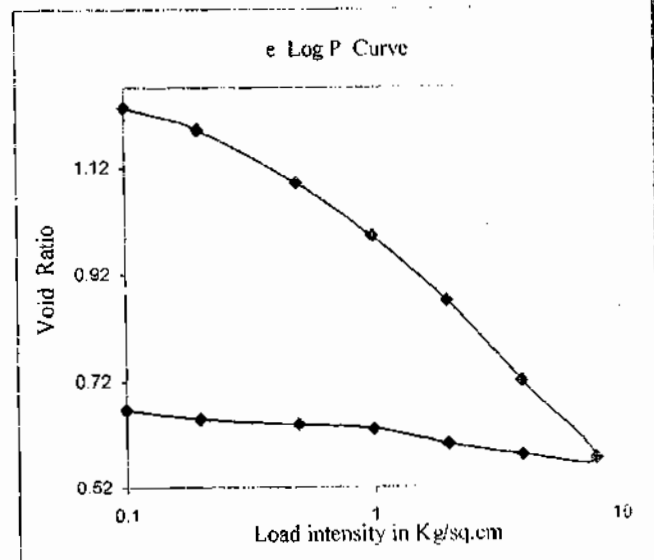
Depth: 0.00-0.45 m

Void Ratio (e_0) 1.2367

Specific Gravity 2.59

Coefficient of Compression 0.312

Applied load in kg/cm ²	Void Ratio (e)=($H-H_s$)/ H_s	Δe_0	a_v	m_v = $a_v/(1+e_0)$
0	1.2367			
0.1	1.2322	-0.0045	0.0450	0.0201
0.2	1.1908	-0.0414	0.4140	0.1851
0.5	1.0902	-0.1006	0.3353	0.1499
1	0.9906	-0.0996	0.1992	0.0891
2	0.8687	-0.1219	0.1219	0.0545
4	0.7178	-0.1509	0.0755	0.0337
8	0.5724	-0.1454	0.0364	0.0163
4	0.5802	0.0078		
2	0.6014	0.0212		
1	0.6294	0.0280		
0.5	0.6384	0.0090		
0.2	0.6495	0.0111		
0.1	0.6663	0.0168		
0	0.6820	0.0157		

**CONSOLIDATION TEST RESULTS**

PROJECT: Bhusawal Replacement Project (1 x 250 MW).

B.H. No. 12 UDS1

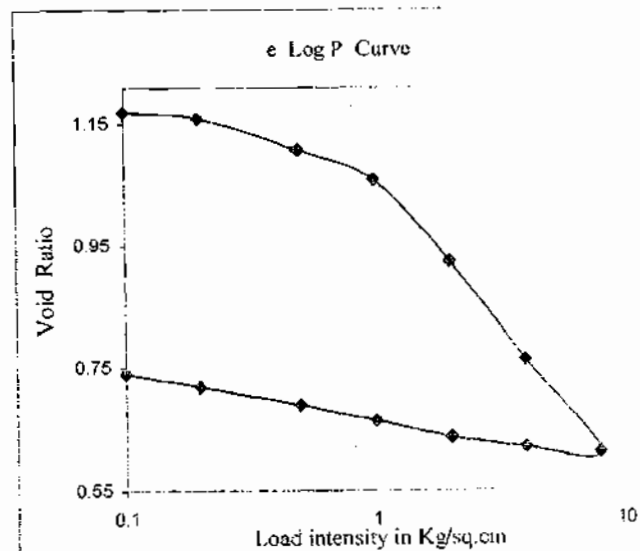
Depth: 0.00-0.25 m

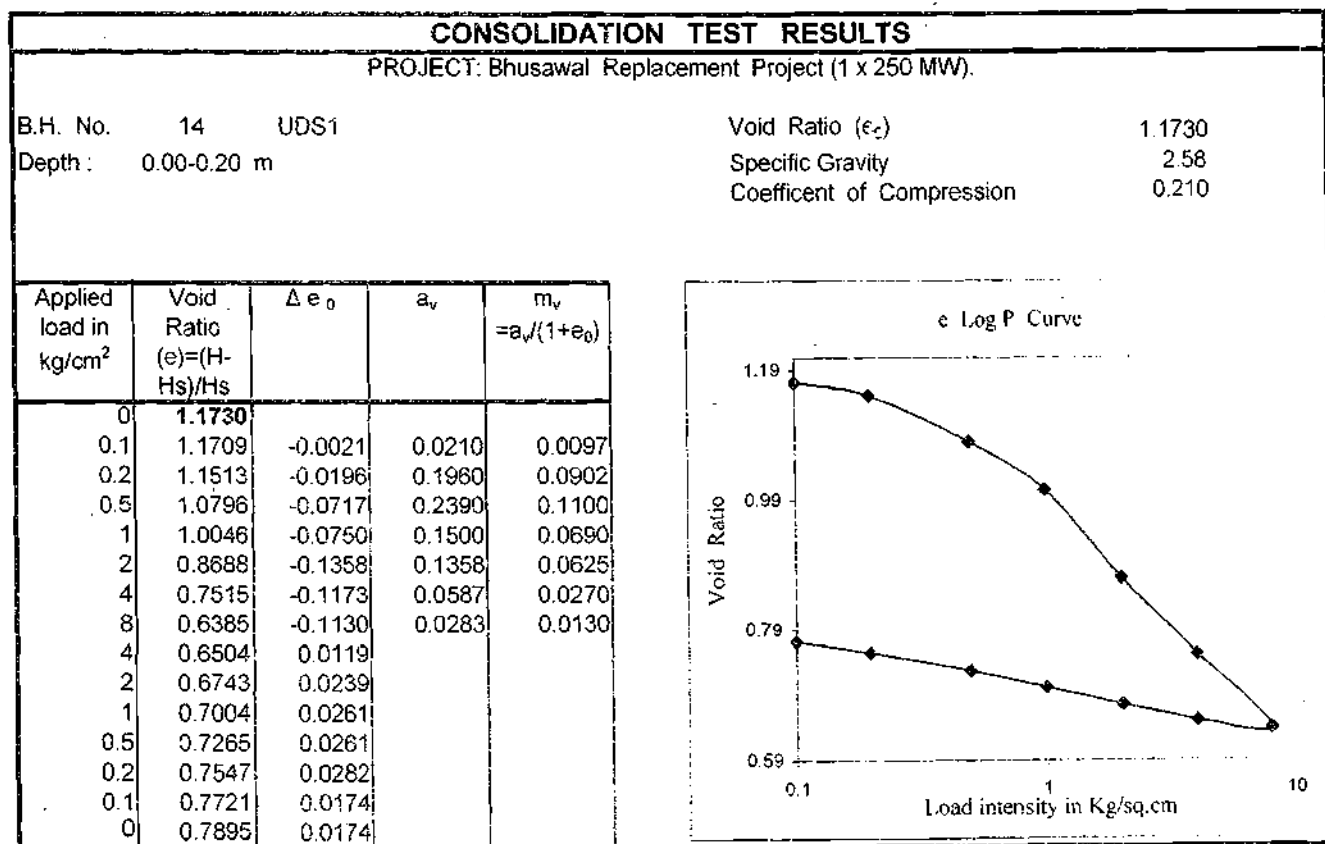
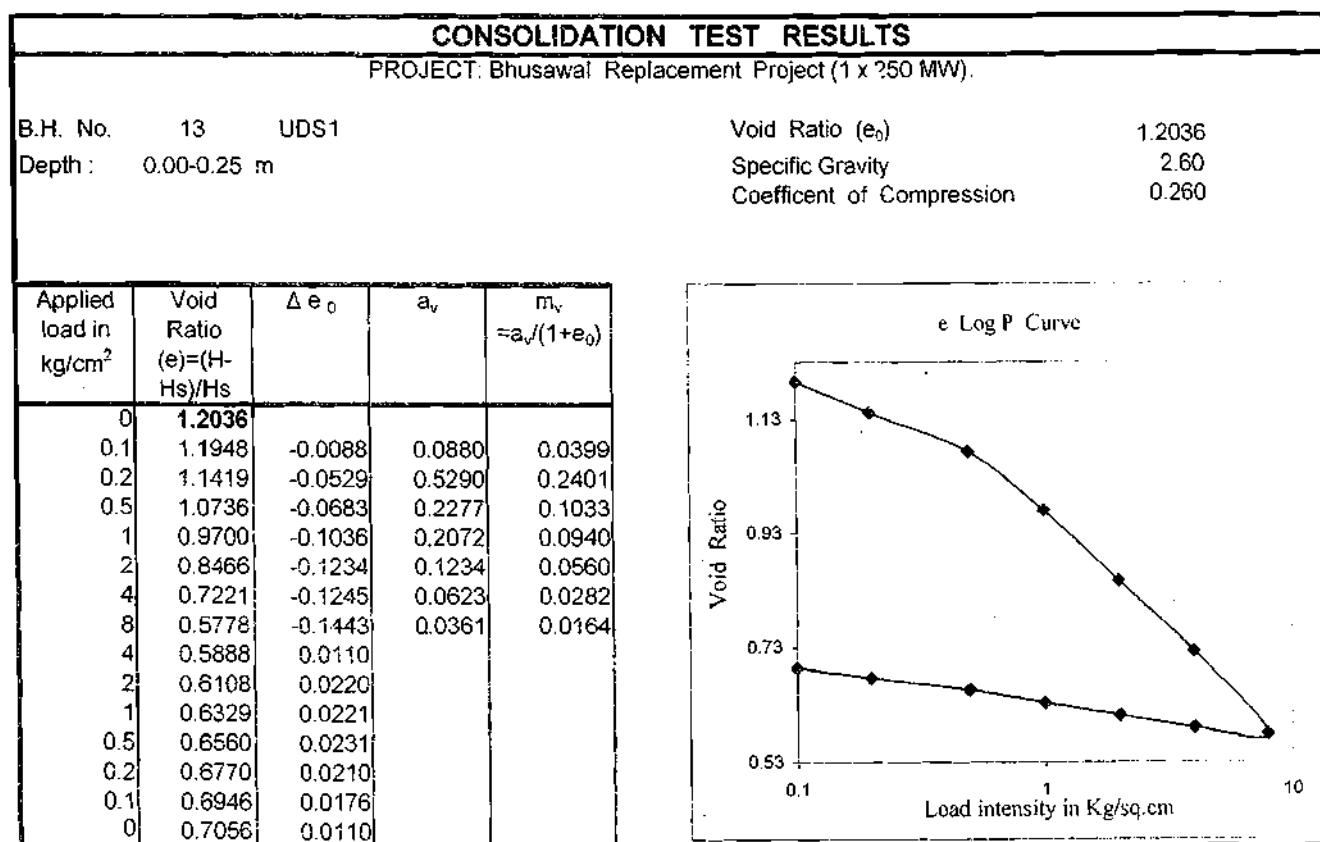
Void Ratio (e_0) 1.1725

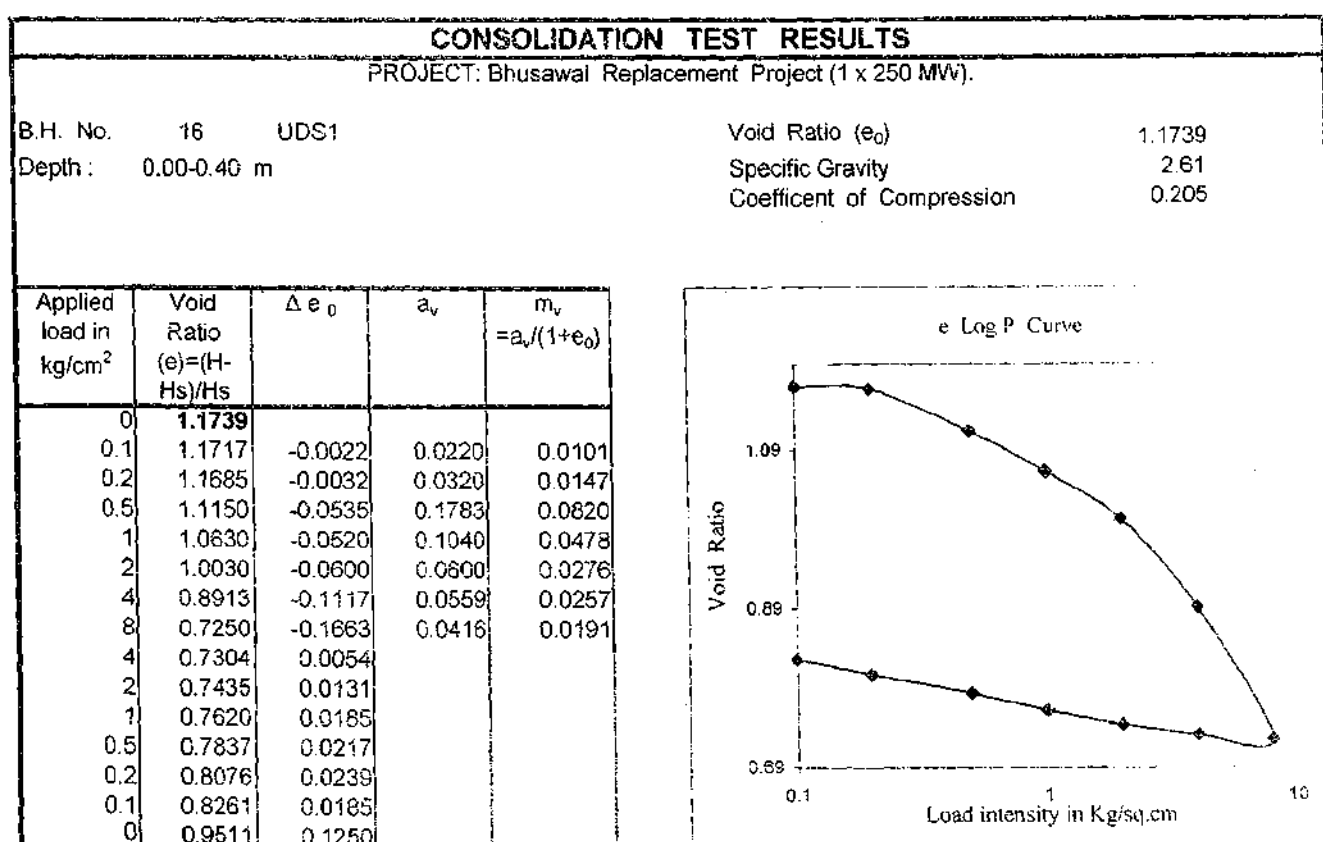
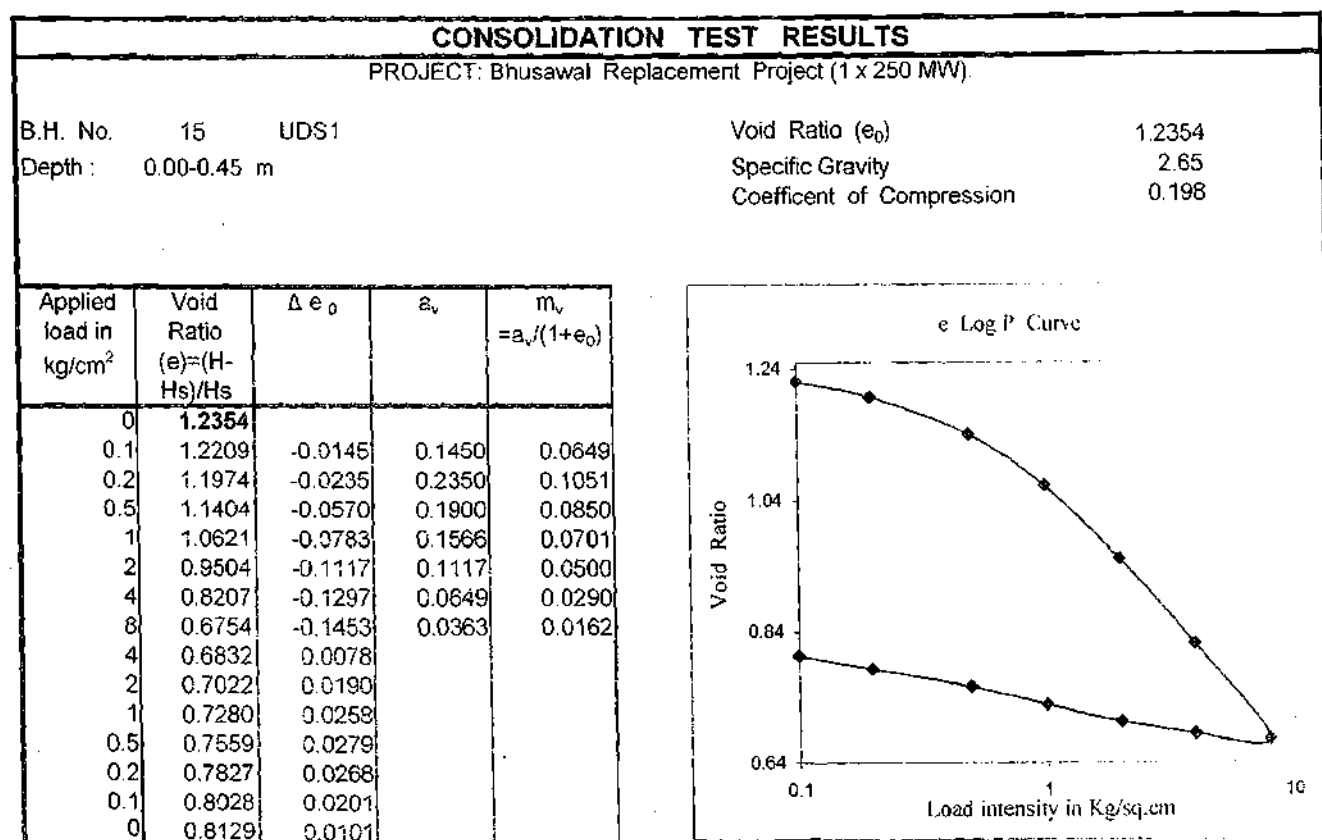
Specific Gravity 2.64

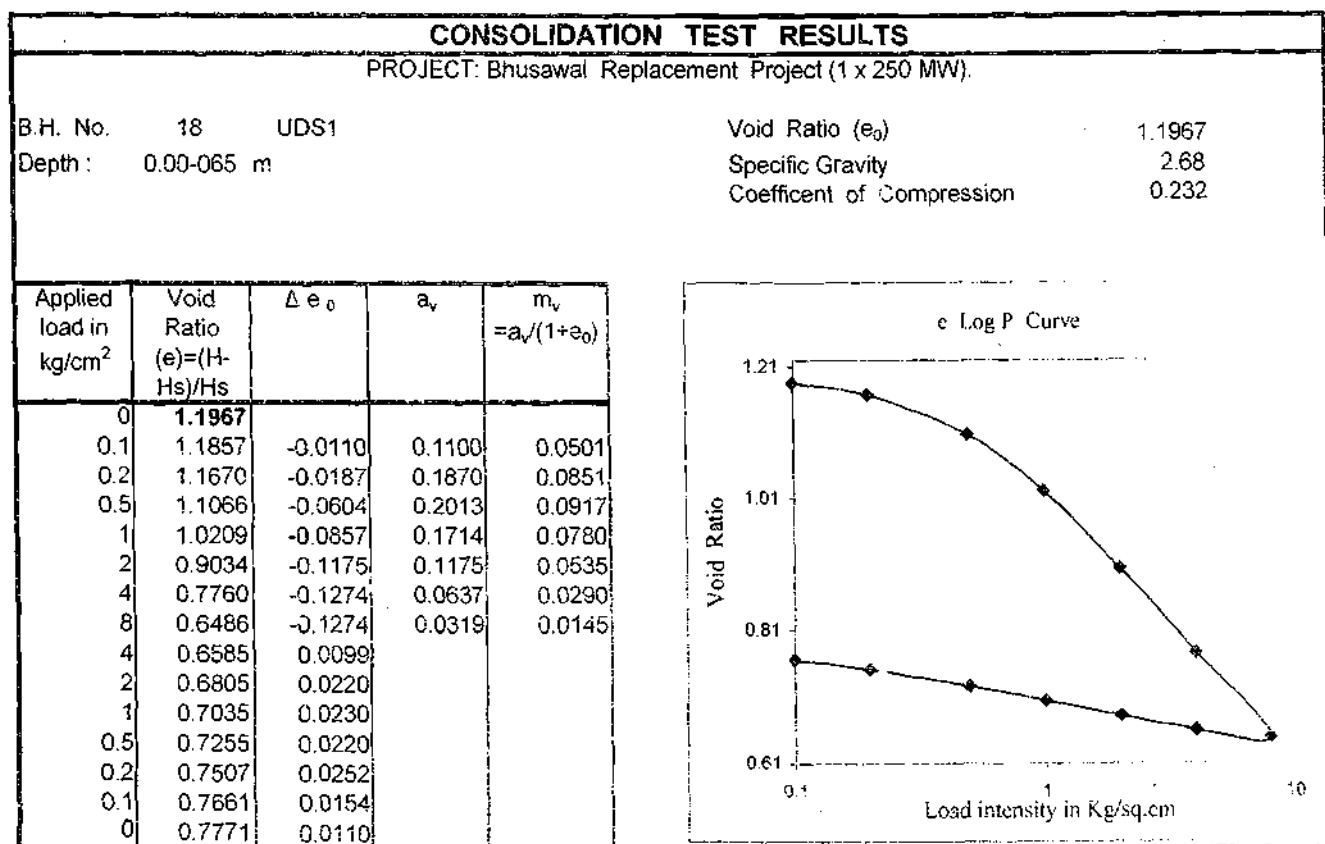
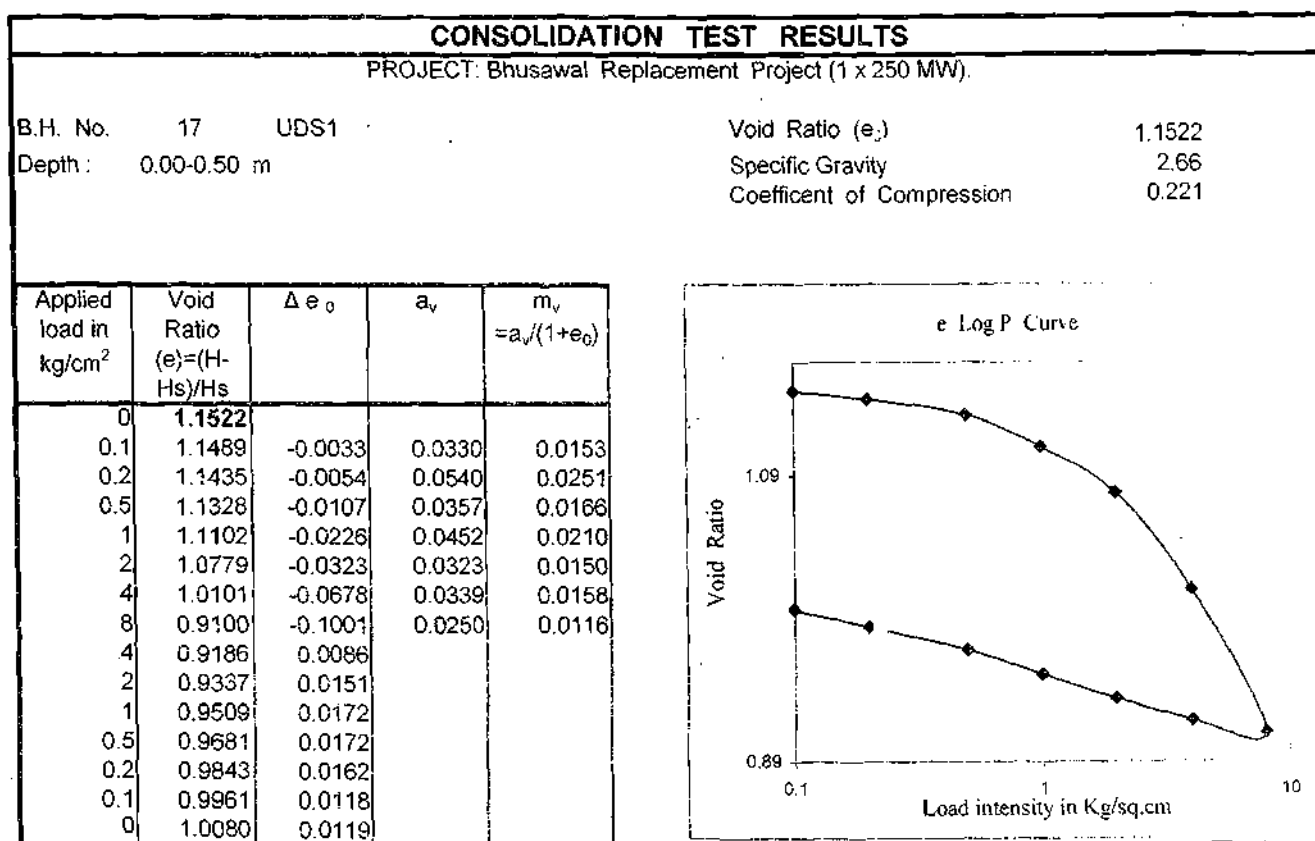
Coefficient of Compression 0.217

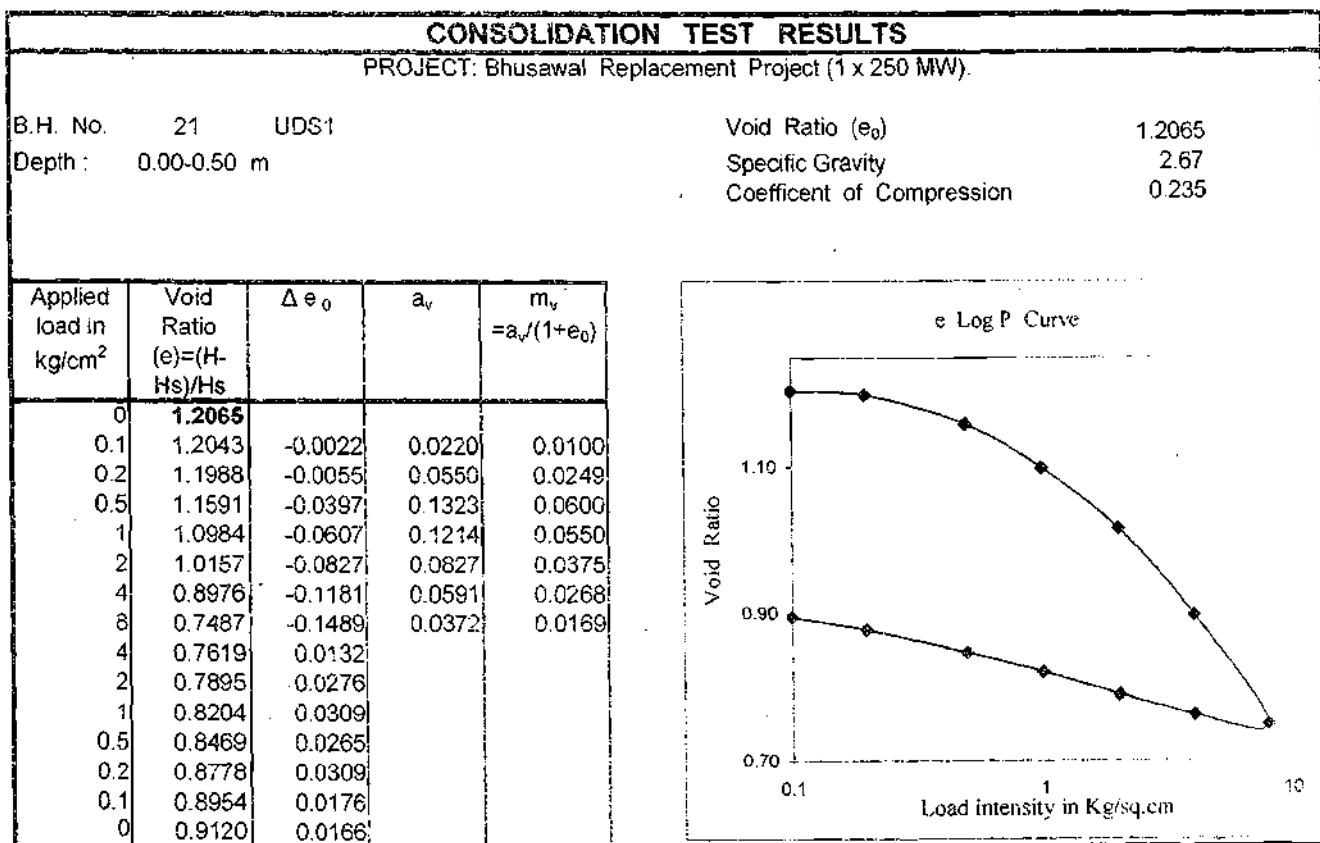
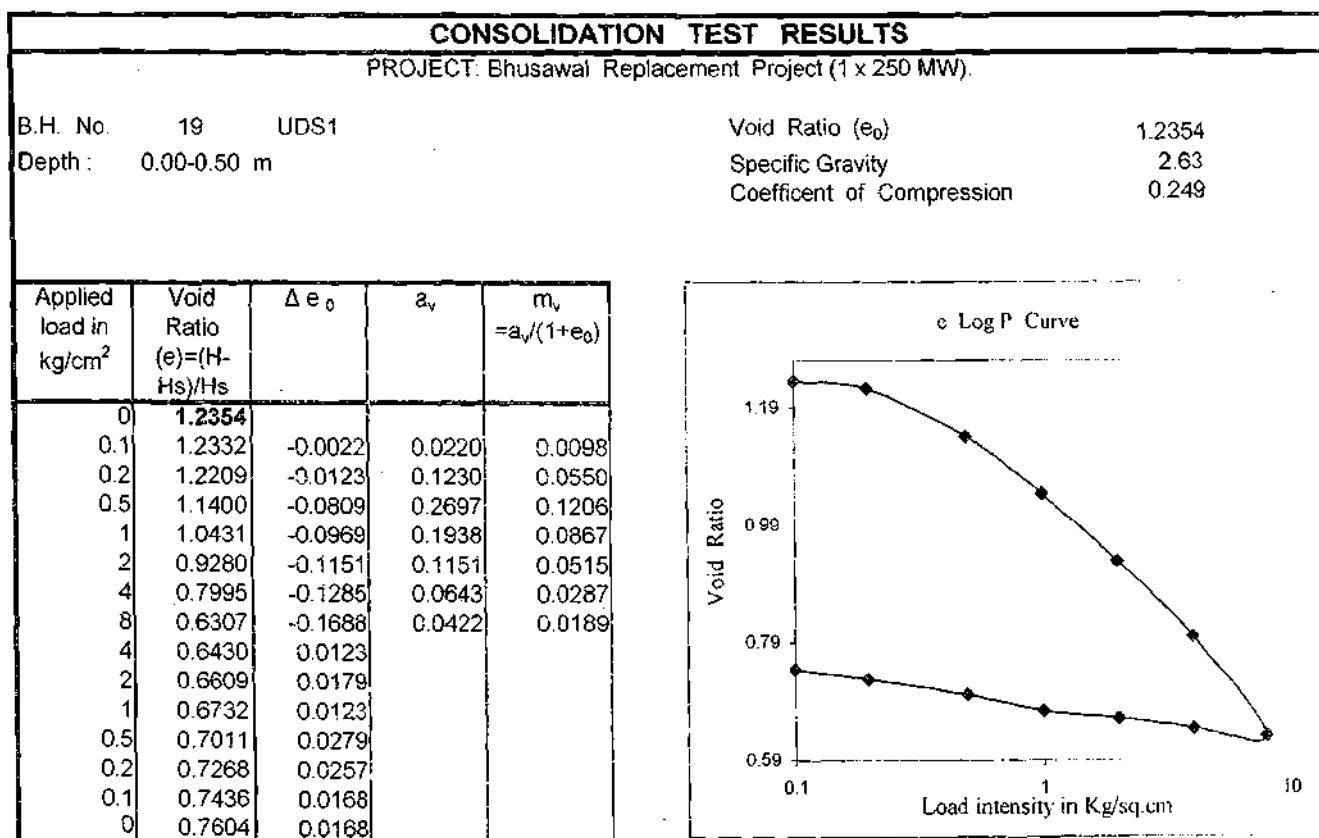
Applied load in kg/cm ²	Void Ratio (e)=($H-H_s$)/ H_s	Δe_0	a_v	m_v = $a_v/(1+e_0)$
0	1.1725			
0.1	1.1692	-0.0033	0.0330	0.0152
0.2	1.1584	-0.0108	0.1080	0.0497
0.5	1.1073	-0.0511	0.1703	0.0784
1	1.0574	-0.0499	0.0998	0.0459
2	0.9227	-0.1347	0.1347	0.0620
4	0.7608	-0.1619	0.0810	0.0373
8	0.6109	-0.1499	0.0375	0.0172
4	0.6185	0.0076		
2	0.6359	0.0174		
1	0.6630	0.0271		
0.5	0.6891	0.0261		
0.2	0.7184	0.0293		
0.1	0.7391	0.0207		
0	0.7673	0.0282		











CONSOLIDATION TEST RESULTS

PROJECT: Bhusawal Replacement Project (1 x 250 MW).

B.H. No. 23 UDS1

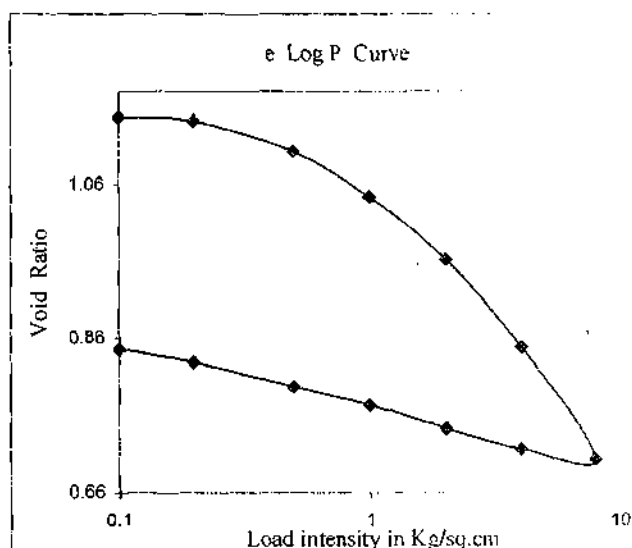
Depth: 0.00-0.45 m

Void Ratio (e_0) 1.1487

Specific Gravity 2.62

Coefficient of Compression 0.187

Applied load in kg/cm ²	Void Ratio (e)=(H-Hs)/Hs	Δe_0	a_v	$m_v = a_v/(1+e_0)$
0	1.1487			
0.1	1.1465	-0.0022	0.0220	0.0102
0.2	1.1412	-0.0053	0.0530	0.0247
0.5	1.1025	-0.0387	0.1290	0.0600
1	1.0434	-0.0591	0.1182	0.0550
2	0.9628	-0.0806	0.0806	0.0375
4	0.8479	-0.1149	0.0575	0.0267
8	0.7028	-0.1451	0.0363	0.0169
4	0.7157	0.0129		
2	0.7426	0.0269		
1	0.7727	0.0301		
0.5	0.7963	0.0236		
0.2	0.8285	0.0322		
0.1	0.8457	0.0172		
0	0.8586	0.0129		



CONSOLIDATION TEST RESULTS

PROJECT: Bhusawal Replacement Project (1 x 250 MW).

B.H. No. 23 UDS2

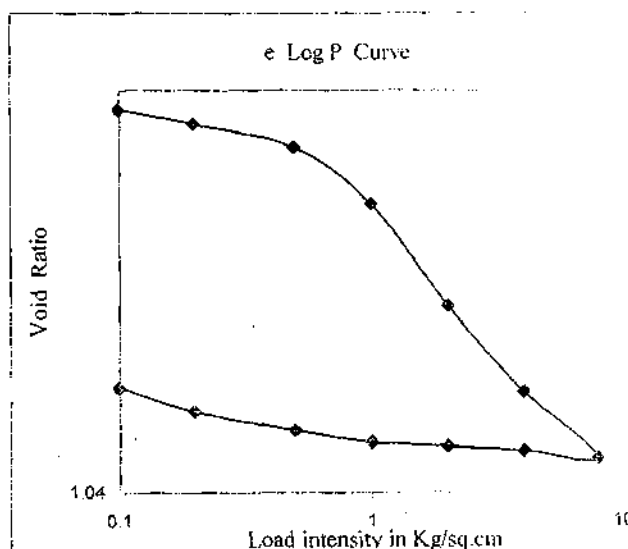
Depth: 0.90-1.70 m

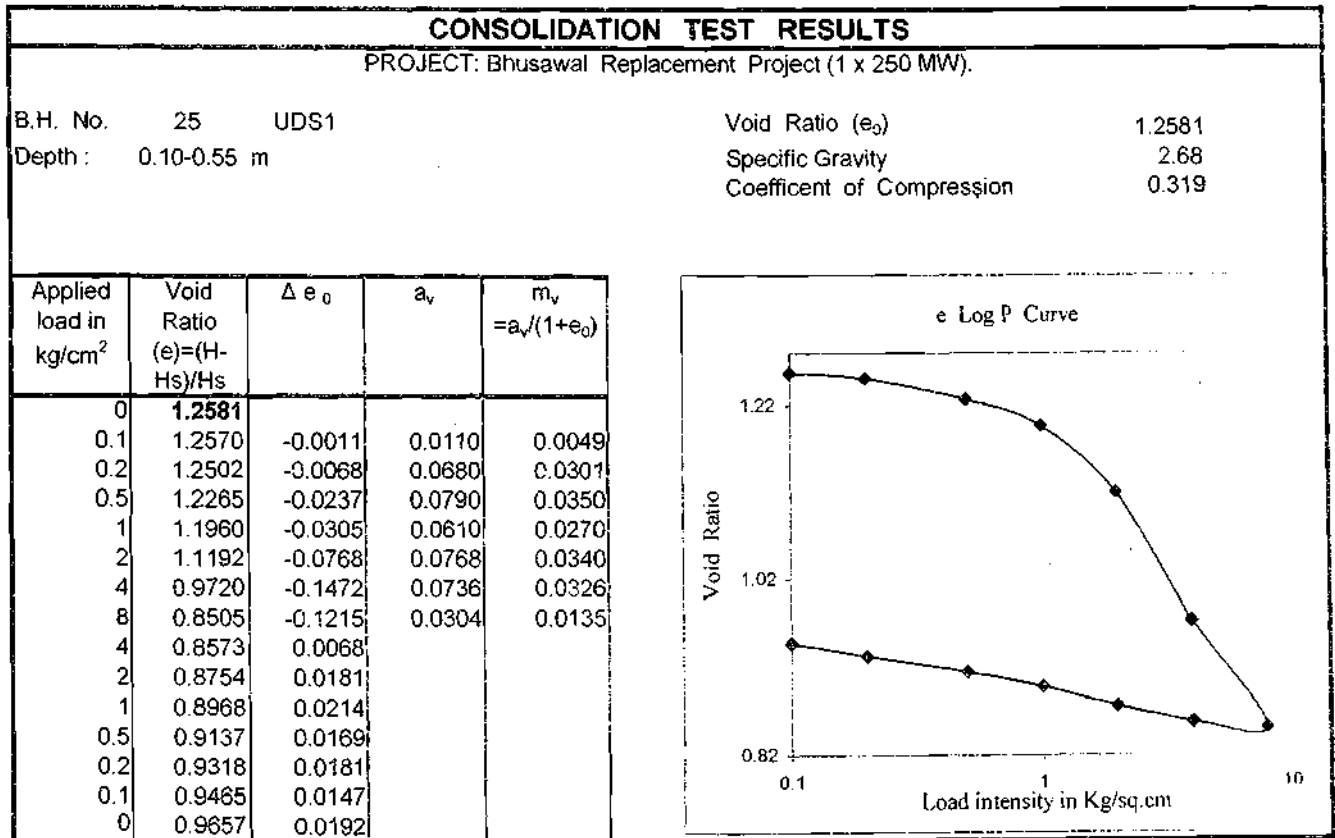
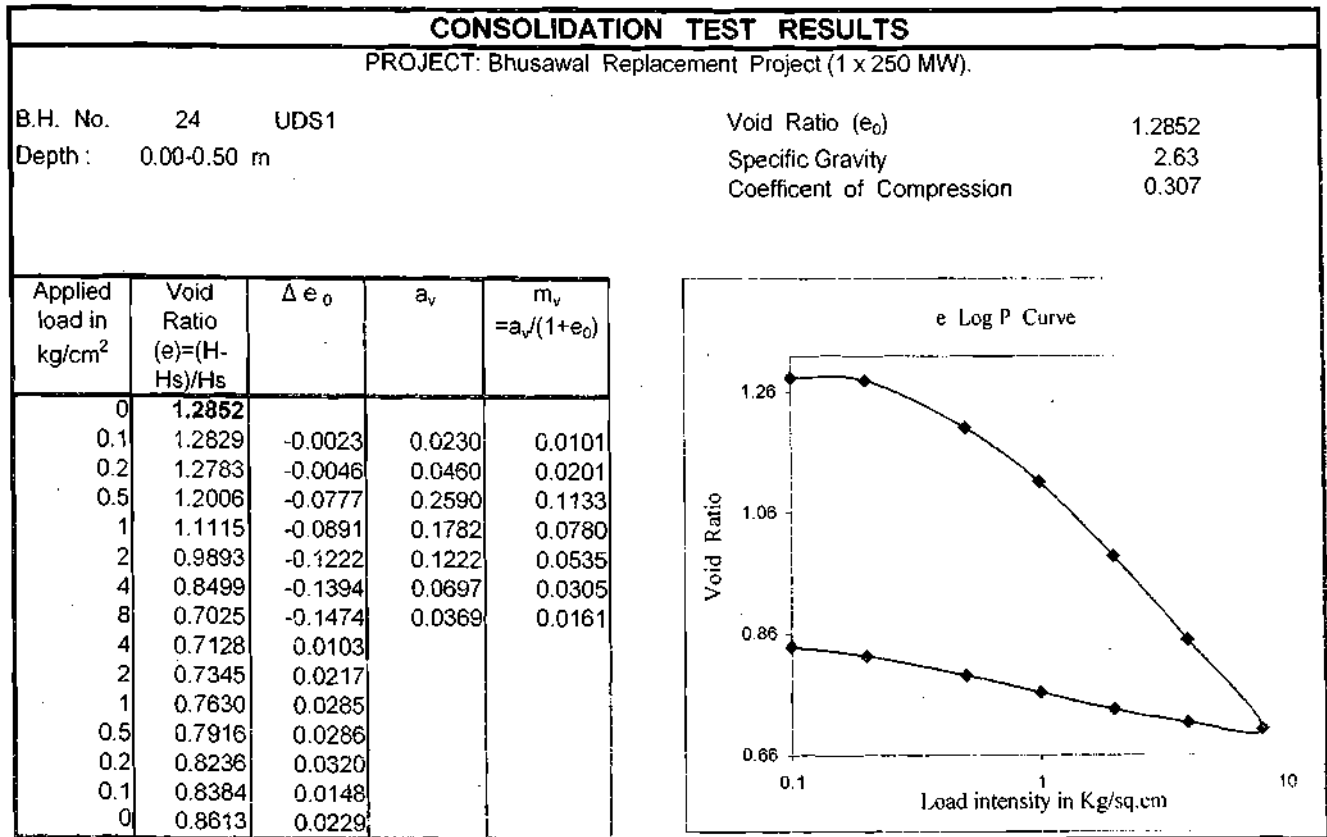
Void Ratio (e_0) 1.2227

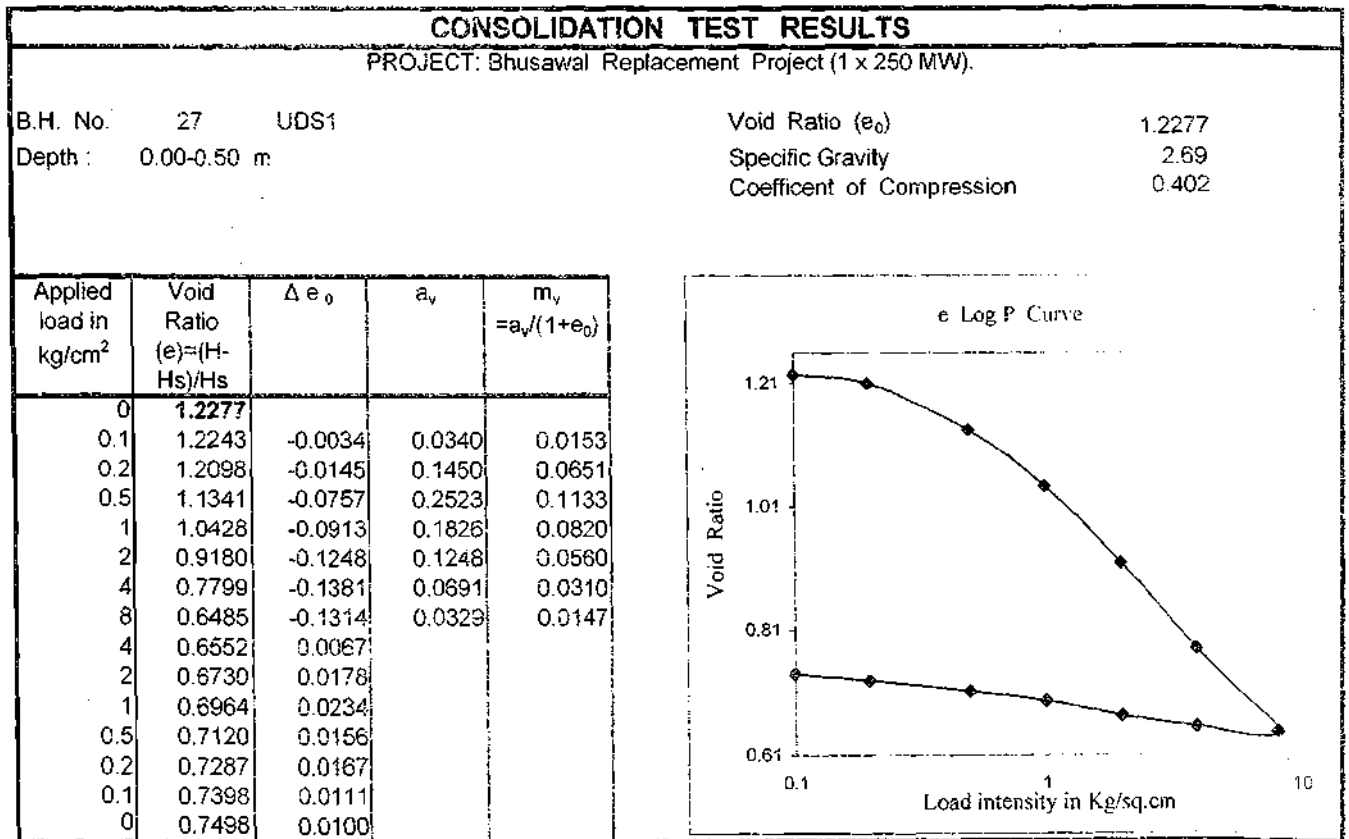
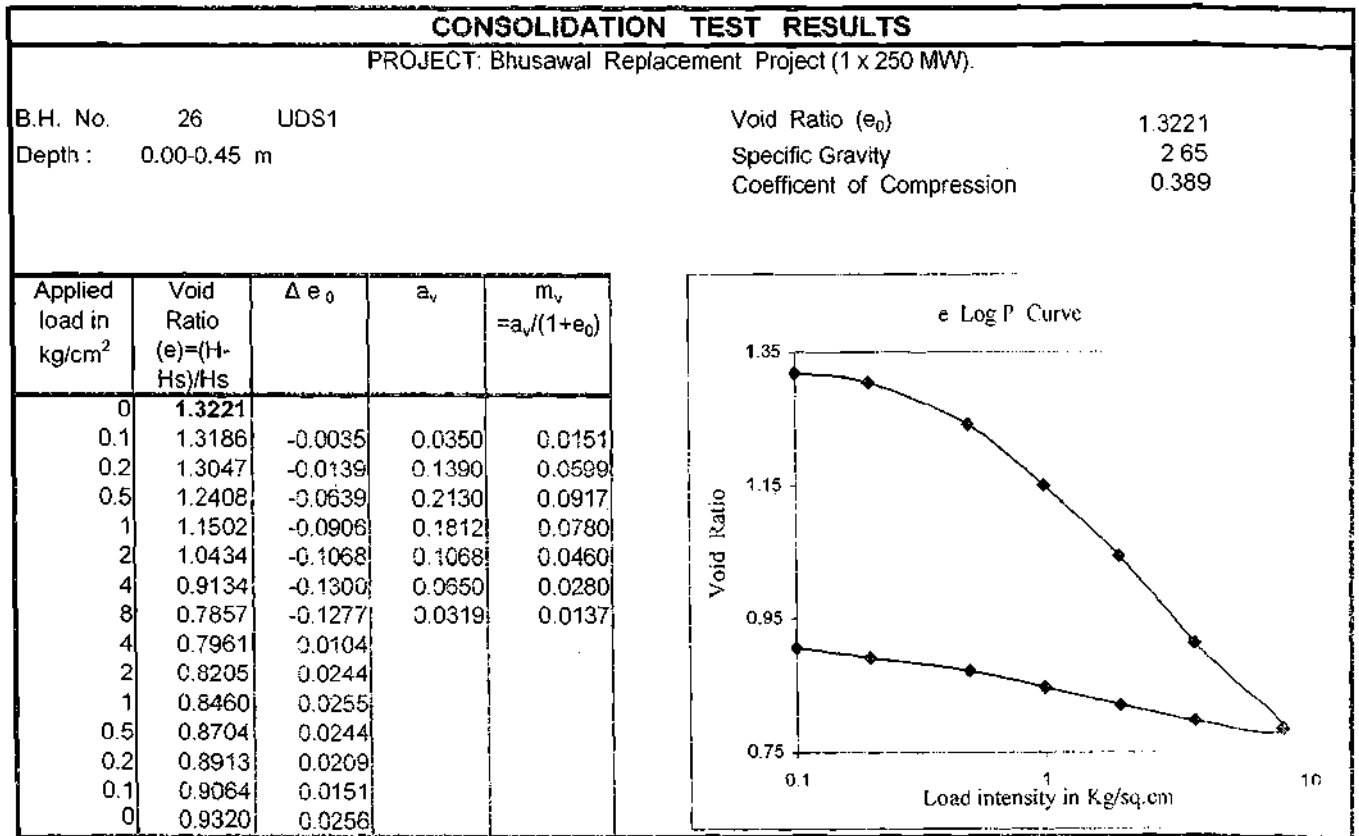
Specific Gravity 2.66

Coefficient of Compression 0.265

Applied load in kg/cm ²	Void Ratio (e)=(H-Hs)/Hs	Δe_0	a_v	$m_v = a_v/(1+e_0)$
0	1.2227			
0.1	1.2205	-0.0022	0.0220	0.0099
0.2	1.2138	-0.0067	0.0670	0.0301
0.5	1.2027	-0.0111	0.0370	0.0166
1	1.1760	-0.0267	0.0534	0.0240
2	1.1276	-0.0484	0.0484	0.0218
4	1.0871	-0.0405	0.0203	0.0091
8	1.0560	-0.0311	0.0078	0.0035
4	1.0593	0.0033		
2	1.0616	0.0023		
1	1.0638	0.0022		
0.5	1.0693	0.0055		
0.2	1.0782	0.0089		
0.1	1.0894	0.0112		
0	1.0971	0.0077		







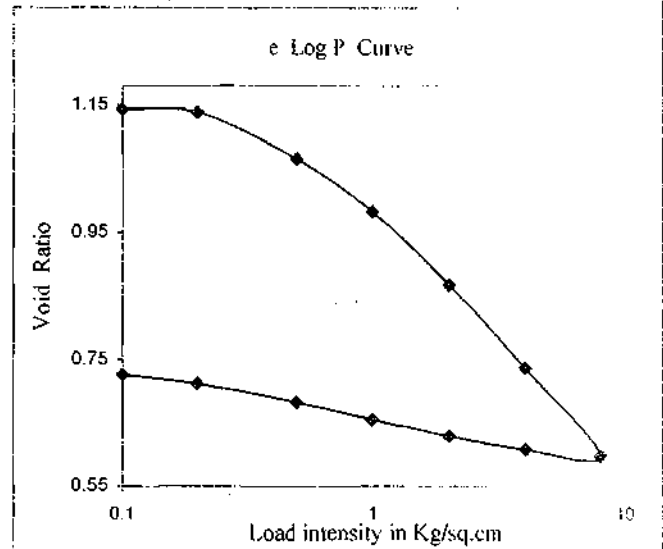
CONSOLIDATION TEST RESULTS

PROJECT: Bhusawal Replacement Project (1 x 250 MW).

B.H. No. 28 UDS1
 Depth: 0.00-0.45 m

Void Ratio (e_0) 1.1448
 Specific Gravity 2.64
 Coefficient of Compression 0.302

Applied load in kg/cm ²	Void Ratio (e)=(H-Hs)/Hs	Δe_0	a_v	m_v = $a_v/(1+e_0)$
0	1.1448			
0.1	1.1426	-0.0022	0.0220	0.0103
0.2	1.1383	-0.0043	0.0430	0.0200
0.5	1.0654	-0.0729	0.2430	0.1133
1	0.9818	-0.0836	0.1672	0.0780
2	0.8670	-0.1148	0.1148	0.0535
4	0.7362	-0.1308	0.0654	0.0305
8	0.5979	-0.1383	0.0346	0.0161
4	0.6075	0.0096		
2	0.6279	0.0204		
1	0.6547	0.0268		
0.5	0.6815	0.0268		
0.2	0.7115	0.0300		
0.1	0.7255	0.0140		
0	0.7469	0.0214		

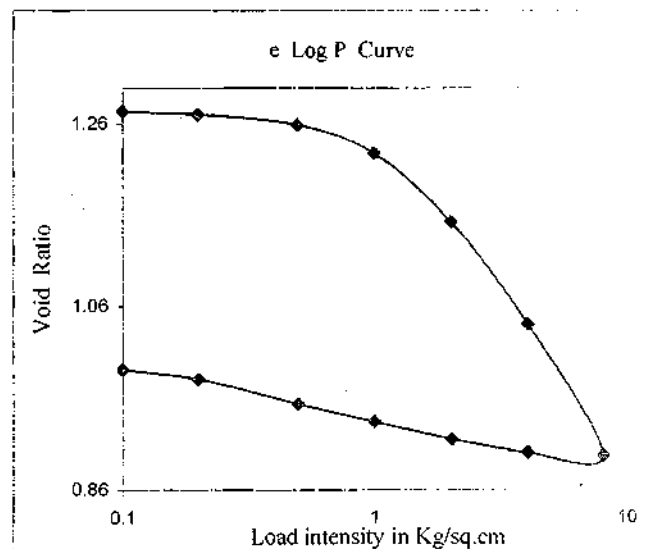
**CONSOLIDATION TEST RESULTS**

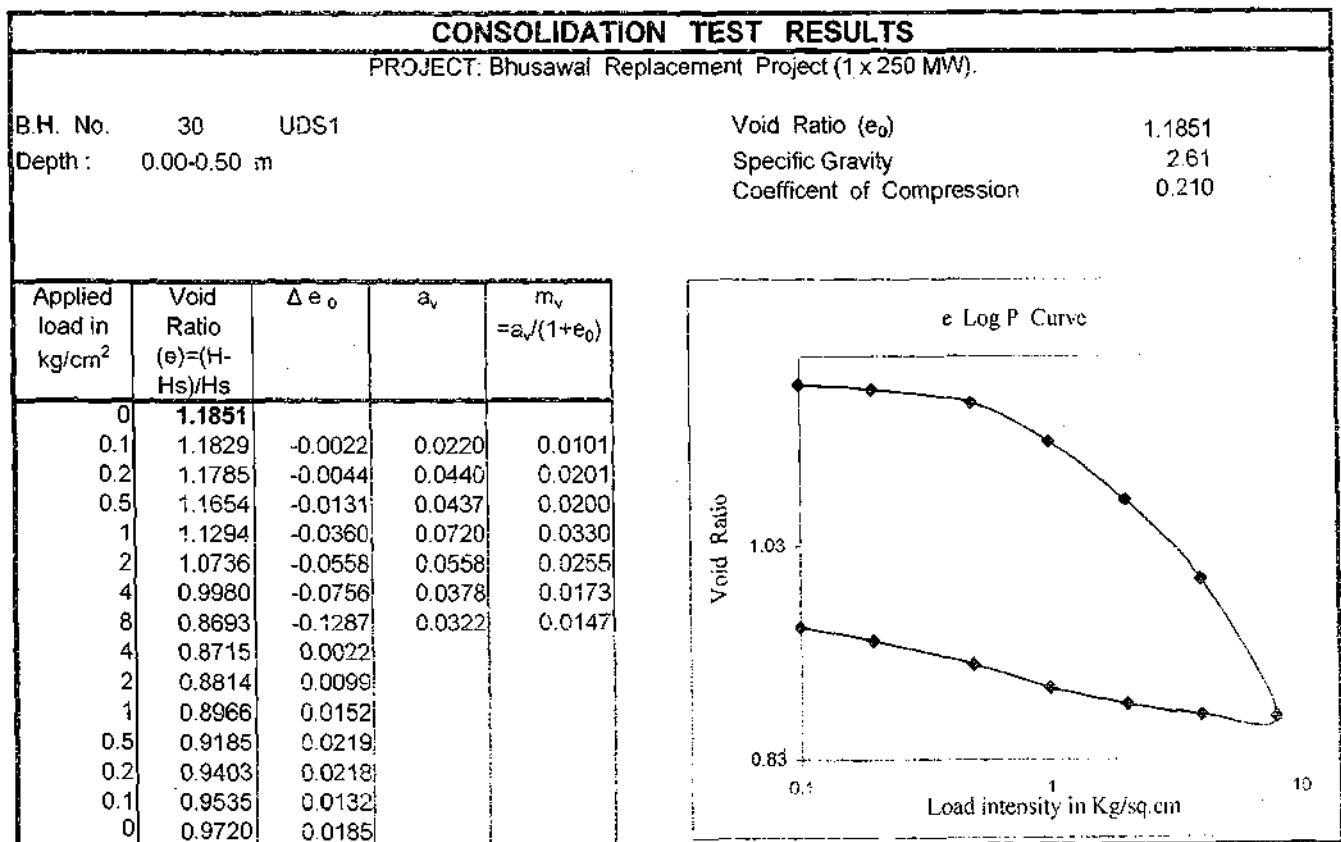
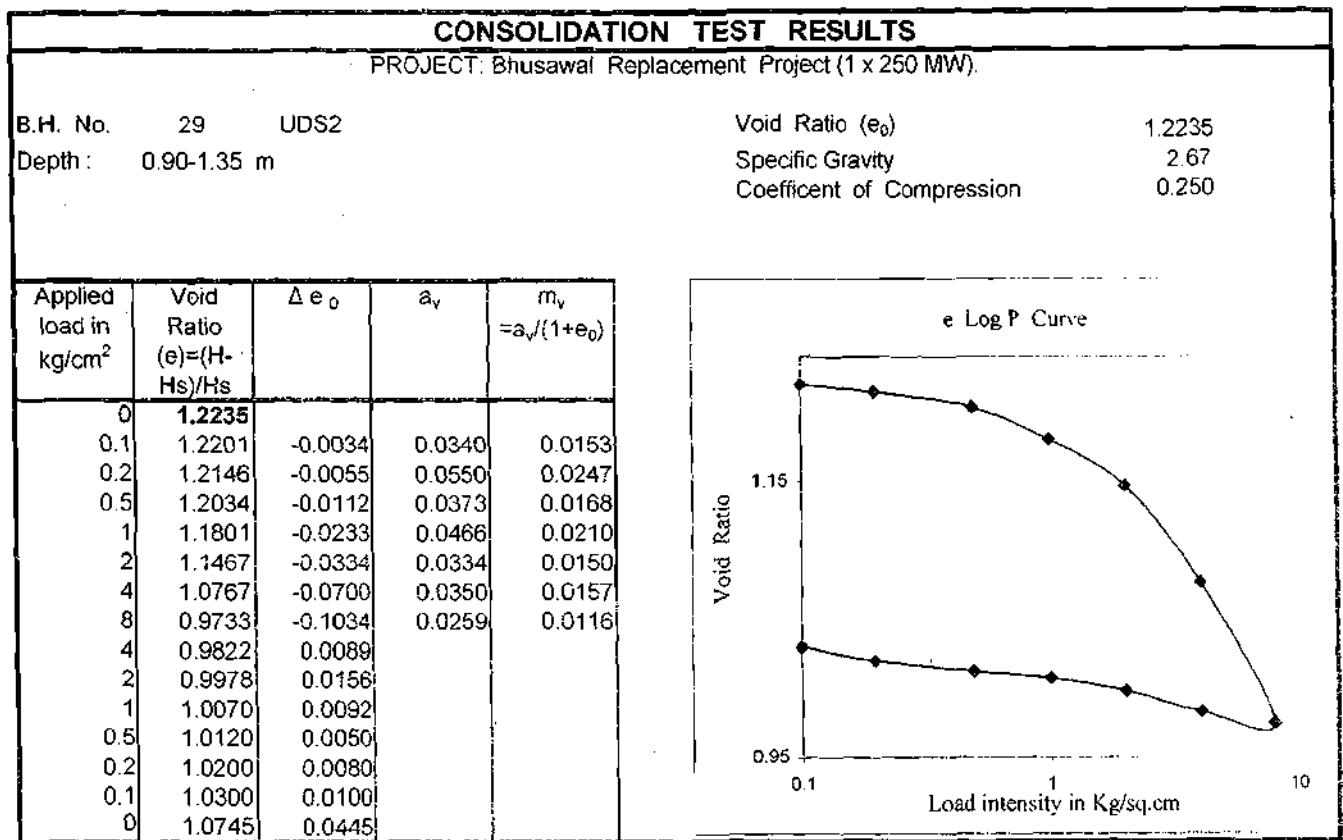
PROJECT: Bhusawal Replacement Project (1 x 250 MW).

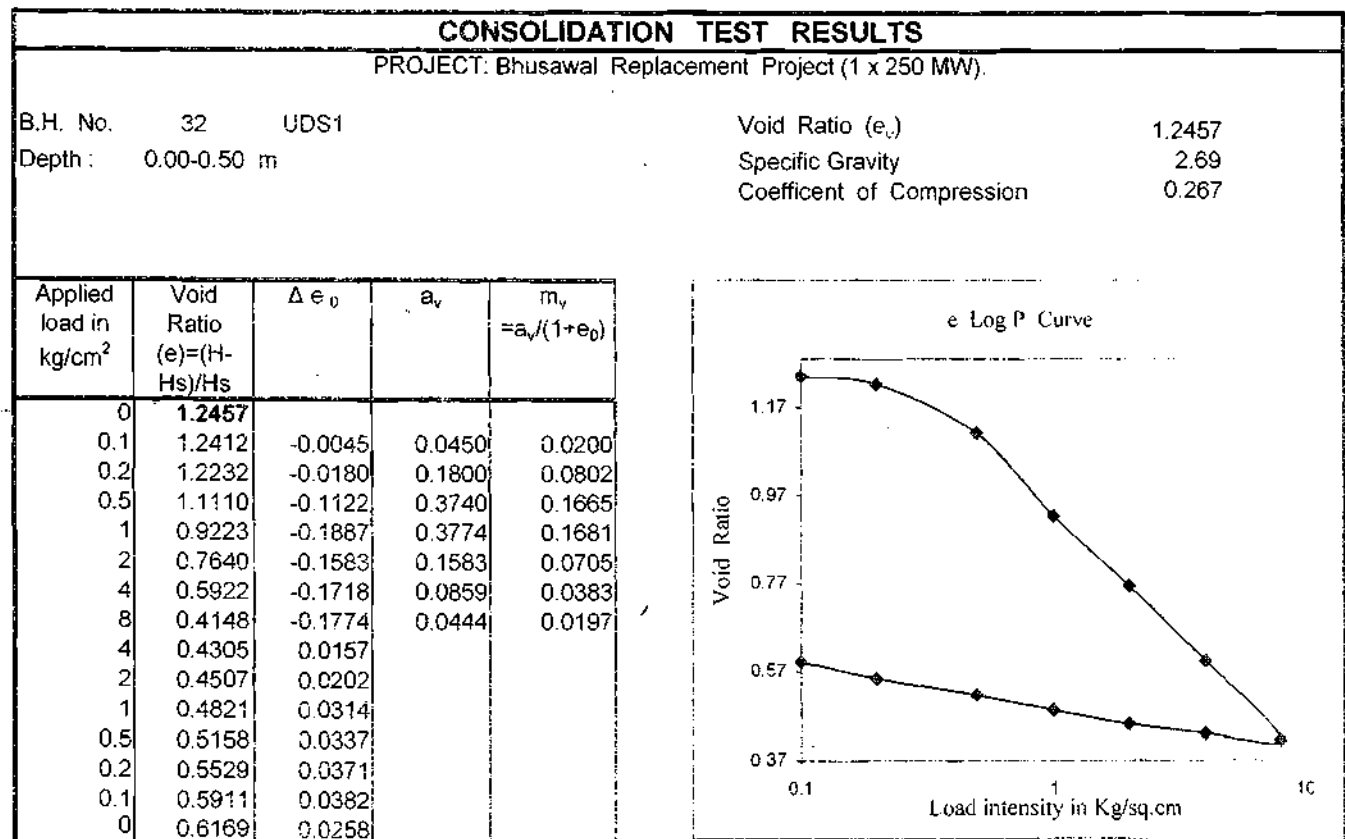
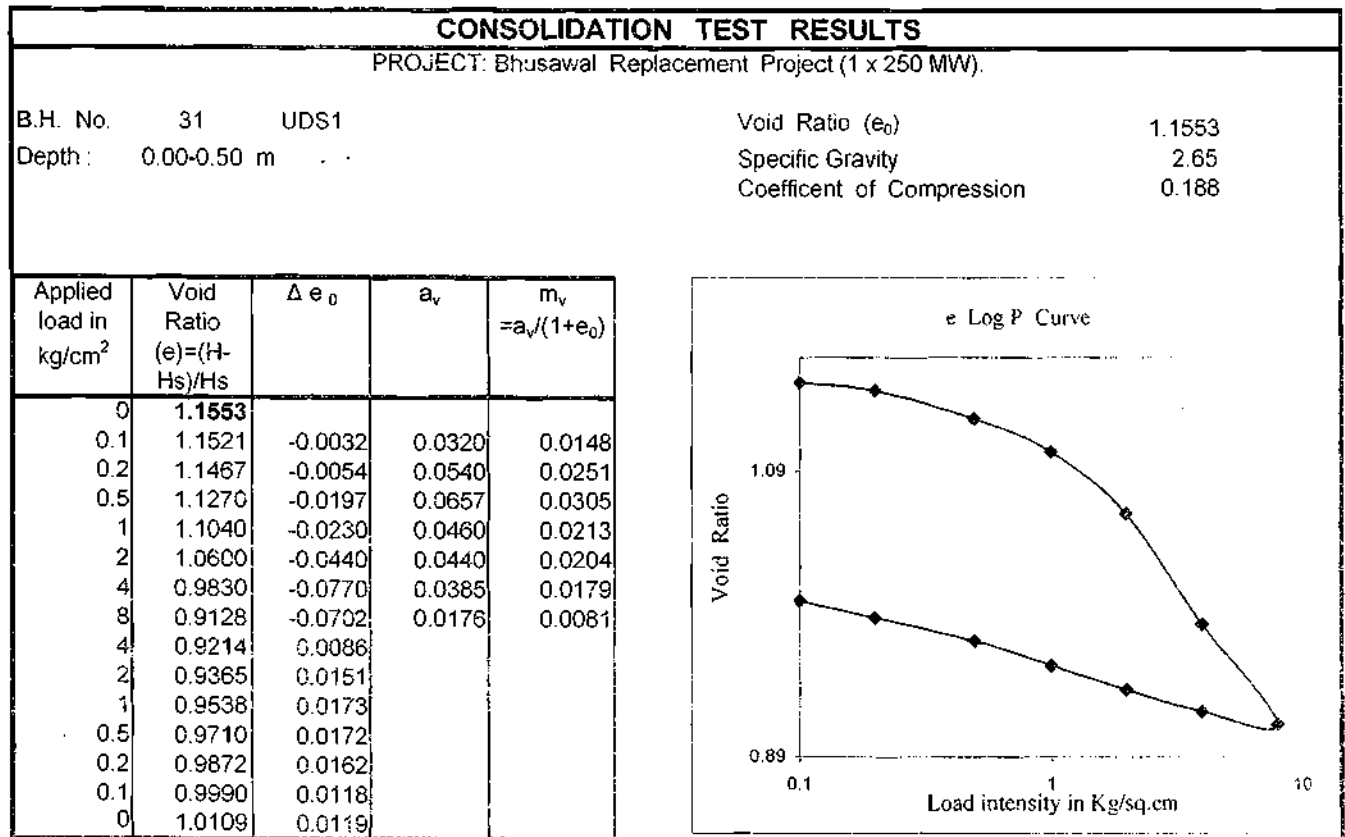
B.H. No. 29 UDS1
 Depth: 0.00-0.45 m

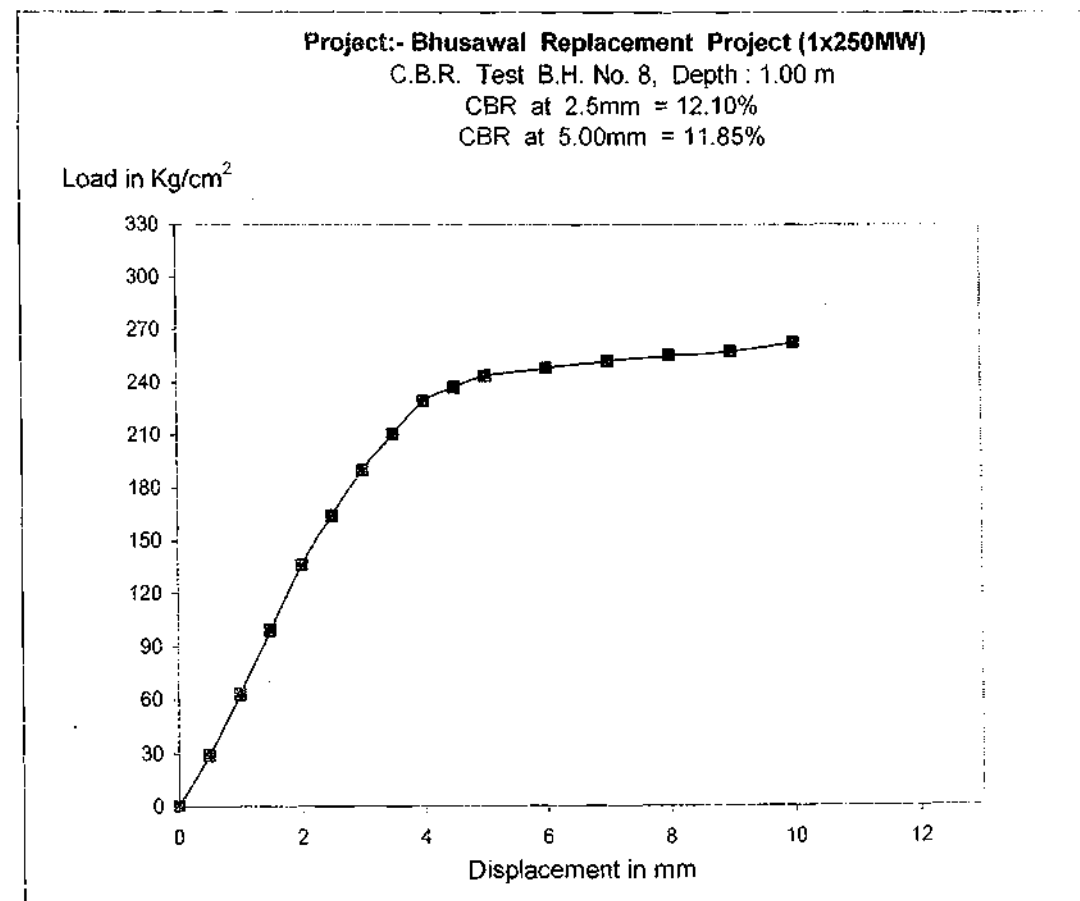
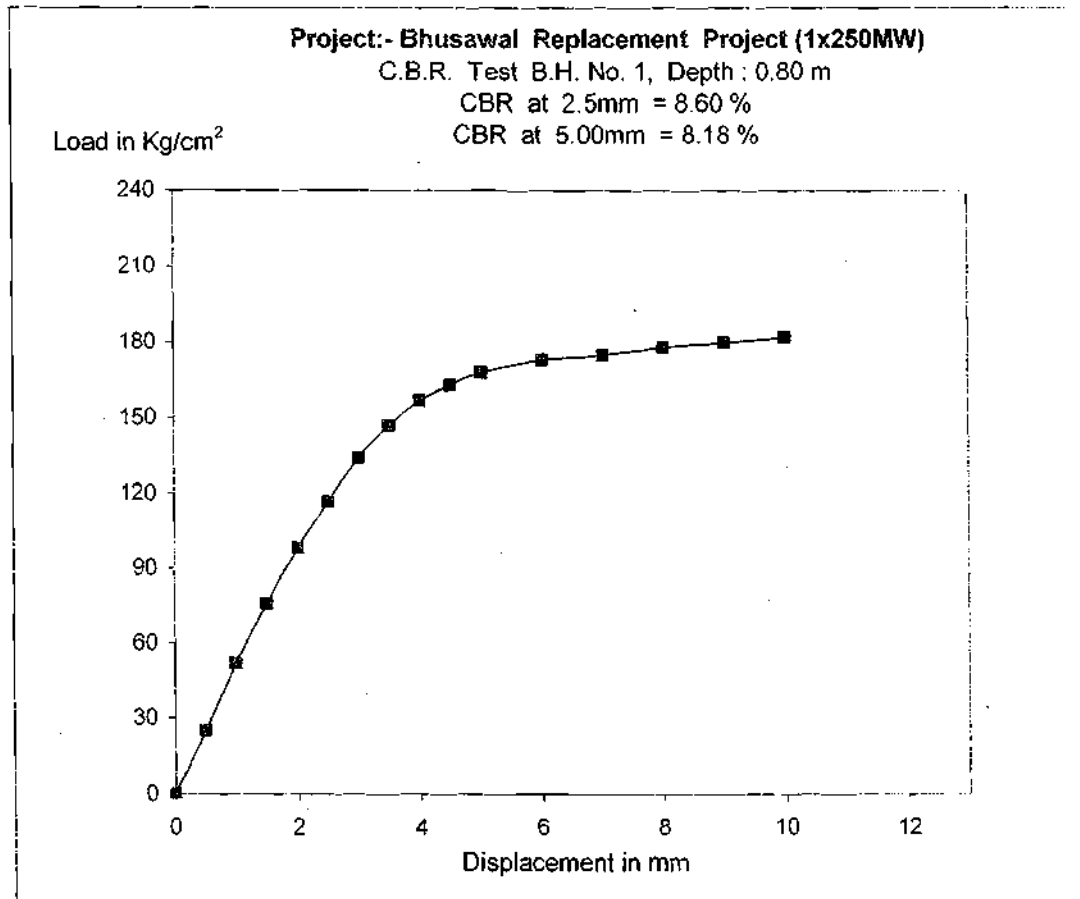
Void Ratio (e_0) 1.2758
 Specific Gravity 2.61
 Coefficient of Compression 0.287

Applied load in kg/cm ²	Void Ratio (e)=(H-Hs)/Hs	Δe_0	a_v	m_v = $a_v/(1+e_0)$
0	1.2758			
0.1	1.2736	-0.0022	0.0220	0.0097
0.2	1.2701	-0.0035	0.0350	0.0154
0.5	1.2588	-0.0113	0.0377	0.0166
1	1.2280	-0.0308	0.0616	0.0271
2	1.1518	-0.0762	0.0762	0.0335
4	1.0403	-0.1115	0.0558	0.0245
8	0.8969	-0.1434	0.0359	0.0158
4	0.9003	0.0034		
2	0.9140	0.0137		
1	0.9333	0.0193		
0.5	0.9527	0.0194		
0.2	0.9800	0.0273		
0.1	0.9902	0.0102		
0	0.9993	0.0091		











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**PROJECTS & PLANNING
DEPARTMENT**

BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1

VOLUME – VI B

**TECHNICAL SPECIFICATIONS FOR
CIVIL, STRUCTURAL AND ARCHITECTURAL
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CONSULTANT

PROCON ENGINEERS

(DIV. OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)

Venus Building, 2nd Floor, Opp. Digha Talao,
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2011



**MAHARASHTRA STATE POWER
GENERATION CO. LTD.**

**PROJECTS & PLANNING
DEPARTMENT**

BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1

VOLUME – VI-B

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REV: R0	CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS	Page 3 of 549
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TECHNICAL SPECIFICATIONS

FOR

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SECTION – 1

AREA GRADING

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1.0 <u>SCOPE</u> This specification shall govern all clearing, grubbing, excavating, area filling, grading and compacting soils for areas designated on the drawings. The work shall include clearing and grubbing, stripping and storage of top soil, excavation, blasting (if required), hauling, dumping and spreading of soil, undercutting to remove unstable soil areas, compacting existing soil surfaces and bottom of excavated areas to receive fills, compacting excavated areas for sub-grade, placing and compacting soils in fills, dealing with surface water, pumping to keep excavated areas and areas to be filled dry, final grading of designated areas, disposing of unsuitable and excess excavated materials and incidentals thereof. 2.0 <u>GENERAL</u> 2.1 <u>WORK TO BE PROVIDED FOR BY THE CONTRACTOR</u> The work to be provided for by the Contractor, unless specified otherwise, shall include but not be limited to the following: 2.1.1 Furnish all labour, supervision, services, earth-moving machineries and equipment, compaction plant and equipment, tools and plants, survey instruments, transportation etc. required for the work. 2.1.2 Prepare and submit working drawings showing the approaches, slopes, berms, sumps for dewatering, space for temporary stacking of spoils, disposal area, borrow pits, fencing etc. and all other details as may be required by the Engineer. 2.1.3 To carry out and submit to the Engineer, results of soil compaction tests whenever required by the Engineer to assess the degree of compaction. 2.1.4 If blasting is resorted to, necessary licenses to be procured from the proper authorities. 2.2 <u>WORK TO BE PROVIDED FOR BY OTHERS</u> No work under this specification will be provided by any agency other		

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than the Contractor unless specifically mentioned elsewhere in the Contract. 2.3 <u>CODES AND STANDARDS</u> All work under this specification, unless specified otherwise, shall conform to the latest revision and/or replacements of the following or any other relevant Indian Standard Specifications and Codes of Practice. In case any particular aspect of work is not covered specifically by Indian Standard Specification any other standard practice as may be specified by the Engineer shall be followed: <table border="0"> <tr> <td>2.3.1</td><td>IS : 1200</td><td>: Method of Measurement of Building and Civil Engineering work, Part-I Earthwork</td></tr> <tr> <td>2.3.2</td><td>IS : 2720 (Part-II)</td><td>: Determination of Moisture Content</td></tr> <tr> <td>2.3.3</td><td>IS : 2720 (Part-IV)</td><td>: Grain Size Analysis</td></tr> <tr> <td>2.3.4</td><td>IS : 2720 (Part-VII)</td><td>: Determination of Moisture Content/Dry</td></tr> <tr> <td>2.3.5</td><td>IS : 2720 (Part-VIII)</td><td>: Determination of Moisture Content/Dry</td></tr> <tr> <td>2.3.6</td><td>IS : 2720 (Part-XIV)</td><td>: Determination of Density Index (Relative)</td></tr> <tr> <td>2.3.7</td><td>IS : 2720 (Part-XXIV)</td><td>: Determination of Dry Density, in place</td></tr> <tr> <td>2.3.8</td><td>IS : 2720 (Part-XXVIII)</td><td>: Determination of Dry Density of Soils,</td></tr> <tr> <td>2.3.9</td><td>IS : 3764</td><td>: Safety Code for Excavation Work</td></tr> <tr> <td>2.3.10</td><td>IS : 4081</td><td>: Blasting and related drilling operations</td></tr> <tr> <td>2.3.11</td><td>IRC : SP-11</td><td>: Hand book of quality control for construction of roads and runways</td></tr> <tr> <td>2.3.12</td><td>IRC : 36</td><td>: Construction of Earth Embankments for Road Work</td></tr> </table> 2.4 <u>CONFORMITY WITH DESIGNS</u> The Contractor shall carry out the work as per the drawings issued to him and/or Contractor's drawings which are approved by the Engineer and/or			2.3.1	IS : 1200	: Method of Measurement of Building and Civil Engineering work, Part-I Earthwork	2.3.2	IS : 2720 (Part-II)	: Determination of Moisture Content	2.3.3	IS : 2720 (Part-IV)	: Grain Size Analysis	2.3.4	IS : 2720 (Part-VII)	: Determination of Moisture Content/Dry	2.3.5	IS : 2720 (Part-VIII)	: Determination of Moisture Content/Dry	2.3.6	IS : 2720 (Part-XIV)	: Determination of Density Index (Relative)	2.3.7	IS : 2720 (Part-XXIV)	: Determination of Dry Density, in place	2.3.8	IS : 2720 (Part-XXVIII)	: Determination of Dry Density of Soils,	2.3.9	IS : 3764	: Safety Code for Excavation Work	2.3.10	IS : 4081	: Blasting and related drilling operations	2.3.11	IRC : SP-11	: Hand book of quality control for construction of roads and runways	2.3.12	IRC : 36	: Construction of Earth Embankments for Road Work
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the Engineer's instructions. 2.5 <u>MATERIALS TO BE USED</u> 2.5.1 General All materials required for the work shall be of best commercial variety and as approved by the Engineer. 2.5.2 Borrow Material Borrow material required for area filling shall be excavated from approved locations and levels, and shall consist of selected material, approved by the Engineer, free from roots, vegetations, decayed organic matter, harmful salts and chemicals, free from lumps and clods. Clean graded sand, free from harmful and deleterious materials from approved quarries, shall be used as fill material at places approved during detail engineering stage. Necessary arrangement shall be done by the Contractor at his own cost for locating and using the borrow areas as the source of supply of filling material. The depth of borrow pits should be so regulated that the borrow pits do not cut an imaginary line having a slope of 1 vertical in 4 horizontal projected from the edge of final section of the adjacent embankment of stack of excavated soil. 2.6 <u>QUALITY CONTROL</u> The Contractor shall establish and maintain quality control for the various aspects of the work, method, materials and equipment used. The quality control operation shall include but not be limited to the following items of work: (a) Lines, Levels and Grades (i) Periodic Surveys (ii) Establishment of markers, Boards etc.		

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(iii) Checking levels and slopes of the graded surface. (b) Area filling (i) Checking the quality of fill material (ii) Checking moisture content of the fill. (iii) Checking the degree of compaction. 2.6.1 Any work which fails to conform to the specifications will be subject to the issue of a Non-conformance Report in line with the Quality Control Procedure to be implemented at site. Corrective or remedial action, design modifications or product rejection will be reviewed in accordance with the site Quality Plan. 2.7 <u>INFORMATION REGARDING SITE CONDITIONS</u> Boring and sub-surface data regarding the nature of soil, rock, sub-soil water etc. shown on drawings or otherwise furnished to the Contractor shall be taken as guidance only and variation there from shall not affect the terms of the Contract. The Contractor must satisfy himself regarding the character and volume of all work under this contract and expected surface, sub-surface and/or sub-soil water to be encountered. He must also satisfy himself about the general conditions of site and ascertain the existing and future construction likely to come up during the execution of the Contract so that he may evolve a realistic programme of execution. 3.0 <u>EXECUTION</u> 3.1 <u>GENERAL</u> The work shall be undertaken in accordance with the lines, levels, grades and details shown on the drawings, specification and the approved method of work. The works shall be carried out in a workman like manner without endangering the safety of nearby structures, roads, railway tracks, cable, pipelines, etc. and without causing hindrance to construction activities.		

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Suitable approaches, fencing, area lighting and temporary works required for the works shall be provided by the contractor. Sturdy and elegant fencing is to be provided around the top edge of the excavation as well as the bottom of the fill at the surplus disposal area where damping from a high bench is in progress, if directed by the Engineer. Adequate area lighting shall be provided by the contractor, if night work is undertaken. The Contractor shall submit a proposal covering the proposed excavation and placement of fill material for approval of the Engineer. The proposal shall include but not be limited to the following. (a) Mobilisation and demobilisation of plant (b) Proposed plant and equipment, labour resources & supervision. (c) Details of proposed method of clearing and grubbing for each area of cut and fill. (d) Drawings showing the areas for placement of material. (e) Management of excavation and filling works i.e. control of setting out, testing procedures, handling, temporary stockpiles etc. (f) Temporary works proposals (g) Excavation, filling and compaction by mechanical plant (h) Dealing with surface water (i) Dewatering (j) Disposal of materials (k) Safety precautions, fencing and lighting (l) Calculations as appropriate to support work proposal		

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3.2	<u>SETTING OUT</u> The Contractor will prepare and submit to the Engineer, detailed drawings of the excavation and filling work necessary, as proposed to be executed by him, showing the dimensions as per drawings and specification, adding his proposals for slopes, approaches, dewatering sumps, berms etc. On receiving the approval from the Engineer with modifications and corrections if necessary, the Contractor will set out the work from the control points furnished by the Engineer and fix permanent points and markers for future checking. These permanent points and markers will be checked by the Engineer and certified by him after which the Contractor will proceed with the work. Engineer shall be provided with necessary men, material and instruments for such checking. It should be noted that this checking by the Engineer prior to start of the work will in no way absolve the Contractor of his responsibility of carrying out the work to true lines, levels and grades as per drawing and subsequent corrections, if any. In case any errors are noticed in the Contractor's work at any stage, the same shall be remedied by the Contractor.	
3.3	<u>INITIAL LEVELS</u> Initial levels either in a definite grid pattern or as directed by the Engineer will be taken by the Contractor jointly with the Engineer over the original ground prior to starting actual excavation work and after setting out. These initial levels will be used for preparing cross-sections for volume measurement or for cross-checking the depths obtained from tape measurements. These initial levels and cross-sections shall be jointly signed by the Contractor and the Engineer before commencement of work.	
3.4	<u>CLEARING AND GRUBBING ETC.</u> The area to be excavated or filled shall be cleared out of fences, trees, logs, stumps, bush, vegetation, rubbish, slush, etc. and levelled up. Trees upto 300 mm girth shall be uprooted. Trees above 300 mm girth which are required to be cut, shall be got identified by the Engineer and then marked. Felling of trees shall include taking out roots upto 600 mm below ground level. After the tree is cut and roots taken out, the pot- holes formed shall be	

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filled with good earth in 250 mm layers and compacted to acceptable degree unless directed by the Engineer otherwise. The trees shall be cut in suitable pieces as instructed by the Engineer and then shall be transported to the Owner's store or any other space as directed by the Engineer. Before earthwork is started, all the spoils and unserviceable materials and rubbish shall be burnt or removed from the site to approved disposal areas as may be specified. Ash shall be spread or removed as directed by the Engineer. Useful materials, saleable timber, firewood, etc. shall be the property of the Owner and shall be stacked properly at the worksite in a manner as directed by the Engineer. 3.5 <u>CLASSIFICATION</u> Materials involved in earthwork shall be classified under the following categories. No distinction will be made whether the material is dry or wet. The Engineer's decision in regard to such classification shall be final and binding on the Contractor: (a) Ordinary and hard soil This shall include clay, silt, sand, moorum, shingle, kankar, gravel, loam, peat, ash and other similar materials in soft, hard or dense state which can generally be excavated with ordinary spade, pick axe, shovel etc. and does not require the use of wedges, pneumatic breaking equipment and/or blasting for removal. It shall also include loose rock boulders present in the soil, with dimensions not exceeding 500 mm in any direction. Breaking of consolidated brick ballast and mud concrete shall be considered equivalent to excavation work under this type of soil. (b) Soft and Decomposed Rock This shall include rocks like chalk, slate, mica schist, laterite and other similar materials which in the opinion of the Engineer is rock, but does not require blasting for removal and could be removed with picks, hammers, crow bars, wedges, pneumatic breaking equipment etc. It shall also include boulders with dimensions greater than 500		

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mm but not exceeding 1000 mm in any direction. The mere fact that the Contractor resorts to blasting for his own convenience shall not mean that the rock will be classified as hard rock. (c) Hard Rock This shall include rocks occurring in large masses which cannot be removed except by blasting. Harder varieties of rock such as trap, with or without veins and secondary mineral which in the opinion of the Engineer require blasting for removal shall also be considered as hard rock. It shall also include boulders bigger than 1000 mm in any direction. Construction in concrete, both reinforced and unreinforced, which is required to be dismantled during earthwork. 3.6 <u>EARTHWORK IN EXCAVATION</u> 3.6.1 General Before commencement of excavation the existing ground surface shall be cleared in accordance with Clause no. 3.4. All excavation shall be done to the minimum dimensions as required for safety and working facility. Prior approval of the Engineer shall be obtained by the Contractor, in each individual case, for the method he proposes to adopt for the excavation including dimension, side slopes, dewatering, disposal, etc. This approval, however, shall not in any way make the Engineer responsible for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. Prior to starting the excavation, the ground level at the location shall be checked jointly with the Engineer. The rough excavation may be carried upto a maximum depth of 150 mm above the final level. The balance shall be excavated with special care. If directed by the Engineer, soft and undesirable spots shall be removed even below the final level.		

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3.6.2	Excavation in Ordinary Soil, Hard Soil & Soft and Decomposed Rock The excavation in ordinary soil, hard soil and soft and decomposed rock shall be carried out as per the approved proposal, modified and corrected where necessary by the Engineer. The work shall be carried out in a workmanlike manner without endangering the safety of nearby structures or roads, railway tracks, cables, pipelines etc. if any, and without causing hindrance to other activities in the area. As the excavation reaches the required dimensions, lines, levels and grades, the work will be checked by the Engineer thoroughly and the balance work will be carried out carefully to avoid any over-excavation. On completion, the work will be finally checked and approved by the Engineer. In case where excavation in soil, soft and decomposed rock and/or hard rock are involved, the soil or soft and decomposed rock layers, shall be removed by turn and levels of the underlying rock surfaces observed to enable measurements. Further work shall be resumed after getting clearance from the Engineer.	
3.6.3	Excavation in Hard Rock Overburden, if any, consisting of top soil, ordinary and hard soil, soft and decomposed rock as per classification of soil, which do not require blasting shall be completely stripped off and the levels of the hard rock surface shall be taken to enable measurement. Further work in hard rock shall be resumed after clearance from the Engineer. Personnel deployed for rock excavations shall be protected from all hazards such as loose rock/boulder rolling down and from general slips of excavated surfaces. Where the excavated surface is such that it is not stable against sliding, necessary supports, props, bracings or bulkheads shall be provided and maintained during the period of construction. Where danger exists of loose rock/boulder falling from the excavated surfaces deeper than 2 metres, steel mesh anchored to the lower edge of excavation and extending over and above the rock face, adequate to retain the dislodged material shall be provided and maintained. In case where blasting, though otherwise required, is prohibited for any reasons, the excavation shall be carried out by chiselling, wedging or any	

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other approved method. All loose or loosened rock in the sides shall be removed by barring, wedging, etc. 3.6.4 Blasting 3.6.4.1 General Excavation shall be continued in hard rock to such widths, lengths, depths and profiles as are shown on the drawings or such other lines and grades as may be specified by the Engineer. As far as possible all blasting shall be completed prior to commencement of construction. At all stages of excavation, precautions shall be taken to preserve the rock below and beyond the lines for the excavation, in the soundest possible condition. The quantity and strength of explosive used, shall be such as will neither damage nor crack the rock outside the limits of excavation. All precautions, as directed by Engineer, shall be taken during the blasting operations and care shall be taken that no damage is caused to adjoining buildings or structure as a result of blasting operations. In case of damage to permanent or temporary structures, Contractor shall repair the same to the satisfaction of Engineer. As excavation approaches its final lines and levels, the depth of the charge holes and amount of explosives used shall be progressively and suitably reduced. Unless otherwise stated herein, I.S. Specification IS: 4081 "Safety Code for Blasting & Related Drilling Operation" shall be followed. Specific permission of Engineer will have to be taken by Contractor for blasting rock and he shall also obtain a valid Blasting licence from the authorities concerned. Contractor shall obtain necessary licence for storage of explosives, fuses and detonators issued to him from owner's stores or from supplier arranged by him, from the authorities dealing with explosives. The fees, if any, required for obtaining such licence, shall be borne by Contractor. Contractor shall have to make necessary storage facilities for the explosives etc. as per rules of local, State and Central Govt. authorities and statutory bodies/ regulations.		

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In no case shall blasting be allowed closer than 30 metres to any structure or to locations where concrete has just been placed. In the latter case the concrete must be at least 7 days old. Contractor shall employ a competent experienced supervisor and licensed blaster in-charge of each set of operation, who shall be held personally responsible to ensure that all safety regulations are carried out. Before any blasting is carried out, Contractor shall intimate Engineer and obtain his approval in writing for resorting to such operations. He shall intimate the hours of firing charges, the nature of explosive to be used and the precautions taken for ensuring safety. The blasting of rock near any existing buildings, equipments or any other property shall be done under cover and Contractor has to make all such necessary muffling arrangements. Covering may preferably be done by M.S. plates with adequate dead weight over them. Blasting shall be done with small charges and where directed by Engineer, a trench shall have to be cut by chiseling prior to the blasting operation separating the area under blasting from the existing structures. When excavation has almost reached the desired level, hand trimming shall have to be done for dressing the surface to the desired level. Any rock excavation beyond an over break limit of 75 mm shall be filled up as instructed by Engineer, with concrete of strength not less than M 10. Stepping in rock excavation shall be done by hand trimming. Contractor shall be responsible for any accident to workmen, public or Owner's property due to blasting operations. Contractor shall also be responsible for strict observance of rules, laid by Inspector of Explosives, or any other authority duly constituted under the State and/or Union Government. Storage, handling and use of explosives shall be governed by the current explosive rules laid down by the Central and the State Governments. The Contractor shall ensure that these rules are strictly adhered to. The following instruction, wherever found in variance with the above rules, shall be considered as superseded by the above rules. No child under the age of 16 and no person who is in a State of intoxication		

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shall be allowed to enter the premises where explosives are stored nor they shall be allowed to handle the explosives. 3.6.4.2 Material All materials such as explosives, detonators, fuses tamping materials etc. proposed to be used in the blasting operations shall have the prior approval of the Engineer. Only explosives of approved make and strength are to be used. The fuses known as instantaneous fuse must not be used. The issue of fuse with only one protective coat is prohibited. The fuse shall be sufficiently water resistant as to be unaffected when immersed in water for thirty minutes. The rate of burning of the fuse shall be uniform and not less than 4 seconds or inch of length with 10% tolerance on either side. Before use, the fuse shall be inspected and moist damaged or broken ones discarded. The rate of burning of fuses or when they have been in stock for long shall be tested before use. The detonators used shall be capable of giving an effective blasting of the explosives. Moist and damaged detonators shall be discarded. 3.6.4.3 Storage of Explosive Storage of explosives shall be governed by the current Explosive Rules. Explosives shall be stored in a clean, dry, well ventilated magazine to be specially built for the purpose. Under no circumstances should a magazine be erected within 400 m of the actual work site or any source of fire. A space surrounding the magazine shall be fenced in. The ground inside the fence shall be kept clear and free from trees, bushes etc. The admission to this fenced space shall be by one gate only and no person shall be allowed inside this fence without permission of the Officer-in-charge. The clear space between the fence and the magazine shall not be less than 90m. The megazine shall be perfectly well drained. Two lightning conductors shall be provided to the magazine, one at each end. The lightning conductors shall be tested once in every year. Fuses and detonators shall be stored in separate magazines. However,		

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detonators can be kept in an annexe adjoining the magazine provided that their number does not exceed 25,000 and that the annexe is so constructed that not less than 60 cm masonry and 100 cm of air space shall intervene between any detonators in such annexe and the interior of the main magazine. Cases containing explosives are not to be opened in a magazine. Explosive in open cases are not to be received into a magazine. Explosives which appear to be in a damaged or dangerous condition are not to be kept in any magazine, but must be removed without delay to a safe distance and destroyed. Persons entering the magazine, must put on the magazine shoes which shall be provided at the magazine for this purpose and should be careful: - Not to put their feet on the clean floor unless they have the magazine shoes on. - Not to allow the magazine shoes to touch the ground outside the clean floor. - Not to allow any dirty or grit to fall on the clean floor. Persons with bare feet, shall before entering the magazine, dip their feet in water and then step direct from the tub over the barrier (if there be one) on to the clean floor. A brush broom shall be kept in the lobby of the magazine for cleaning out the magazine on each occasion, if it is opened for the receipt, delivery or inspection of explosives. No matches or inflammable materials shall be allowed inside the magazine. Illumination shall be obtained from an electric storage battery lantern. No smoking shall be allowed within 100 m of a magazine. No person having article of steel or iron on him shall be allowed to enter the magazine. Oily cotton, rag waste and articles liable to spontaneous ignition shall not be allowed inside the magazine.		

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Workmen shall be examined before they enter the magazine to see that they have none of the prohibited articles on their person.

The mallets, levers, wedges etc. for opening barrels or cases are to be of wood. Inside a magazine the cases of explosives are to be carried by hand and shall not be rolled or dragged. Explosives which have been issued and returned to the magazine are to be issued first; otherwise those which have been longest in store are to be issued first.

Cases of explosives must be kept clear of the walls and floors for free circulation of air on all sides, special care is to be taken to keep the floor free from grains of powder or portions of explosive matter fallen on the floors due to leakage of cases etc.

The magazine shall not be opened during any dust storm or thunderstorm nor any person shall be allowed in the vicinity of the magazine.

All magazines shall be officially inspected at definite intervals and a record of the results of such inspections shall be kept.

3.6.4.4 Carriage of Explosives

Detonators and explosives shall be transported separately to the blast site. Explosives shall be kept dry and away from the direct rays of the sun, naked lights, steam pipes or heated metal and other sources of heat. Before explosives are removed, each cage or package is to be carefully examined to ascertain that it is properly closed and shows no sign of leakage.

No person except the driver shall be allowed to travel on a vehicle conveying explosives. No carriage or vessel shall be used for transporting explosives unless all iron or steel therein with which a package containing any explosive is likely to come in contact is effectually covered with lead, leather, wood, cloth or other suitable material. No lights shall be carried on the vehicle carrying explosives.

No operation connected with the loading, unloading and handling of explosives shall be conducted after sunset.

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3.6.4.5 Use of Explosives

The Contractor shall appoint an agent who shall personally superintend the firing and all operations connected therewith.

The contractor shall satisfy himself that the person so appointed is fully acquainted with the responsibilities imposed on him.

Holes for charging explosives shall be drilled with Pneumatic drills, the drilling pattern being so planned that the rock pieces after blasting will be suitable for handling.

The hole diameter shall be of such a size that cartridges can easily pass down them and undue force is not required during charging. Charging operations shall be carried out by or under the personal supervision of the shotfirer. Wrappings shall never be removed from explosive cartridges. Only wooden rods shall be used for loading and stemming shotholes. Only one cartridge at a time shall be inserted and gently passed home with the wooden tamping rod.

Only such quantities of explosives as are required for the particular amount of work to be done shall be brought to the works. Should any surplus remain when all the holes have been charged, it shall be carefully removed to a point at least 300 m from the firing point.

The explosives shall be fired by means of an electric detonator placed inside the cartridge. For simultaneous firing of a number of charges the electric detonators shall be connected with the exploder through the shotfiring cable in a simple series circuit.

Due precautions shall be taken to keep the firing circuit insulated from the ground, bare wires, rails, pipes or any other path of stray current and to keep the lead wires short circuited until ready to fire. Any Kinks in detonator leading wire shall be avoided.

For simultaneous firing of a large number of shotholes, use of cordtex may be done. Cordtex shall be initiated by an electric detonator attached to its side with adhesive tape, connecting wire or string.

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All connections shall be made by the authorised shotfirer himself. The shotfiring cable shall not be dragged along the ground to avoid possible damage to the insulation. The shotfiring cable shall be tested for continuity and possible short circuiting before it is used each time. The shotfirer shall always carry the exploder handle on his person until he is ready to fire shots. The number of shots fired at a time shall not exceed the permissible limits. Before any blasting is carried out, it shall be ensured that all workmen, vehicles and equipment on the site are cleared from an area of minimum 300 metres radius from the firing point, or as required by statutory regulations, at least ten minutes before the time of firing by sounding a warning siren. The area shall be encircled by red flags. At least five minutes after the blast has been fired in case of electric firing or as stipulated in the regulations, the authorised shotfirer shall return to the blast area and inspect carefully and shall compare the number of blasts planted/fired to the actual number of shots heard and satisfy himself that all blast have exploded. Withdrawal unexploded charges shall not be permitted. The unexploded charges shall be flooded with water and the hole shall be marked in distinguishable manner. Another hole shall be made by drilling a parallel fresh hole not less than 450 mm from misfired hole and fired in the usual way. The process shall be continued till the original blast is exploded. The engineer shall also be informed by the Contractor of all the cases of misfired/unexploded charges, their causes and steps taken. The authorised shotfirer shall be present during removal of the debris liable to contain unexploded explosives near the misfired hole. The workmen shall not return to the site of firing until at least half an hour after firing. Adequate safety precautions as per building bye-laws, safety code, statutory regulations etc. shall be taken during blasting operations. 3.6.5 Disposal The excavated spoils will be disposed off within the specified lead in any or		

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a combination of some of the following manners, as directed by the Engineer: (a) By stacking separately the materials suitable for area filling and materials not suitable. (b) By stacking it temporarily for use in backfilling at a later date. (i) By either spreading, or (ii) Spreading and compacting at designated filling areas and/or disposal areas. 3.6.6 Dewatering All areas shall be kept free of water. Grading in the vicinity of excavations shall be controlled to prevent surface water running into excavated areas. The Contractor shall remove by pumping or other means approved by the Engineer, any water inclusive of rain water and subsoil water accumulated in the area. Method of dewatering shall be got approved by the Engineer. 3.6.7 Dealing with Surface Water All working areas shall be kept free of surface water as far as reasonably practicable. Works in the vicinity of cut areas shall be controlled to prevent the ingress of surface water. Working surfaces shall be formed to such falls to shed water and prevent ponding. No works shall commence until surface water streams have been properly intercepted, redirected or otherwise dealt with. Where works are undertaken in the monsoon period, the Contractor may need to construct temporary drainage systems to drain surface water from working areas.		

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3.7	<u>TREATMENT OF SLIPS</u> The Contractor will take all precautions to avoid high surcharges and provide proper surface drainage to prevent flow of water over the sides. These precautions along with proper slopes, berms and control of ground water should cause no slips to occur. If however slips do occur due to causes beyond control of the Contractor, the same shall be removed by him.	
3.8	<u>EARTHWORK IN FILLING</u>	
3.8.1	Area Filling for Grading	
	The material to be used for area filling shall be selected material capable of being compacted to the requirements stated herein below and approved by the Engineer, obtained directly from excavation for area grading, from nearby areas where excavation work by the same agency is in progress, from temporary stacks of excavated spoils or from borrow pits in selected areas designated/approved by the Engineer. The quality of the material shall conform to that mentioned in clause 2.5.2 of this specification. Where excavated material is mostly rock, the boulders shall be broken into pieces not more than 150 mm size, mixed with properly graded fine material consisting of murum or earth to fill up the voids and the mixtures used for filling. If any material is rejected by the Engineer, Contractor shall remove the same forthwith from the site at no extra cost to the Owner. Surplus fill material shall be deposited/disposed of as directed by the Engineer after the fill work is completed. No earthfill shall commence until surface water discharges and streams have been properly intercepted or otherwise dealt with as directed by the Engineer. Before commencement of area filling, the existing top soil shall be removed upto a minimum depth of 150 mm or more, as directed by the Engineer in order to clear the surface of undesirable materials. After this, the filling operation shall be performed with earth in layers not exceeding 250 mm,	

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loose thickness. Successive layers shall not be placed until the layer under construction has been thoroughly compacted to the specified requirements as given below and got approved by the Engineer. (a) Each layer of earth of cohesive in nature shall be compacted to 95% of proctors dry density unless otherwise permitted/directed by the Engineer. (b) Each layer of earth of non-cohesive in nature shall be compacted to minimum 75% relative density unless otherwise permitted/directed by the Engineer. Each shall be compacted with approved machine (mechanical plant) and usually manual compaction shall not be allowed unless specifically permitted by the Engineer. The original ground formation and each fill layer shall be compacted by rollers as described below with a maximum of six passes of 8/10 tonne roller. (i) When the optimum moisture content of soil is relatively high, a pneumatic tyred roller (tyre pressure 3.0 - 3.5 kg/sq.cm) shall be considered to give better performance for mechanical compaction. (ii) When the optimum moisture content of soil is relatively low, a vibrating roller shall be considered to give better performance for mechanical compaction. Since the degree of compaction depends on the moisture content of the soil, a close watch shall be kept on this aspect and corrections done to optimise the moisture content. The adequacy of the compaction and moisture content of the soil shall be determined by performing field density tests and other tests as and when directed by the Engineer and shall conform to the stipulations laid down in IS:4701. The cohesionless soil to be used for area filling, should be placed in fully saturated condition to obtain the maximum possible density. The saturation moisture content shall be determined by laboratory tests prior to commencement of work. Field compaction test shall be carried out at different stages of filling and also after the fill to the entire height has been completed.		

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When density measurements reveal soft areas in the construction, further compaction shall be undertaken at the contractor's cost as directed by the Engineer. If the required compaction is not achieved, the material in the soft area shall be removed and replaced by approved material and compacted in accordance with this specification, all to the contractor's account.

The fill shall be carried out to such dimensions and levels as indicated on the drawings after the stipulated compaction. The fill will be considered as incomplete if the desired compaction has not been obtained.

If so specified, the rock as obtained from excavation may be used for filling and levelling to indicate grades without further breaking. In such an event, filling shall be done in layers not exceeding 50 cms approximately. After rock filling to the approximate level, indicated above has been carried out, the void in the rocks shall be filled with finer materials such as earth, broken stone etc. and the area flooded so that the finer materials fill up the voids. Care shall be taken to ensure that the finer fill material does not get washed out. Over the layer so filled, a 100 mm thick mixed layer of broken material and earth shall be laid and consolidation carried out by a 12 tonne roller. No less than 12 passes of the roller shall be accepted before subsequent similar operations are taken up.

3.8.2 Filling in Disposal Areas

Excavated materials if not used in area filling, will be disposed of in designated disposal areas as directed or as indicated in the drawings. The earth shall not be dumped haphazardly but shall be spread in horizontal layers not exceeding 500 mm in thickness and nominal compaction done to the satisfaction of the Engineer.

All clods shall be broken before placing the fill. Earthmoving machinery including dumpers, dozers and trucks shall be allowed to ply over the fill to permit compaction to take place.

In wide areas rollers may be employed and nominal compaction done to the satisfaction of the Engineer.

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3.9 COMPACTION CONTROL

The density of each layer of compacted soil shall be ascertained by testing a number of samples. For this purpose the necessary arrangements for soil testing at the site shall be made by the Contractor in accordance with these specifications and as directed by the Engineer.

The Contractor shall arrange the provision of the field laboratory including the testing equipment and a suitable motor vehicle. He shall also supply all consumable materials such as kerosene, spirit, gas and sample bags, as required.

All soil testing is to be carried out by a competent and suitable qualified engineering testing firm. The Contractor is to obtain the Engineer's approval for the firm to be used. The Contractor may undertake this work with the Engineer's approval.

All density testing shall be carried out on a lot by lot basis. A lot shall be considered to be a portion of work which is essentially homogeneous with respect to material type general appearance response during compaction, moisture condition during compaction, compaction process and state of underlying material.

All fill testing shall be carried out in accordance with the recent editions of relevant Indian Standards. The chainage and the off-set from the centre line of the fill of each test sample shall be recorded and presented along with the test results.

Each test lot shall be classified as cohesionless or cohesive. The classification shall be determined by the Engineer based upon particle size distribution. Cohesionless fill shall have 10% or less by mass of particles finer than 0.075 mm. Otherwise fill shall be treated cohesive.

For cohesionless fill material, a representative laboratory sample obtained from three field samples from each test lot shall be tested to determine its maximum and minimum dry density. These reference values of dry density shall be used to compute the density index (relative density) of each of the field density test samples taken from the test lot.

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For cohesive fill material, a representative laboratory sample obtained from three field samples from each test lot shall be tested to determine its maximum dry density and optimum moisture content (OMC). These reference values of dry density and moisture content shall be used to compute the dry density ratio of each of the field density test samples taken from that test lot. The degree of compaction shall be determined by considering the mean density of the samples in each test lot. The mean dry density shall be equal to or exceed the minimum specified density. In no individual case shall density be less than the minimum value specified by more than 2 percent; otherwise further rolling shall be done at the appropriate locations. The contractor shall lay a further layer or fill only after compaction or a particular layer has been found and approved by the Engineer. 4.0 <u>TESTING AND ACCEPTANCE CRITERIA</u> 4.1 <u>SOIL TESTING</u> The following tests shall be undertaken by the Contractor and results and reports shall be submitted to the Engineer for approval. Test failures are to be immediately notified to the Engineer, otherwise results to be submitted within 24 hours of testing. Each layer of material shall be tested for compaction. Each layer is to be tested in a manner that is representative of its full depth. The Engineer may at his discretion instruct the Contractor to increase or decrease the frequency of testing. (a) Minimum one test per 500 cu.m. of soil coming out of the borrow pits for determination of natural moisture contents in order to evaluate how far the natural moisture content tallies with the optimum value and whether further addition or reduction of water content would be necessary. Test to be done in accordance with IS: 2720 (Part-II). (b) Minimum two sets of laboratory tests per 8000 cu.m. of soil coming out of the borrow pits for determination of dry density at optimum		

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moisture content. Test to be done in accordance with IS: 2720 (Part-VII, XIV, XXVIII, XXIV) as applicable. (c) Minimum two sets of test per 500 cu.m. of loose fill for determination of moisture content just prior to compaction of area filling. Test to be done in accordance with IS: 2720 (Part-II). (d) For each compacted layer, minimum one test per 2000 sq.m. of compacted area for determination of moisture content and dry density. (e) Minimum two tests per 8000 cu.m. of soil for determination of soil classification. Test to be done in accordance with IS: 2720 (Part-IV). (f) Minimum 10 (ten) density measurements shall be plotted to establish moisture content-dry density relationship. 4.2 <u>ACCEPTANCE CRITERIA</u> 4.2.1 Excavation On completion of excavation, the dimensions of the area will be checked as per the drawings after the area is completely dewatered. The work will be accepted after all undercuts have been set right and all over excavations filled back to required lines, levels and grades by compacted earth. Over excavation of the sides will be made good free of cost by the Contractor. The excavation work will be accepted after the above requirements are fulfilled & all temporary approaches encroaching inside the required dimension of the excavation have been removed. 4.2.2 Area-filling The degree of compaction required will be as per the stipulations laid down in appropriate sections of this specification. The actual method for measuring the compaction achieved will be as decided by the Engineer. The work of area filling will be accepted after the Engineer is satisfied with the degree of compaction achieved.		

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5.0 INFORMATION TO BE SUBMITTED

5.1 WITH TENDER

Following details of Machineries, transport vehicles, equipment proposed to be used for excavation, area-filling and compaction have to be submitted along with the tender:

- (a) Equipment, machinery & earthmoving vehicles, available with the Contractor and proposed to be used for excavation and haulage giving details regarding make, model, capacity, year of manufacture, numbers available for this contract and general condition.
- (b) Equipment proposed to be used for area filling and compaction giving similar details as in item 5.1 (a) above.
- (c) Method of transportation.

5.2 AFTER AWARD

After award of contract the successful bidder shall submit the following for approval and adoption:

- (a) Within 15 days of Award of the contract, the Contractor shall submit a detailed programme of work as proposed to be executed giving completion dates of excavation of the various areas and the time required for area-filling and compaction. The programme should also show how the excavation and area-filling quantities will be balanced, minimising temporary stacking of spoils.

It is to be noted that the Engineer even after initial approval of the programme, may instruct to enhance or retard the progress of work during the actual execution, in order to match with overall construction schedule without attracting any claims from the Contractor. The initial programme being submitted by the Contractor should have sufficient flexibility to take care of such reasonable variations.

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(b) Within 15 days of award, the Contractor shall submit drawings showing details of slopes, approaches, sump pits, dewatering lines, borrow pits, if any, fencing etc. for approval of the Engineer for adoption.		

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1.0 <u>SCOPE</u> This specification covers excavation in all types of soil, soft and decomposed rock not requiring blasting and rocks requiring blasting, shoring, dewatering, filling around foundations and to grade, compaction of fills and approaches, protective fencing, lighting, etc. relevant to structures and locations covered under the scope of this contract. 2.0 <u>GENERAL</u> 2.1 <u>WORK TO BE PROVIDED FOR BY THE CONTRACTOR</u> The work to be provided for by the Contractor, unless specified otherwise, shall include but not be limited to the following: (a) Furnish all labour, supervision, services including facilities as required under statutory labour regulations, materials, scaffolds, equipment, tools and plants, transportation, etc. required for the work. (b) Prepare and submit working drawings showing the approaches, slopes, berms, shoring, sumps for dewatering, including drains and outfall for drainage, space for temporary stacking of spoils, disposal area, fencing, etc. and all other details as may be required by the Engineer. (c) To carry out sampling and testing and submit to the Engineer, results of soil compaction tests whenever required by the Engineer to assess the degree of compaction. (d) Construction, maintenance and removal after completion of magazine of proper capacity as well as design for storing of explosives required for blasting work to be carried out under the scope of this Tender including procurement of necessary licenses from proper authorities.		

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2.2 WORK TO BE PROVIDED FOR BY OTHERS

2.3 CODES AND STANDARDS

(a)	IS:1200 (Part-I)	:	Method of Measurement of Building and Civil Engineering work; Part - I Earthwork.
(b)	IS:2720 (Part-II)	:	Determination of Moisture Content
(c)	IS:2720 (Part-VII)	:	Determination of Moisture content / Dry Relation using Light Compaction.
(d)	IS:2720 (Part-XIV)	:	Determination of Density Index (Relative Density) of cohesionless soils.
(e)	IS:2720 (Part xxix)	:	Determination of Dry Density, in place, by core cutter method.
(f)	IS:2720 (Part-xxviii)	:	Determination of Dry Density of soils, in place, by sand replacement methods.
(g)	IS:3764	:	Safety code for Excavation work.
(h)	IS:4081	:	Blasting and Related Drilling Operations
(i)	IS:4701	:	Earthwork on canals

2.4 CONFORMITY WITH DESIGNS

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the Engineer's instructions. 2.5 <u>MATERIALS TO BE USED</u> 2.5.1 General All materials required for the work shall be of best commercial variety and approved by the Engineer. 2.5.2 Borrow Material Borrow material required for back-filling shall be excavated from approved locations and levels, and shall consist of material, approved by the Engineer, free from roots, vegetations, decayed organic matter, harmful salts and chemicals, free from lumps and clods. If specified, clean graded sand free from harmful and deleterious material from approved quarries shall be used as fill material. 2.6 <u>QUALITY CONTROL</u> The Contractor shall establish and maintain quality control for the various aspects of the work, method, materials and equipment used. The quality control operation shall include but not be limited to the following items of work: 2.6.1 Lines, Levels and Grades (a) Periodic Surveys (b) Establishment of markers, boards etc. (c) Checking the quality of fill material 2.6.2 Back-filling (a) Checking moisture content of the back fill (b) Checking the degree of compaction		

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2.7	<u>INFORMATION REGARDING SITE CONDITIONS</u> Surface and Sub-surface data regarding the nature of soil, rock, sub-soil water etc. shown on drawing or otherwise furnished to the Contractor shall be taken as guidance only and variation there from shall not affect the terms of the contract. The Contractor must satisfy himself regarding the character and volume of all work under this contract and expected surface, sub-surface and/or sub-soil water to be encountered. He must also satisfy himself about the general conditions of site and ascertain the existing and future construction likely to come up during the execution of the contract so that he may evolve a realistic programme of execution. <u>3.0 EXECUTION</u> <u>3.1 SETTING OUT</u> The Contractor will prepare and submit to the Engineer, detailed drawings of the excavation work as proposed to be executed by him showing the dimensions as per drawings and specification adding his Proposals of slopes, shorings, approaches, dewatering sumps, berms, etc. On receiving the approval from the Engineer with modifications and corrections, if necessary, the Contractor will set out the work from the control points furnished by the Engineer and fix permanent points and markers for ease of future checking. These permanent points and markers will be fixed at intervals prescribed by the Engineer and checked by the Engineer and certified by him after which the Contractor will proceed with the work. Engineer shall be provided with necessary men, material and instructions for such checking. It should be noted that this checking by the Engineer prior to start of the work will in no way absolve the Contractor of his responsibility of carrying out the work to true lines and levels and grades as per drawing and subsequent corrections, if necessary, in case any errors are noticed in the Contractor's work at any stage. <u>3.2 INITIAL LEVELS</u> Initial levels of the ground either in a definite grid pattern or as directed by	

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the Engineer will be taken by the Contractor jointly with the Engineer over the original ground prior to starting actual excavation work and after setting out. These initial levels will be used for preparing cross-sections for volume measurement or for cross-checking the depths obtained from tape measurements. All records of levels, measurements etc. and also any drawing, cross section etc. made there from, shall be jointly signed by the authorised representative of the contractor and the Engineer before the commencement of work and they shall form the basis of all payments in future. 3.3 <u>CLEARING AND GRUBBING ETC.</u> The area to be excavated or filled shall be cleared out of fences, trees, logs, stumps, bush, vegetation, rubbish, slush, etc. and levelled up. Trees upto 300mm girth shall be uprooted. Trees above 300 mm girth to be cut, shall be approved by the Engineer and then marked. Felling of trees shall include taking out roots upto 600 mm below ground level or 150 mm below formation level whichever is lower. After the tree is cut and roots taken out, the pot-holes formed shall be filled with good earth in 250 mm layers and consolidated unless directed by the Engineer otherwise. The trees shall be cut in suitable pieces as instructed by the Engineer. Before earthwork is started, all the spoils and unserviceable materials and rubbish shall be burnt or removed from the site to approved disposal areas as may be specified. Ash shall be spread or removed. Useful materials, saleable timber, firewood, etc. shall be the property of the Owner and shall be stacked properly at the worksite in a manner as directed by the Engineer. 3.4 <u>CLASSIFICATION</u> All earthwork shall be classified under the following categories : No distinction will be made whether the material is dry or wet. (a) Ordinary Soil This shall comprise vegetable or organic soil, turf, sand, silt, loam, clay, mud, peat, black cotton soil, soft shale or loose moorum, a mixture of these and similar material which yields to the ordinary		

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application of pick and shovel, rake or other ordinary digging implement. Removal of gravel or any other nodular material having diameter in any one direction not exceeding 75 mm occurring in such strata shall be deemed to be covered under this category. (b) Hard Soil This shall include: (i) Stiff heavy clay, hard shale, or compact moorum requiring grafting tool or pick or both and shovel, closely applied. (ii) gravel and cobble stone having maximum diameter in any one direction between 75 and 300 mm, soling of roads, paths, etc. and hard core, (iii) macadam surfaces such as water bound and bitumen/tar bound, (iv) lime concrete, stone masonry in lime mortar and brick work in lime/ cement mortar, below ground level, (v) soft conglomerate, where the stones may be detached from the matrix with picks and (vi) generally any material which requires the close application of picks, or scarifiers to loosen and not affording resistance to digging greater than the hardest of any soil mentioned in (i) and (vi) above. (c) Soft and Decomposed Rock This shall include: (i) limestone, sandstone, laterite, hard conglomerate or other soft or disintegrated rock which may be quarried or split with crowbars; (ii) Unreinforced cement concrete which may be broken up with		

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crowbars or picks and stone masonry in cement mortar below ground level ; (iii) Boulders which do not require blasting having maximum diameter in any direction of more than 300 mm, found lying loose on the surface or embedded in river bed, soil, talus, slope wash and terrace material of dissimilar origin ; and (iv) Any rock which in dry state may be hard, requiring blasting, but which when wet becomes soft and manageable by means other than blasting. (d) Hard Rock (requiring blasting) This shall include: (i) Any rock or cement concrete for the excavation of which the use of mechanical plant or blasting is required ; (ii) Reinforced cement concrete (reinforcement cut through but not separated from the concrete) below ground level; and (iii) Boulders requiring blasting. (e) Hard Rock (blasting prohibited) Hard rock requiring blasting as described under (d) but where blasting is prohibited for any reason and excavation has to be carried out by chiselling, wedging or any other agreed method. In case of any dispute regarding classification, the decision of the Engineer shall be final. 3.5 EXCAVATION FOR FOUNDATIONS AND TRENCHES 3.5.1 General All excavations shall be done to the minimum dimensions as required for safety and working facility. Prior approval of the Engineer shall be obtained		

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by the Contractor, in each individual case, for the method he proposes to adopt for the excavations including dimension, side slopes, shoring, dewatering, disposal, etc. This approval, however, shall not in any way make the Engineer responsible for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. All excavation in open cuts shall be made true to line, slopes and grades shown on the drawing or directed by the Engineer. No material shall project within the dimension of minimum excavation lines marked. Boulders projecting out of the excavated surfaces shall be removed, if in the opinion of the Engineer they are likely to be a hindrance to the workers. Method of excavation shall be in every case subject to the approval of the Engineer and the Contractor shall ensure the stability and safety of the excavation, adjacent structures, services and works. The Contractor shall have full responsibility of the stability of the excavation and safety of the workmen. If any slip occurs, the Contractor shall remove all slipped material from the excavated pit. All loose boulders, semi-detached rocks, not directly in excavation but so close to the area to be excavated as to be liable, in the opinion of the Engineer, to fall or otherwise endanger the workmen, equipment of the work etc., shall be stripped off and removed away from the areas of excavation. The method used shall be such as not to shatter or render unstable or unsafe the portion which was originally sound and safe. Any materials not requiring removal as contemplated in the work, but which, in the opinion of the Engineer, is later to become loose or unstable shall also be promptly and satisfactorily removed as directed by the Engineer. Prior to starting the excavation, the ground level at the location shall be checked jointly with the Engineer. The rough excavation may be carried upto a maximum depth of 150 mm above the final level. The balance shall be excavated with special care. If directed by the Engineer, soft and undesirable spots shall be removed even below the final level. The extra excavation shall be filled up as instructed by the Engineer.		

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If the excavation is done to a depth greater than that shown on the drawing, or directed by the Engineer, due to the Contractor's fault, the excess depth shall be filled up to the required level (with cement concrete not leaner than 1:4:8 ordinary concrete or richer) as directed by the Engineer in each individual case. In formation of rock requiring blasting, those overcuts which are unavoidable will be made up by ordinary cement concrete 1:2:4. All excavated materials such as hard rock, boulders, bricks, dismantled concrete blocks etc. shall be stacked separately as directed by the Engineer and shall be the property of the Owner. 3.5.2 Excavation in Ordinary Soil, Hard Soil and Soft and Decomposed Rock The excavation in ordinary soil, hard soil, soft and decomposed rock will be carried out as per the approved proposal, modified and corrected where necessary by the Engineer. The work will be carried out in a workmanlike manner without endangering the safety of nearby structures/services or works and without causing hindrance to other activities in the area. As the excavation reaches the required dimensions, lines, levels and grades, the work will be checked by the Engineer thoroughly and the balance work will be carried out carefully to avoid any over-excavation. On completion, the work will be finally checked and approved by the Engineer. In certain cases, where deterioration of the ground, upheaval, slips etc. are expected, the Engineer may order to suspend the work at any stage and instruct the Contractor to carry out the balance work just before the foundation work of the structure can be started. 3.5.3 Excavation in Hard Rock In case where excavation, both in ordinary soil and hard rock, are involved, the ordinary soil comprising of soft, hard and dense soils (including laterite formations) and rock including weathered rocks, lateritic rocks, etc. which can be excavated without blasting, shall be completely stripped off. Further work in hard rock shall be resumed after clearance from the Engineer. Personnel deployed for rock excavations shall be protected from all hazards such as loose rock/boulder rolling down and from general slips of excavated surfaces. Where the excavated surface is such that it is not stable		

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against sliding, necessary supports, props, bracings or bulkheads shall be provided and maintained during the period of construction. Where danger exists of loose rock/boulder falling from the excavated surfaces deeper than 2 metres, steel mesh anchored to the lower edge of excavation and extending over and above the rock face, adequate to retain the dislodged material shall be provided and maintained. In case where blasting, though otherwise required, is prohibited for any reasons, the excavation shall be carried out by chiselling, wedging or any other approved method. 3.5.4 Blasting 3.5.4.1 General Storage, handling and use of explosives shall be governed by the current explosive rules laid down by the Central and the State Governments. The Contractor shall ensure that these rules are strictly adhered to. The following instruction, wherever found in variance with the above rules, shall be considered as superseded by the above rules. No child under the age of 16 and no person who is in a state of intoxication shall be allowed to enter the premises where explosives are stored nor they shall be allowed to handle the explosives. 3.5.4.2 Storage of Explosive Storage of explosives shall be governed by the current Explosive Rules, Explosives shall be stored in a clean, dry, well ventilated magazine to be specially built for the purpose. Under no circumstances should a magazine be erected within 400 m of the actual work site or any source of fire. A space surrounding the magazine shall be fenced in. The ground inside the fence shall be kept clear and free from trees, bushes etc. The admission to this fenced space shall be by one gate only and no person shall be allowed inside this fence without permission of the Officer-in-charge. The clear space between the fence and the magazine shall not be less than 90m. The mezzanine shall be perfectly well drained.		

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Two lightning conductors shall be provided to the magazine, one at each end. The lightning conductors shall be tested once in every year. Fuses and detonators shall be stored in separate magazines. However, detonators can be kept in an annexe adjoining the magazine provided that their number does not exceed 25,000 and that the annexe is so constructed that not less than 60 cm masonry and 100 cm of air space shall intervene between any detonators in such annexe and the interior of the main magazine. Cases containing explosives are not to be opened in a magazine. Explosive in open cases are not to be received into a magazine. Explosives which appear to be in a damaged or dangerous condition are not to be kept in any magazine, but must be removed without delay to a safe distance and destroyed. Artificial light is not to be allowed in any magazine. No smoking shall be allowed within 100 m of a magazine. Magazine shoes without nails shall be used while entering the magazine. The mallets, levers, wedges etc. for opening barrels or cases are to be of wood. Inside a magazine the cases of explosives are to be carried by hand and shall not be rolled or dragged. Explosives which have been issued and returned to the magazine are to be issued first; otherwise those which have been longest in store are to be issued first. Cases of explosives must be kept clear of the walls and floors for free circulation of air on all sides. Special care is to be taken to keep the floor free from grains of powder or portions of explosive matter fallen on the floors due to leakage of cases etc. The magazine shall not be opened during any dust storm or thunderstorm nor shall any person be allowed in the vicinity of the magazine. All magazines shall be officially inspected at definite intervals and a record kept of the results of such inspections. 3.5.4.3 Carriage of Explosives Detonators and explosives shall be transported separately to the blast site.		

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Explosives shall be kept dry and away from the direct rays of the sun, naked lights, steam pipes or heated metal and other sources of heat. Before explosives are removed, each cage or package is to be carefully examined to ascertain that it is properly closed and shows no sign of leakage. No person except the driver shall be allowed to travel on a vehicle conveying explosives. No carriage or vessel shall be used for transporting explosives unless all iron or steel therein with which a package containing any explosive is likely to come in contact is effectually covered with lead, leather, wood, cloth or other suitable material. No lights shall be carried on the vehicle carrying explosives. No operation connected with the loading, unloading and handling of explosives shall be conducted after sunset. 3.5.4.4 Use of Explosives The Contractor shall appoint an agent who shall personally superintend the firing and all operations connected therewith. The contractor shall satisfy himself that the person so appointed is fully acquainted with the responsibilities imposed on him. Holes for charging explosives shall be drilled with Pneumatic drills, the drilling pattern being so planned that the rock pieces after blasting will be suitable for handling. The hole diameter shall be of such a size that cartridges can easily pass down them and undue force is not required during charging. Charging operations shall be carried out by or under the personal supervision of the shot firer. Wrappings shall never be removed from explosive cartridges. Only wooden rods shall be used for loading and stemming shotholes. Only one cartridge at a time shall be inserted and gently passed home with the wooden tamping rod. Only such quantities of explosives as are required for the particular amount of work to be done shall be brought to the works. Should any surplus remain when all the holes have been charged, it shall be carefully removed to a point at least 300 m from the firing point.		

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The explosives shall be fired by means of an electric detonator placed inside the cartridge. For simultaneous firing of a number of charges the electric detonators shall be connected with the exploder through the shotfiring cable in a simple series circuit. Due precautions shall be taken to keep the firing circuit insulated from the ground, bare wires, rails, pipes or any other path of stray current and to keep the lead wires short circuited until ready to fire. Any kinks in detonator leading wire shall be avoided. For simultaneous firing of a large number of shotholes, use of cordtex may be done. Cordtex shall be initiated by an electric detonator attached to its side with adhesive tape, connecting wire or string. All connections shall be made by the authorised shotfirer himself. The shotfiring cable shall not be dragged along the ground to avoid possible damage to the insulation. The shotfiring cable shall be tested for continuity and possible short circuiting before it is used each time. The shotfirer shall always carry the exploder handle on his person until he is ready to fire shots. The number of shots fired at a time shall not exceed the permissible limits. Blasting shall only be carried out at certain specified times to be agreed jointly by the contractor and the Engineer. Before any blasting is carried out, it shall be ensured that all workmen, vehicles and equipment on the site are cleared from an area of minimum 300 metres radius from the firing point, or as required by statutory regulations, at least ten minutes before the time of firing by sounding a warning siren. The area shall be encircled by red flags. At least five minutes after the blast has been fired in case of electric firing or as stipulated in the regulations the authorised shotfirer shall return to the blast area and inspect carefully the work and satisfy himself that all charged holes have exploded. Cases of misfired unexploded charges shall be exploded by drilling a parallel fresh hole not less than 600 mm from the misfired hole and by exploding a new charge. The authorised shotfirer shall be present during removal of the debris liable to contain unexploded explosives near the misfired hole. The workmen shall not return to the site of firing until at least half an hour after firing.		

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3.5.5 3.5.6 3.5.7 Disposal The excavated spoils will be disposed of in any or all the following manners: (a) By using it for backfilling straightway. (b) By stacking it temporarily for use in backfilling at a later date during execution of the Contract. (c) (i) By either spreading, Or (ii) Spreading and compacting at designated filling areas and /or disposal areas. (d) By selecting the useful material and stacking it neatly in areas designated by the Engineer for use in backfilling by some other agency. Disposal of Surplus All surplus material from excavation shall be carried away from the excavation site to designated disposal area selected by the Engineer. All good and sound rock excavated from the pits and all assorted materials of dismantled structures shall be the property of the Owner. Protection The Engineer shall be notified by the Contractor as soon as the excavation is expected to be completed within a day so that it may be inspected by him at the earliest. Immediately after approval of the Engineer, the excavation must		

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be covered up in the shortest possible time. But, in no case the excavation shall be covered up or worked on before approval and measurement by the Engineer. Excavated material shall be placed beyond 1.5 metres from the edge of the pit or trench or half the depth of the pit or trench whichever is more or further away if directed by the Engineer. Excavation shall not be carried out below the foundation level of structure close by until required precautions have been taken. Adequate fencing is to be made enclosing the excavation. The Contractor shall protect all under-ground services exposed by excavation. The Contractor shall also divert all surface drains, etc. affected by the excavation to maintain the working area neat and clean. 3.5.8 Dealing with Surface Water All working areas shall be kept free of surface water as far as reasonably practicable. Works in the vicinity of cut areas shall be controlled to prevent the ingress of surface water. No works shall commence until surface water streams have been properly intercepted, redirected or otherwise dealt with. Where works are undertaken in the monsoon period, the Contractor may need to construct temporary drainage systems to drain surface water from working areas. 3.5.9 Dewatering All excavations shall be kept free of water and slush. Grading in the vicinity of excavations shall be controlled to prevent surface water running into excavated areas. The Contractor shall remove by pumping or other means approved by the Engineer any water inclusive of rain water and subsoil water accumulated in excavation and keep the trench dewatered until the construction of foundation structure and backfilling are complete in all respects. (Except where such dewatering would need installation of well points or deep wells for which separate payment will be made) Sumps made for dewatering must be kept clear of the foundations. Method of pumping		

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shall be approved by the Engineer but in any case, the pumping arrangement shall be such that there shall be no movement of subsoil or blowing in due to differential head of water during pumping. 3.5.10 Timber Shoring Timber Shoring made out of approved quality of timber shall be 'close' or 'open' type, depending on the nature of soil and the depth of pit or trench and the type of timbering shall be determined by the Engineer. It shall be the responsibility of the Contractor to take all necessary steps to prevent the sides of trenches and pits from collapsing. 3.5.10.1 Close Timbering Close timbering shall be done by completely covering the sides of the trenches and pits generally with short, upright members called 'polling boards'. These shall be of minimum 250 x 40 mm sections as directed by the Engineer. The boards shall generally be placed in position vertically in pairs, one board on each side of cutting, and shall be kept apart by horizontal walers of strong wood at maximum 1.2 metres spacing, cross strutted with ballies or as directed by the Engineer. The length of the bally struts shall depend on the width of the trench or pit. In case where the soil is very soft and loose, the boards shall be placed horizontally against the sides of the excavation and supported by vertical walers, which shall be strutted to similar timber pieces on the opposite face of the trench or pit. The lowest board supporting the sides shall be taken into the ground. No portion of the vertical side of the trench or pit shall remain exposed, so that the earth is not liable to slip out. The withdrawal of the timber shall be done very carefully to prevent the collapse of the pit or trench. It shall be started at one end and preceded systematically to the other end. Concrete or masonry shall not be damaged during the removal of the timber. No claim shall be entertained for any timber which cannot be withdrawn and is lost or buried. 3.5.10.2 Open Timbering In the case of open timbering, the entire surface of the side of trench pit is		

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not required to be covered. The vertical board of minimum 250 mm width and minimum 40 mm depth shall be spaced sufficiently apart to leave unsupported strips of maximum 500 mm average width. The detailed arrangement, sizes of the timber and the distances apart shall be subject to the approval of the Engineer. In all other respects, specification for close timbering shall apply to open timbering. 3.6 <u>TREATMENT OF SLIPS</u> The Contractor will take all precaution to avoid high surcharges and provide proper surface drainage to prevent flow of water over the sides. These precautions along with proper slopes, berms, shoring and control of ground water should cause no slips to occur. If however slips do occur due to causes beyond the control of the Contractor, the same shall be removed by him and payment shall be made to him on appropriate item rate of earthwork. Slips caused due to negligence of the Contractor will be cleared and back- filled later by him. 3.7 <u>BACK-FILLING</u> 3.7.1 General The material used for backfilling shall consist of material, approved by the Engineer obtained directly from nearby areas where excavation work by the same agency is in progress, from temporary stacks of excavated spoils or from borrow pits from selected areas designated by the Engineer. The material shall be free from lumps and clods, roots and vegetations, harmful salts and chemicals, organic materials, etc. In certain locations, the Engineer may direct sand fillings. The sand should be clean, well graded and be of quality normally acceptable for use in concrete. 3.7.2 Filling and Compaction in Pits and Trenches around Structures As soon as the work in foundations has been accepted and measured, the spaces around the foundation structures in pits and trenches shall be cleared of all debris, brick bats, mortar droppings, etc., and filled with earth in layers not exceeding 250 mm in loose thickness each layer being watered,		

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rammed and properly compacted to achieve a dry density of not less than 95% of proctor's dry density at optimum moisture content as per IS-2720 (Part-VII) where backfilling with cohesive soil and sandy silt containing high percentage of silt. For back filling with sand having little or no silt, each layer shall be compacted to a relative density of 75% as per IS 2720 part XIV. Earth shall be rammed with approved mechanised compaction machine. Usually, no manual compaction shall be allowed unless specifically permitted by the Engineer. The final surface shall be trimmed and levelled to proper profile as shown in the drawing and as desired by the Engineer. Since the degree of compaction depends on the moisture content of the soil, a close watch should be kept on it and corrections done to optimise the moisture content. 3.7.3 Plinth Filling The plinth shall be filled with earth in layers not exceeding 250 mm in loose thickness, watered and compacted as stated under clause no. 3.7.2 with approved compaction machine or manually, if specifically permitted by the Engineer. When the filling reaches the finished level, the surface shall be flooded with water for at least 24 hours, allowed to dry and then rammed and compacted, in order to avoid any settlement at a later stage. The finished level of the filling shall be trimmed to the slope intended to be given to the floor. 3.7.4 Filling in Trenches for Water Pipes and Drains Earth used for filling shall be free from salts, organic or other foreign matter. All clods of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not bigger than 150 mm size in any direction, mixed with fine material consisting of disintegrated rock, moorum or earth as available, so as to fill up the voids as far as possible and then the mixture used for filling. The types of bedding & pipe surround material shall be as specified in the drawings. Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed.		

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3.7.5	Where the trenches are excavated in soil, the filling shall be done with earth on the sides and top of pipes in layers not exceeding 150 mm, watered, rammed and compacted taking care that no damage is caused to the pipe below. Filling of trenches shall be carried out simultaneously on both sides of the pipe in such a manner that unequal pressures do not occur. In case of excavation of trenches in rock, the filling upto a depth of 300 mm or the diameter of the pipe whichever is more, above the crown of pipe or barrel shall be done with fine material such as earth, moorum, disintegrated rock or ash according to the availability at site. The remaining filling shall be done with rock filling of boulders of size not exceeding 150 mm mixed with fine material as available to fill up the voids, watered, rammed and compacted. Surplus material from excavation which is not required for backfilling will be disposed of in designated disposal areas. The spoils shall not be dumped haphazardly but should be spread in layers approximately 250 mm thick when loose and compacted with the help of compacting equipment. In wide areas rollers will be employed and compaction done to the satisfaction of the Engineer at the optimum moisture content which shall be checked and controlled by the Contractor. In certain cases the Engineer may direct disposal without compaction which can be done by tipping the spoils from a high bench neatly maintaining always a proper level and grade of the bench. 3.8 <u>APPROACHES AND FENCING</u> The Contractor should provide and maintain proper approaches for workmen and for inspection. The roads and approaches around the excavated pits should be kept clear at all times so that there is no hindrance to the movement of men, material and equipment of various agencies connected with the Project. Sturdy and elegant fencing is to be provided around the top edge of the excavation as well as the bottom of the fill at the surplus disposal area where dumping from a high bench is in progress.	

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3.9	<u>LIGHTING</u> Full scale area lighting is to be provided if night work is permitted or directed by the Engineer. If no night work is in progress, red warning lights should be provided at the corners of the excavated pit and the edges of the fill.	
4.0	<u>TESTING AND ACCEPTANCE CRITERIA</u>	
4.1	<u>EXCAVATION</u> On completion of excavation, the dimensions of the pits will be checked as per the drawings after the pits are completely dewatered the work will be accepted after all undercuts have been set right and all over excavations filled back to required lines, levels and grades by placing ordinary concrete of 1:4:8 proportion and/or richer and/or by compacted earth, as directed by the Engineer. The choice of grade of concrete will be a matter of unfettered discretion of the Engineer. Over excavation of the sides will be made good by the Contractor while carrying out the back-filling. The excavation work will be accepted after the above requirements are fulfilled and all temporary approaches encroaching inside the required dimension of the excavation have been removed.	
4.2	<u>BACK-FILLING</u> The degree of compaction shall be sufficient to achieve a dry density of not less than 95% of proctor's dry density at optimum moisture content as per IS-2720 (Part-VII) or a relative density of 75% as per IS-2720 (Part-XIV) as applicable depending on the nature of back filling material as stated in clause no. 3.7.2 of this specification. The work of back-filling will be accepted after the Engineer is satisfied with the degree of compaction achieved.	
5.0	<u>INFORMATION TO BE SUBMITTED</u>	
5.1	<u>WITH TENDER</u> Details of Equipment proposed to be used for excavation, back-filling and compaction have to be submitted along with the tender.	

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5.2 <u>AFTER AWARD</u> After award of the Contract the successful tenderer shall submit the following for approval and adoption: (a) The Contractor shall submit a detailed programme of the work as proposed to be executed giving completion dates of excavation of the various foundations and the time required for back-filling and compaction after completing the foundation for structures. The programme should show how the excavation and back-filling quantities will be balanced, minimising temporary stacking of spoils. It is to be noted that the Engineer even after initial approval of the programme, may instruct to enhance or retard the progress of work during the actual execution, in order to match with the progress of foundations without attracting any claims from the Contractor. The initial programme being submitted by the Contractor should have sufficient flexibility to take care of such reasonable variations. (b) The Contractor shall submit drawings showing details of slopes, shorings, approaches, sump pits, dewatering lines, fencing etc. for approval of the Engineer for adoption.		

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SECTION – 3

CEMENT CONCRETE (PLAIN & REINFORCED)

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1.0 <u>SCOPE</u> 1.1 <u>GENERAL</u> This specification covers all the requirements, described hereinafter for general use of Plain and Reinforced Cement Concrete work in Structures and locations, cast-in-situ or precast, and shall include all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work. 1.2 This specification shall also apply to the extent it has been referred to or applicable with the special requirements of structures covered in SCOPE of IS:456. 1.3 IS:456 shall form a part of this specification and shall be complied with unless permitted otherwise. For any particular aspect not covered by this Code, appropriate IS Code, specifications and/or replacement by any International Code of practice as may be specified by the Engineer shall be followed. All codes and Standards shall conform to its latest revisions. A list of IS codes and Standards is enclosed hereinafter for reference. 2.0 <u>GENERAL</u> 2.1 <u>WORK TO BE PROVIDED FOR BY THE CONTRACTOR</u> The work to be provided for by the Contractor, unless otherwise specified shall include but not be limited to the following:- (a) Furnish all labour, supervision, services including facilities as may be required under statutory labour regulations, materials, forms, templates, supports, scaffolds, approaches, aids, construction equipment, tools and plants, transportations, etc. required for the work (b) Contractor shall prepare progressively and submit for approval detailed drawings and Bar Bending Schedules for reinforcement bars showing the positions and details of spacers, supports, chairs, hangers etc		

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(c) Design and prepare working drawings of formworks, scaffolds, supports, etc. and submit for approval (d) Submit for approval shop drawings for various inserts, anchors, anchor bolts, pipe sleeves, embedment, hangers, openings, frames etc. (e) Submit for approval detailed drawings of supports, templates, hangers, etc. required for installation of various embedments like inserts, anchor bolts, pipe sleeves, frames, joint seals, frames, openings etc. (f) Submit for approval detailed schemes of all operations required for executing the work, e.g. Material handling, Concrete mixing, Placement of concrete, Compaction, curing, services, Approaches, etc. (g) Design and submit for approval concrete mix designs required to be adopted on the job. (h) Furnish samples and submit for approval results of tests of various properties of the following: (i) The various ingredients of concrete. (ii) Concrete. (iii) Embedments (iv) Joint seals (i) Provide all incidental items not shown or specified in particular but reasonably implied or necessary for successful completion of the work in accordance with the drawings and specifications. (j) For supply of certain materials normally manufactured by specialist firms, the Contractor may have to produce, if directed by the Engineer, a guarantee in approved proforma for satisfactory performance for reasonable period as may be specified, binding both		

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the manufacturers and the Contractor, jointly and severally. 2.2 <u>WORK BY OTHERS</u> No work under this specification will be provided by any agency other than the Contractor unless specifically mentioned elsewhere in the contract. 2.3 <u>INFORMATION TO BE SUBMITTED BY THE TENDERER</u> 2.3.1 With Tender The following technical information are required with the tender: (a) Source and arrangement of processing of aggregates proposed to be adopted. (b) Type of plant and equipment proposed to be used. (c) Names of firms, if any, with which association is sought for to, execute the special items of work in the contract. (d) Types of formwork proposed to be used. 2.3.2 After Award The following information and data including samples where necessary shall be submitted by the Contractor progressively during the execution of the contract. (a) Programme of Execution and Requirement of Materials The Contractor will submit a Master Programme for completion of the work giving monthwise requirements of materials for the procurement. This Master Programme may have to be reviewed and updated by the Contractor, quarterly or at more frequent intervals as may be directed by the Engineer depending on the exigencies of the work.		

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Detailed day to day programme of every month is to be submitted by the Contractor before the end of the previous month (b) Samples Samples of the following materials and any other materials proposed to be used shall be submitted as directed by the Engineer, in sufficient quantities for approval. Approved samples will be preserved by the Engineer for future reference. The approval of the Engineer shall not, in any way, relieve the Contractor of his responsibility of supplying materials of specified qualities: (i) Coarse and fine aggregates (ii) Admixtures. (iii) Plywood for Formwork (iv) Embedded and anchorage materials as may be desired by the Engineer (v) Joint sealing strips and other waterproofing materials (vi) Joint filling compounds (vii) Foundation quality Rubber Pads (c) Design Mix Design mix as per Clauses 2.1 (g) & 3.4 of this specification giving proportions of the ingredients, sources of aggregates and cement, along with accompanying test results of trial mixes as per relevant I.S., is to be submitted to the Engineer for his approval before it can be used on the works. (d) Detail Drawings and Bar Bending Schedules Detailed working drawings and Bar Bending Schedules in accordance with Clause 2.1(b) and 3.16.1 of this specification.		

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(e) Detailed Drawings and Designs of Formworks to be used Detailed design data and drawings of standard formworks to be used as per clause 2.1 (c). (f) Detailed Drawings for Templates & Temporary Supports for Embedments. As per Clause 2.1 (e). (g) Mill Test Reports for Cement & Reinforcing Steel. (h) Inspection Reports Inspection Reports in respect of Formwork and Reinforcement and any other item of work as may be desired by the Engineer in accordance with Clause 2.4 of this specification. (i) Test Reports Reports of tests of various materials and concrete as required under Clause 4.0: SAMPLING & TESTING of this specification. (j) Any other data which may be required as per this specification.		
2.4	<u>CONFORMITY WITH DESIGN</u> The Contractor will prepare check lists in approved proforma which will be called 'Pour Cards'. These Pour Cards will list out all items of work involved. The Contractor will inform the Engineer, sufficiently in advance, whenever any particular pour is ready for concreting. He shall accord all necessary help and assistance to the Engineer for all checking required in the pour. On satisfying himself that all details are in accordance to the drawings and specifications, the Engineer will give written permission on the same 'Pour Card' allowing the Contractor to commence placement of concrete. Details of all instructions issued by the Engineer and the records of compliance by the Contractor, deviations allowed by the Engineer and any other relevant information will be written on accompanying sheets attached to the Pour Cards. These sheets, termed as 'Progress Cards', will be	

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prepared by the Contractor on approved proforma. The Pour Cards along with accompaniments will be handed over to the Engineer before starting placement of concrete. One of the mix designs developed by the Contractor as per the I.S. Specifications and established to the satisfaction of the Engineer by trial mixes shall be permitted to be used by the Engineer, the choice being dictated by the requirements of designs and workability. The methods of mixing, conveyance, placement, vibration, finishing, curing, protection and testing of concrete will be as approved or directed by the engineer. 2.5 <u>MATERIALS TO BE USED</u> 2.5.1 General Requirement All materials whether to be incorporated in the work or used temporarily for the construction shall conform to the relevant IS Specifications unless stated otherwise and be of best approved quality. 2.5.2 Cement Generally cement shall be 33 grades ordinary Portland cement conforming to IS 269 .In special cases any of the following type of cement may be permitted or directed to be used with prior approval by the Engineer (a) 43 Grade ordinary Portland Cement conforming to IS-8112 (b) 53 Grade ordinary Portland Cement conforming to IS-12269 (c) Rapid hardening Portland Cement conforming to IS-8041 (d) Portland slag cement conforming to IS-455 (e) Portland Pozzolona Cement (flyash based) Conforming to IS-1489 (Part-1) (f) Portland pozzolona Cement (calcined clay based) conforming to IS-1489 (Part-2) (g) Hydrophobic Cement conforming to IS-8043		

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- (h) Low heat Portland Cement conforming to IS : 12600
- (i) Sulphate Resisting Portland Cement conforming to IS-12330

Aggregates shall be natural or crushed gravel or crushed rock and free from deleterious material. It shall comply with the requirements of IS-383. All fine and coarse aggregate shall be tested for susceptibility to Alkali Silicate reaction in a laboratory approved by the Engineer.

Aggregate of sizes ranging between 4.75 mm and 150 mm will be termed as Coarse Aggregate. Only Coarse Aggregate from approved quarries and conforming to IS:383 will be allowed to be used on the works. Aggregates shall be washed to make it free from deleterious materials, if necessary

- (b) Fine Aggregate

In certain cases there may be two types of sand, one very fine and the other very coarse. In such cases, the two types shall be combined to meet the requirements of a particular zone of IS:383. In all cases, the preferred zone is Zone - II.

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be used only with the approval of the Engineer. 2.5.4 Water Water for use in Concrete shall be clear and free from injurious oils, acids, alkalis, organic matter, salt, silts or other impurities. Normally potable water is found to be suitable. Generally, IS:3550 will be followed for routine tests. Acceptance test for water shall be as per IS:3025, and Table-1 of IS:456. In case of doubt regarding development of strength, the suitability of water for making concrete shall be ascertained by compressive strength and initial setting time tests as per method of tests in accordance with the requirements of IS-516 & IS- 4031 respectively. The PH value of water shall generally be not less than 6 2.5.5 Admixture Only admixture of approved quality will be used when directed or permitted by the Engineer. The different types of admixtures which may be necessary to satisfy the concrete mix and the design requirement shall be as per the following I.S. Standards: IS : 2645 : Integral cement water proofing compound IS : 9103 : Indian standard specification for Admixtures Concrete or equivalent American Codes (ASTM C494 and ASTM C260) or British Codes (BS 5075, part 1 to 3)and may be one of the following: (a) Accelerating admixtures: (i) Set accelerating admixtures like "Sigunit Powder" or "Sigunit LN10" (b) Retarding admixtures: (i) Modified ligno sulphonate based set retarding concrete admixture like, "Plastiment R".		

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(c) Water reducing admixtures: (i) Modified sulphonated melamine formaldehyde based water reducing concrete admixture like, "Sikament". (d) Air entraining admixtures: (i) Modified ligno sulphonate based air entraining concrete admixture like "FLOMO AEP "or surface - active agents like "Sika AER". (e) Water proofing admixtures (i) Modified lingo-sulphonate based waterproofing admixture like "Plastocrete Super". However, the Contractor shall furnish following technical information about the admixtures (along with the manufacturer's Catalogue) which he is planning to use in different areas within the scope of work for the approval of the Engineer. (i) Type of admixture (ii) Mix proportion & mode of application in concrete/mortar (iii) Manufacturer's specification & necessary quality assurance certificates (mainly on chloride & sulphate content, PH value infra red analysis & solid content) 2.5.6 Reinforcement Reinforcement shall be as per relevant IS Specification as mentioned in the Contract /Drawing/Instructions. All bars shall be of tested quality. 2.6 <u>STORAGE OF MATERIALS</u> 2.6.1 General All materials shall be so stored as to prevent deterioration or intrusion of		

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2.6.2 Cement	foreign matter and to ensure the preservation of their quality and fitness for the work. Any material, which has deteriorated or has been damaged or is otherwise considered defective by the Engineer, shall not be used for concrete and shall be removed from site immediately, failing which, the Engineer shall be at liberty to get the materials removed and Storage of materials shall conform to IS:4082. Sufficient space for storage, with open passages between stacks, shall be arranged by the Contractor to the satisfaction of the Engineer. Cement shall be stored off the ground in dry, leak proof, well-ventilated ware-houses at the works in such a manner as to prevent deterioration due to moisture or intrusion of foreign matter. Cement shall be stored in easily countable stacks with consignment identification marks. Consignments shall be used in the order of their receipts at site. Sub-standard or partly set cement shall not be used and shall be removed from the site, with the knowledge of the Engineer, as soon as it is detected. Different types of cement shall be clearly marked with the Type and different types of cement shall not be intermixed. 2.6.3 Aggregates Aggregates shall be stored on planks or steel plates or on concrete or masonry surface. Each size shall be kept separated with wooden or steel or concrete or masonry bulk-heads or in separate stacks and sufficient care shall be taken to prevent the material at the edges of the stock piles from getting intermixed. Stacks of fine and coarse aggregates shall be kept sufficiently apart with proper arrangement of drainage. The aggregates shall be stored in easily measurable stacks of suitable depths as may be directed by the Engineer. 2.6.4 Reinforcement Reinforcing steel shall be stored consignment-wise and size wise off the	

ground and under cover, if desired by the Engineer. It shall be protected from rusting, oil, grease and distortions. If necessary, the reinforcing steel may be coated with cement wash before stacking to prevent scale and rust. The stacks shall be easily measurable. Steel needed for immediate use shall only be removed from storage.

Quality Control

The quality control operation shall include but not be limited to the following items of work:

: For air entraining admixtures, dosage to be adjusted to maintain air contents within desirable limits

(c) Water : Impurities tests.

(e) Formwork : Material, shapes, dimensions, lines, elevations, surface finish, adequacy of form, ties, bracing and shoring and coating.

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	(f) Reinforcement : Shapes, dimensions, length of plices, clearances, ties and supports. Quality and requirement of welded splices. Material tests or certificates to satisfy relevant IS Specification (g) Grades of concrete : Usage and mix design, testing of all properties. (h) Batching & Mixing : Types and capacity of plant, concrete mixers and transportation equipment. (i) Joints : Locations of joints, water stops and filler materials. Dimension of joints, quality and shape of joint material and splices. (j) Embedded and Anchorage Items : Material, shape, location, setting. (k) Placing : Preparation, rate of pouring, weather limitations, time intervals between mixing and placing and between two successive lifts, covering over dry or wet surfaces, cleaning and preparation of surfaces on which concrete is to be placed, application of mortar/slurry for proper bond, prevention of cold joint, types of chutes or conveyors. (l) Compaction : Number of vibrators, their prime mover, frequency and amplitude of vibration, diameter and weight of vibrators, duration of vibration, hand-spreading, rodding and tamping. (m) Setting of base & Beaming plates : Lines, elevations and bedding mortar. (n) Concrete Finishes : Repairs of surface defects, screening, floating, steel trowelling and brooming, special finishes. (o) Curing : Methods and length of time.	

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Copies of records and tests for the items noted above, as well as, records of corrective action taken shall be submitted to the Engineer for approval as may be desired. 3.0 <u>INSTALLATION</u> All installation requirements shall be in accordance with IS:456 and as supplemented or modified herein or by other best possible standards where the specific requirements mentioned in this section of the specification do not cover all the aspects to the full satisfaction of the Engineer. 3.1 <u>WASHING AND SCREENING OF AGGREGATES</u> Washing and Screening of coarse aggregate shall be carried out to remove fines, dirt or other deleterious materials. Washing of fine aggregate shall not be allowed, Fine aggregates shall be screened only to remove dirt or other deleterious materials. However, all washing & screening of aggregates shall be carried out by approved means to ensure compliance with the aggregate specification. 3.2 <u>ADMIXTURE</u> All concrete shall be designed for normal rate of setting and hardening at normal temperature. Variations in temperature and humidity under different climatic conditions will affect the rate of setting and hardening, which will, in turn, affect the workability and quality of the concrete. Admixtures may be permitted to be used in accordance with IS: 456 to modify the rate of hardening, to improve workability or as an aid to control concrete quality. The Engineer reserves the right to require laboratory test or use test data, or other satisfactory reference before granting approval. The admixture shall be used strictly in accordance with the manufacturer's directions and/or as directed by the Engineer.		

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3.3	<u>GRADES OF CONCRETE</u> Structural concrete shall be of M30 grade and for other part of the work shall be as shown on the drawing as per grade classification of IS-456. In case of liquid retaining structures, IS:3370 will be followed.	
3.4	<u>PROPORTIONING AND WORKS CONTROL</u>	
3.4.1	General	
	Proportioning of ingredients of concrete shall be made by any of the two following methods as directed by the Engineer:	
	(a) With preliminary tests by designing the concrete mix. Such concrete shall be called 'Design Mix Concrete'.	
	(b) Without preliminary tests adopting nominal concrete mix. Such concrete shall be called 'Nominal Mix Concrete'.	
	As far as possible, design mix concrete shall be used on all concrete works. Nominal mix concrete, in grades permitted in accordance with IS:456, may be used if shown on drawings or approved by the Engineer. In all cases the proportioning of ingredients and works control shall be in accordance with IS:456 and shall be adopted for use after the Engineer is satisfied regarding its adequacy and after obtaining his approval in writing.	
3.4.2	Mix Design Criteria	
	Concrete mixes will be designed by the Contractor to achieve the strength, durability and workability necessary for the job, by the most economical use of the various ingredients. In general, the design will keep in view the following considerations:	
	(a) Consistent with the various other requirements of the mix, the quantity of water should be kept at the lowest possible level.	
	(b) The nominal maximum size of coarse aggregate shall be as large as possible within the limits specified.	

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(c) The various fractions of coarse and fine aggregates should be mixed in such a proportion as to produce the best possible combined internal grading giving the densest and most workable mix. (d) Chemical admixtures may be used to modify the rate of hardening, to improve workability (maintaining low water - cement ratio) or as an aid to control concrete quality. (e) The finished concrete should have adequate durability in all conditions, to withstand satisfactorily the weather and other destructive agencies which it is expected to be subjected to in actual service. The requirement of adequate structural strength is catered for by the choice of proper grade of concrete by the Engineer. The Contractor will strictly abide by the same in his design of concrete mix installation. Notwithstanding anything mentioned in various tables given in IS:456 giving specific values and degrees of workability for different condition of concrete placing, minimum cement content and maximum water-cement ratio for concrete exposed to sulphate attack and for concrete to ensure durability under different condition of exposure, strength requirement for different grades of concrete, proportion for nominal mix concrete, values given in the tables in IS:456, shall be followed. Various trials shall be given by the contractor with specific cement content on each trial. In some cases, plasticizers and other admixtures may be necessary to achieve the desired results.		

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<u>TABLE – I</u> <u>STRENGTH REQUIREMENT OF CONCRETE</u>		
Specified Characteristic Compressive Grade of concrete strength of 15cm Cubes at 28 days conducted in accordance with IS:516 (All values in N/Sq.mm)		
M – 10	10	
M – 15	15	
M – 20	20	
M – 25	25	
M – 30	30	
M – 35	35	
M – 40	40	
Note: 1. Nominal mix concrete of proportions 1:4:8 or 1:3:6 may be used as lean concrete for simple foundations for masonry walls, below the reinforced concrete foundations and mass filling. These mixes need not be designed.		

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TABLE – II

MIX PROPORTION (BY WEIGHT) EXPECTED TO GIVE
DIFFERENT DEGREES OF WORK ABILITY WITH DIFFERENT
VALUES OF WATER – CEMENT RATIO
(FOR GUIDANCE)
CEMENT / TOTAL AGGREGATE RATIOS

	WORKABILITY	WATER / CEMENT / RATIO	RATIO BY WEIGHT OF CEMENT OF GRAVEL AGGREGATE		RATIO BY WEIGHT OF CEMENT OF CRUSHED STONE AGGREGATE	
			20 mm size	38 mm size	20 mm size	38 mm size
(a)	Very low	0.4	01:04.8	01:05.3	01:04.5	01:05.0
(b)	Slump	0.5	01:07.2	01:07.7	01:06.5	01:07.4
(c)	0-25 mm	0.6	01:09.4	1:10	01:07.8	01:09.6
		0.7	1:10	1:12	01:08.7	01:10.6
(a)	Low	0.4	01:03.9	01:04.5	01:03.5	01:04.0
(b)	Slump	0.5	01:05.5	01:06.7	01:05.0	01:05.5
(c)	25-50 mm	0.6	01:06.8	01:07.4	01:06.3	01:07.0
(d)		0.7	01:08.0	01:08.5	01:07.4	01:08.0
(a)	Medium	0.4	01:03.5	01:03.8	01:03.1	01:03.6
(b)	Slump	0.5	01:04.8	01:05.7	01:04.2	01:05.0
(c)	50-100 mm	0.6	01:06.0	01:07.3	01:05.2	01:06.2
(a)	High	0.4	01:03.2	01:03.5	01:02.9	01:03.3

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(b)	Slump	0.5	01:04.4	01:05.2	01:03.9	01:04.6
(c)	100-175 mm	0.6	01:05.4	01:06.7	01:04.7	01:05.7
		0.7	01:06.2	01:07.4	01:05.5	01:06.5

NOTES:

1. Notwithstanding anything mentioned above, the cement/Total aggregate ratio is not to be increased beyond 1:9.0 without specific permission of the Engineer.
2. It should be noted that such high aggregate cement ratios will be required for concretes of very low slump and high water- cement ratios which may be required to be used in mass concrete work only.
3. The above figures are for guidance only, the actual cement/aggregate ratios are to be worked out from the specific gravities of coarse aggregates and sand being used and from trial mixes.

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3.5 <u>STRENGTH REQUIREMENTS</u> The strength requirements of both design mix and nominal mix concrete where ordinary Portland Cement or Portland slag cement is used, shall be as per Table-2 of IS:456. All other relevant clauses of IS:456 shall also apply. 3.6 <u>MINIMUM CEMENT CONTENT</u> The minimum cement content for each grade of concrete shall be as per Table -5 of IS : 456. 3.7 <u>WATER-CEMENT RATIO</u> The choice of water-cement ratio in designing a concrete mix will depend on- (a) The requirement of strength. (b) The requirement of durability. 3.7.1 Strength Requirement In case of 'Design Mix Concrete', the water-cement ratio of such value as to give acceptable test results as per IS: 456 will be selected by trial and error. The values of water-cement ratios for different grade and mix designs will have to be established after conducting sufficiently large number of preliminary tests in the laboratory to the satisfaction of the Engineer. Frequent checks on test will have to be carried out and the water-cement ratios will be revised if the tests produce unsatisfactory results. Notwithstanding anything stated above the Contractor's responsibility to produce satisfactory test results and to bear all the consequences in case of default remains unaltered. In case of nominal mix concrete, proportions for different grades of concrete is specified in Table-9 of IS:456 and no tests are necessary. The acceptance test criteria for nominal mix concrete shall be as per IS: 456.		

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3.7.2 Durability Requirement Table-5 of IS:456 gives the maximum water-cement ratio permissible from the point of view of durability of concrete subjected to adverse exposure to weather, sulphate attacks, and contact with harmful chemicals. Impermeability may also be an important consideration. Whenever the water-cement ratio dictated by durability consideration is lower than that required from strength criterion, the former shall be adopted. In general the water cement ratio between 0.4 and 0.45 will be desirable to satisfy the durability requirement and from the consideration of impermeability of concrete. The contractor may propose lower water cement ratio as mentioned above by addition of a suitable plasticizer/super-plasticizer. However the contractor has to propose specifically along with field trials in the event of lower cement content if found suitable along with a plasticizer. It will be preferable to use Melamine based plasticizer 3.8 <u>WORKABILITY</u> The degree of workability necessary to allow the concrete to be well consolidated and to be worked into the corners of formwork and around the reinforcement and embedment and to give the required surface finish shall depend on the type and nature of structure and shall be based on experience and tests. The usual limits of consistency for various types of structures are given below:		

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<u>TABLE - III</u> <u>LIMITS OF CONSISTENCY</u>			
Degree of workability	Slump in mm with Standard Cone as per IS:1199		Use for which concrete is suitable.
	Min.	Max.	
Very low	0	25	Large Mass concrete structure with heavy compaction equipment, roads and like.
Low	25	50	Uncongested wide and shallow R.C.C. structures.
Medium	50	100	Deep but wide R.C.C. structures with congestion or reinforcement and inserts
High	100	150	Very narrow and deep R.C.C. Structures with congestion due to reinforcement and inserts.
(NOTE: Notwithstanding anything mentioned above, the slump to be obtained for work in progress shall be as per direction of the Engineer) With the permission of the Engineer, for any grade of concrete, if the water has to be increased in special cases, cement shall also be increased proportionately to keep the ratio of water to cement same as adopted in trial mix design for each grade of concrete. The workability of concrete shall be checked at frequent intervals by slump tests. Alternatively where facilities exist or if required by the Engineer, the compacting factor test in accordance with IS:1199. 3.9 <u>SIZE OF COARSE AGGREGATES</u> The maximum size of coarse aggregates for different locations shall be as follows unless otherwise directed by the Engineer:-			

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(a) Very narrow space : 12 mm (b) Reinforced concrete except foundation : 20 mm (c) Ordinary Plain concrete and Reinforced concrete foundations : 40 mm (d) Mass concrete : 80 mm (e) Mass concrete in very large structure : 150 mm Grading of coarse aggregates for a particular size shall conform to relevant I.S. Codes and shall also be such as to produce a dense concrete of the specified proportions, strength and consistency that will work readily into position without segregation. Coarse aggregate will normally be separated into the following sizes and stacked separately in properly designed stockpiles : 150 mm to 80 mm, 80 mm to 40 mm, 40 mm to 20 mm and 20 mm to 5 mm. In certain cases it may be necessary to further split the 20 mm to 5 mm fraction into 20 mm to 10 mm and 10 mm to 5 mm fractions. This separation of aggregates in different size fractions is necessary so that they may be remixed in the desired proportion to arrive at a correct internal grading to produce the best mix. 3.10 <u>MIXING OF CONCRETE</u> Concrete shall always be mixed in mechanical mixer unless specifically approved by the Engineer for concrete to be used in unimportant out of the way locations in small quantities. Water shall not normally be charged into the drum of the mixer until all the cement and aggregates constituting the batch are already in the drum and mixed for at least one minute. Mixing of each batch shall be continued until there is a uniform distribution of the materials and the mass is uniform in colour and consistency, but in no case shall mixing be done for less than 2 (two) minutes and at least 40 (forty) revolutions after all the materials and water are in the drum. When absorbent aggregates are used or when the mix		

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is very dry, the mixing time shall be extended as may be directed by the Engineer. Mixers shall not be loaded above their rated capacity as this prevents thorough mixing. The entire contents of the drum shall be discharged before the ingredients for the next batch are fed into the drum. No partly set or remixed or excessively wet concrete shall be used. Such concrete shall be immediately removed from site. Each time the work stops, the mixer shall be thoroughly cleaned & when the next mixing commences, the first batch shall have 10% additional cement to allow for loss in the drum. Regular checks on mixer efficiency shall be carried out as directed by the Engineer as per IS: 4634 on all mixers employed at site. Only those mixers whose efficiencies are within the tolerances specified in IS: 1791 will be allowed to be employed. Ingradients for design mix concrete shall be measured by weight. For small jobs portable swing weigh Bachers conforming to IS: 2722 may be used. Batching plant conforming to IS: 4925 shall be used for large jobs. The accuracy of the measuring equipment shall be within + 2% of the quantity of Cement, water or total aggregates being measured and within + 5% of the quantity of any admixture being used. The batching equipment shall be fitted with an accurate mechanism for weighing separately the cement, fine aggregate and coarse aggregate. Water may be measured by volume or by weight. All measuring equipment should be maintained in a clean serviceable condition, and their accuracy shall be checked periodically. Mechanical / electrical control shall be provided on the mixing equipment to ensure the batch cannot be discharged until approved mixing time has elapsed and the entire batch shall be discharged before the mixer is recharged. Where admixtures are employed, separate containers & measuring devices shall be used. For minor concreting works, batching by volume according to specific weight may be permitted by the Engineer. In that case the whole bags of cement shall be used and gauge boxes used for measuring aggregates.		

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When hand mixing is permitted by the Engineer, it shall be carried out on a water-tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. In case of hand-mixing, 10% extra cement shall be added to each batch. 3.11 <u>CONVEYING CONCRETE</u> Concrete shall be handled and conveyed from the place of mixing to the place of laying as rapidly as practicable by approved means and placed and compacted in the final position before the initial setting of the cement starts. Concrete should be conveyed in such a way as will prevent segregation or loss of any of the ingredients. For long distance haulage, agitator cars of approved design will be used. If, in spite of all precautions, segregation does occur during transport, the concrete shall be properly re-mixed before placement. During very hot or cold weather, if directed by the Engineer, concrete shall be transported in deep containers which will reduce the rate of loss of water by evaporation or loss of heat. If necessary, the container may have to be covered and insulated. Conveying equipments for concrete shall be well maintained and thoroughly cleaned before commencement of concrete mixing. Such equipments shall be kept free from set concrete. 3.12 <u>PLACING AND COMPACTING CONCRETE</u> Where specifically covered, the relevant I.S. Code will be followed for the procedure of surface preparation, placement, consolidation, curing, finishes, repairs and maintenance of concrete. If, however, there is no specific provision in the relevant I.S. Code for any particular aspect of work, any other standard Code of practice, as may be specified by the Engineer, will be adopted. Concrete may have to be placed against the following types of surfaces: (a) Earth foundation (b) Rock foundation (c) Formwork		

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(d) Construction joint in concrete or masonry The surface on or against which concrete is to be placed has to be cleaned thoroughly. Rock or old construction joint has to be roughened by wire brushing, chipping, sand blasting or any other approved means for proper bond. All cuttings, dirt, oil, foreign and deleterious material, laitance, etc. are to be removed by air water jetting or water at high pressure. All excavated areas for foundations, ring beams, plinths, pile caps etc. shall be rammed & consolidated properly before blinding with nominal mix plain concrete, as per drawing and / or direction of the Engineer and shall be allowed to cure prior to setting out steel fixing, shuttering and concrete pouring for the main structural element. Formwork, reinforcement, preparation of surface, embedment, joint seals etc., shall be approved in writing by the Engineer before concrete is placed. As far as possible, concrete shall be placed in the formwork by means approved by the Engineer and shall not be dropped from a height or handled in a manner which may cause segregation. Any drop over 1500 mm shall have to be approved by the Engineer. Rock foundation or construction joint will be kept moist for at least 72 hours prior to placement. Concrete will be placed always against moist surface but never on pools of water. In case the foundation cannot be dewatered completely, special procedure and precaution, as directed by the Engineer will have to be adopted. Formwork will be cleaned thoroughly and smeared lightly with form oil or grease of approved quality just prior to placement. A layer of mortar of thickness 12 mm of the same or less w/c ratio and the same proportion as that of the concrete being placed and cement slurry will be spread thoroughly on the rock foundation or construction joint just prior to placement of concrete. The cost of application of such cement slurry and mortar will be deemed to be included. After concrete has been placed, it shall be spread, if necessary and thoroughly compacted by approved mechanical vibration to maximum subsidence without segregation and thoroughly worked around shape. Vibrators shall not be used for pushing concrete into adjoining areas.		

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Vibrators must be operated by experienced workmen and the work carried out as per relevant IS Code of Practice. In thin members with heavy congestion of reinforcement or other embedment, where effective use of internal vibrator is, in the opinion of the Engineer, doubtful, in addition to immersion vibrators the contractor may have to employ form vibrators conforming to IS: 4656. For slabs and other similar structures, the contractor will additionally employ screed vibrator as per IS: 2506. Hand tamping may be allowed in rare cases, subject to the approval of the Engineer. Care must be taken to ensure that the inserts, fixtures, reinforcement and formwork are not displaced or distorted during placing and consolidation of concrete. The rate of placement of concrete shall be such that no cold joint is formed and fresh concrete is placed always against green concrete which is still plastic and workable. No concrete shall be placed in open, during rains. During rainy season, no placement in the open is to be attempted unless sufficient tarpaulins or other similar protective arrangement for completely covering the still green concrete from rain is kept at the site of placement. If there has been any sign of washing of cement and sand, the entire affected concrete shall be removed immediately. Suitable precautions shall be taken in advance to guard against rains before leaving the fresh concrete unattended. No accumulation of water shall be permitted on or around freshly laid concrete. The size of the concrete pours must be carefully considered prior to commencement to ensure the structural elements are poured in on continuous shift to avoid cold joints. Slabs, beams and similar members shall be poured in one operation, unless otherwise instructed by the Engineer. Moulding, throating, drip course, etc., shall be poured as shown on the drawings or as directed by the Engineer. Holes shall be provided and bolts, sleeves, anchors, fastenings or other fixtures shall be embedded in concrete as shown on the drawings or as directed by the Engineer. Any deviation there from shall be set right by the Contractor as instructed by the Engineer. In case the forms or supports get displaced during or immediately after the placement and bring the concrete surface out of alignment beyond tolerance limits, the Engineer may direct to remove the portion and		

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reconstruct or repair the same. The Engineer shall decide upon the time interval between two placements of concrete of different ages coming in contact with each other, taking in consideration the degree of maturity of the older concrete, shrinkage, heat dissipation and the ability of the older concrete to withstand the load imposed upon it by the fresh placement. Once the concrete is deposited, consolidated and finished in its final position, it shall not be distributed. 3.13 <u>CONSTRUCTION JOINTS AND COLD JOINTS</u> 3.13.1 Construction Joints It is always desirable to complete any concrete structure by continuous pouring in one operation. However, due to practical limitation of methods and equipment and certain design considerations, construction joints are formed by discontinuing concrete at certain predetermined stages. These joints will be formed in a manner specified in the drawings/Instruction. Vertical construction joints will be made with rigid stop-board forms having slots for allowing passage of reinforcement rods and any other embedments and fixtures that may be shown. Next stage concrete shall be placed against construction joint as per clause 3.12. For water retaining structures and leak-proof buildings suitable approved water bars will be installed at the construction joints. Where the locations of the joints are not specified, it will be in accordance with the following: (a) In a column, the joint shall be formed 75 mm below the lowest soffit of the beam framing into it. (b) Concrete in a beam shall preferably be placed without a joint, but if provision of a joint is unavoidable, the joint shall be vertical and within the middle third of the span.		

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(c) A joint in a suspended floor slab shall be vertical and within the middle third of the span and at right angles to the principal reinforcement. (d) Feather-edges in concrete shall be avoided while forming a joint. (e) A construction joint should preferably be placed in a low-stress zone and at right angles to the direction of the principal stress. (f) In case the Contractor proposes to have a construction joint anywhere to facilitate his work, the proposal should be submitted well in advance to the Engineer for study and approval without which no construction joint will be allowed. 3.13.2 Cold Joint An advancing face of a concrete pour, which could not be covered by fresh concrete before expiry of initial setting time (due to an unscheduled stoppage or delay on account of breakdown in plant, inclement weather, low rate of placement or any other reason), is called a cold joint. The Contractor should always remain vigilant to avoid cold joints. If, however, a cold joint is formed due to unavoidable reasons, the following procedure shall be adopted for treating it: (a) If the concrete is so green that it can be removed manually and if vibrators can penetrate the surface without much effort, fresh concrete can be placed directly against the old surface. The old concrete should be covered by fresh concrete as quickly as possible and the joint thoroughly and systematically vibrated. (b) In case concrete has hardened a bit more than (a) but can still be easily removed by a light hand pick, the surface will be raked thoroughly and the loose concrete removed completely without disturbing the rest of the concrete in depth. A rich mortar layer 12 mm in thickness, will be placed on the cold joint fresh concrete shall be placed on the mortar layer and the joint will be thoroughly and systematically vibrated penetrating the vibrator deep into the old layer of concrete.		

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(c) In case the concrete at the joint has become so stiff that it cannot be remoulded and mortar or slurry does not rise inspite of extensive vibration, the joint will be left to harden for at least 12 - 24 hrs. It will then be treated as a regular construction joint, after cutting the concrete to required shape and preparing the surface as described under clause 3.12. 3.14 <u>REPAIRS, FINISHES AND TREATMENT OF CONCRETE SURFACES</u> 3.14.1 Adequate and sound concrete surfaces, whether formed or unformed, can be obtained by employing a concrete mix of proper design, competent formwork, and appropriate methods of handling, placing and consolidation by experienced workmen. Unsound concrete resulting from improper mix design, incompetent methods, equipment and formwork, poor workmanship and protection will not be accepted and will have to be dismantled, removed and replaced by sound concrete. The Engineer may, at his sole discretion, allow to retain concrete with minor defects provided the Contractor is able to repair it by approved methods. All concrete work shall be inspected by the Contractor immediately after the forms are removed and he will promptly report occurrence of any defects to the Engineer. All repair works will be carried out as per the instructions and in the presence of the Engineer or his representative. Generally, repair work will consist of any or all of the following operations : (a) Sack rubbing with mortar and stoning with carborundum stone. (b) Cutting away the defective concrete to the required depth and shape. (c) Cleaning of reinforcement and embedments. It may be necessary to provide an anti-corrosive coating on the reinforcement. (d) Roughening by sand blasting or chipping. (e) Installing additional reinforcement/welded mesh fabric. (f) Dry packing with stiff mortar.		

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(g) Plastering, guniting, shotcreting etc. (h) Placing and compacting concrete in the void left by cutting out defective concrete. (i) Grouting with cement sand slurry of 1:1 mix. (j) Repairing with a suitable mortar either cement or resin modified mortar. (k) Polyer modified patching and adhesive repair mortar for beams & columns. 3.14.2 Finishing Unformed Surface A few typical and common cases of treatment of concrete surface are cited below: (a) Floor Whenever a non-integral floor finish is indicated, the surface of reinforcement concrete slab shall be struck off at the specified levels and slopes and shall be finished with a wooden float fairly smooth removing all laitance. No over trowelling, to obtain a very smooth surface, shall be done as it will prevent adequate bond with the subsequent finish. If desired by the Engineer, the surface shall be scored and marked to provide better bond. Where monolithic finish is specified or required, concrete shall be compacted and struck off at the specified levels and slopes with a screed, preferably a vibrating type and then floated with a wooden float. Steel trowelling by hand or by rotary power float is then started after the moisture film and shine have disappeared from the surface and after the concrete has hardened enough to prevent excess of fines and water to rise to the surface but not hard enough to prevent proper finishing of aberrations. Steel trowelling properly done will flatten and smoothen sandy surface left by wooden floats and produce a dense surface free from blemishes,		

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ripples and trowel marks. A fine textured surface that is not slick and can be used where there is likelihood of spillage of oil or water can be obtained by trowelling the surface lightly with a circular motion after initial trowelling keeping the steel trowel flat on the surface. To provide a better grip the Engineer may instruct marking the floor in a regular geometric pattern after initial trowelling. (b) Beams, Columns & Walls If on such or any other concrete structure it is intended to apply plaster or such concrete surfaces against which brickwork or other allied works are to be built, the Contractor shall hack the surface adequately as soon as the form is stripped off so that proper bond can develop. Pattern, adequacy and details of such hacking shall meet with the approval of the Engineer, who shall be informed to inspect such surfaces before they are covered up. 3.15 <u>PROTECTION AND CURING OF CONCRETE</u> Newly placed concrete shall be protected by approved means from rain, sun and wind. Concrete placed below the ground level shall be protected against contamination from falling earth during and after placing. Concrete placed in ground containing deleterious substances, shall be protected from contact with such ground, or with water draining from such ground, during placing of concrete and for a period of at least three days or as otherwise instructed by the Engineer. The ground water around newly poured concrete shall be kept to an approved level by pumping out or other adequate means of drainage to prevent floatation or flooding. Steps, as approved by the Engineer, shall be taken to protect immature concrete from damage by debris, excessive loadings, vibration, abrasion, mixing with earth or other deleterious materials, etc. that may impair the strength and durability of the concrete. As soon as the concrete has hardened sufficiently, it shall be covered either with sand, polythene sheet, hessian, canvas or similar materials and kept continuously wet for at least 14 (fourteen) days after final setting. Curing by continuous sprinkling of water will be allowed if the Engineer is satisfied with the adequacy of the arrangements made by the Contractor.		

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If permitted by the Engineer, curing compound like "ANTISOLE (WP)" may be used for prevention of premature water loss in concrete and thereby effecting curing of concrete. This type of curing compound shall be sprayed on newly laid concrete surfaces to form thin film barrier against premature water loss without disturbances to normal setting action. The curing compound shall comply with ASTM requirements for acceptance. The curing compound shall be applied following the final finishing operation and immediately after disappearance of water sheen from concrete surface. It is important not to apply the curing compound when standing water is still present on concrete. The contractor shall arrange for the manufacturer's supervision. The Contractor shall remain extremely vigilant and employ proper equipment and workmen under able supervision for curing. The Engineer's decision regarding the adequacy of curing is final. In case any lapse on the part of the Contractor is noticed by the Engineer, he will inform the Contractor or his supervisor verbally or in writing to correct the deficiency in curing. If no satisfactory action is taken by the Contractor within 3 (three) hours of issuance of such instruction, the Engineer will be at liberty either to employ sufficient means through any agency to make good the deficiency and entirely at the discretion of the Engineer. 3.16 <u>REINFORCEMENT</u> Mild steel round bars, cold twisted and deformed bars as medium tensile or high yield strength steel, plain hard drawn steel wire fabric etc., will be used as reinforcement as per drawings and directions. In an aggressive environment an anti-corrosive coating on the reinforcement may be provided as per IS: 9077, as shown on the drawing or as directed by the Engineer. 3.16.1 Bar Bending Schedules The Contractor shall submit to the Engineer for approval Bar Bending Schedules with working drawings in triplicate, showing clearly the		

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arrangements proposed by the Contractor to match available stock of reinforcing steel, within one month of receipt of the Letter of Intent or of the receipt of the relevant design drawings, whichever is later. Upon receipt of the Engineer's final approval of the Bar Bending Schedule and drawings, the Contractor shall submit 6 (six) prints of the final drawings with one reproducible print after incorporating necessary modifications or corrections, for final record and distribution. Approval of such detailed drawings by the Engineer shall not relieve the Contractor of his responsibility for correctness nor of any of his obligations to meet the other requirements of the Contract. 3.16.2 Cleaning All steel for reinforcement shall be free from loose scales, oil, grease, paint or other harmful matters immediately before placing the concrete. 3.16.3 Cutting & Bending of Reinforcement Unless otherwise specified, reinforcing steel shall be bent in accordance with the procedure specified in IS:2502 or as approved by the Engineer. Bends and shapes shall comply strictly with the dimensions corresponding to the approved Bar Bending Schedules. Bar Bending Schedules shall be rechecked by the Contractor before any bending is done. No reinforcement shall be bent when already in position in the work, without approval of the Engineer, whether or not it is partially embedded in concrete. Bars shall not be straightened in a manner that will injure the material. Re bending can be done only if approved by the Engineer. Reinforcing bars above 16 mm diameter shall be bent by machine producing a gradual and even motion. Bars of 16 mm or below may be bent by hand. All the bars shall be cold bent unless otherwise approved. Bending hot at a cherry-red heat (not exceeding 845°C) may be allowed under very exceptional circumstances except for bars whose strength depends on cold working. Bars bent hot shall not be cooled by quenching. Reinforcing bars, whether high yield or mild steel shall be cut using either hand held shears, guillotines or foot operated pneumatic cutters. Cutting bars using cold chisels may be allowed by the Engineer at exceptional cases.		

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3.16.4 Placing in Position

All reinforcements shall be accurately fixed and maintained in position as shown on the drawings by such approved and adequate means like mild steel chairs and/or concrete spacer blocks irrespective of whether such supports are payable or not. Bars intended to be in contact at crossing points, shall be securely tied together at all such points by No. 20 G annealed soft iron wire. Tack welding of bars should not be done unless permitted by the Engineer. Binders shall tightly embrace the bars with which they are intended to be in contact and shall be securely held. The vertical distance between successive layers of bars shall be maintained by provision of mild steel spacer bars. They should be spaced such that the main bars do not sag perceptibly between adjacent spacers.

Before actual placing, the Contractor shall study the drawings thoroughly and inform the Engineer in case he feels that placement of certain bars is not possible due to congestion. In such cases he should not start placing any bar before obtaining clearance from the Engineer.

3.16.5 Welding

Normal bond laps in reinforcement may be placed by lap or butt welding reinforcement bars, if asked by the Engineer, under certain conditions. The work should be done with suitable safeguards in accordance with relevant Indian Standards for welding of mild steel bars used in reinforced concrete construction as per IS:2751 and IS:456. Welded mesh fabrics conforming to IS: 1566 may also be used if specified in the Schedule of Items and Drawings.

3.16.6 Control

The placing of reinforcements shall be completed well in advance of concrete pouring. Immediately before pouring, the reinforcement shall be examined by the Engineer for accuracy of placement and cleanliness. Necessary corrections as directed by him shall be carried out. Laps and anchorage lengths of reinforcing bars shall be in accordance with IS: 456, unless otherwise specified. If the bars in a lap are not of the same diameter, the smaller will guide the lap length. The laps shall be staggered as far as practicable and as directed by the Engineer. Arrangements for

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placing concrete shall be such that reinforcement in position do not have to bear extra load and get disturbed. The cover for concrete over the reinforcements shall be as shown on the approved drawings unless otherwise directed by the Engineer. Where concrete blocks are used for ensuring the cover and positioning reinforcement, they shall be made of mortar not leaner than 1 (one) part cement to 2 (two) parts sand by volume and cured in a pond for at least 14 (fourteen) days. The type, shape, size and location of the concrete blocks shall be as approved by the Engineer. 3.17 <u>COLD WEATHER CONCRETING</u> When conditions are such that any operation of concreting may be expected to be done at 5Deg.C atmospheric temperature or below the work shall conform to the requirement of Clause 14 of IS:456 and IS:7861. (Part. II). 3.18 <u>HOT WEATHER CONCRETING</u> When depositing concrete in very hot weather, the Contractor shall take all precautions as per IS:7861 (Part-I) and stagger the work to the cooler parts of the day to ensure that the temperature of wet concrete used in massive structures does not exceed 40 Deg.C while placing. Positive temperature control by pre cooling, post cooling or any other method, if required, will be specified`. 3.19 <u>CONCRETING UNDER WATER</u> When it is necessary to deposit concrete under water it shall be done in accordance with the requirements of clause 14 of IS:456. 3.20 <u>FORM WORK</u> 3.20.1 General Formwork shall conform to the shape, grade, lines, levels and dimension as shown on the drawings. The contractor shall prepare design & working drawings for formwork & temporary support system for important		

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structures and get them approved by the Engineer prior to commencement of actual work.

Materials used for the formwork inclusive of the supports and centering shall be capable of withstanding the working load and remain undistorted throughout the period it is left in service. All supports and scaffolds should be manufactured from structural or tubular steel except when specifically permitted otherwise by the Engineer.

The centering shall be true to vertical, rigid and thoroughly braced both horizontally and diagonally. Reckers are to be used where forms are to support inclined members. The forms shall be sufficiently strong to carry without undue deformation, the dead weight of the concrete as a liquid as well as the working load, in case the Contractor wishes to adopt any other design criteria, he has to convince the Engineer about its acceptability before adopting it. Where the concrete is vibrated, the formwork shall be strong enough to withstand the effects of vibration without appreciable deflection, bulging, distortion or loosening of its components. The joints in the formwork shall be sufficiently tight to prevent any leakage of slurry or mortar.

To achieve the desired rigidity, tie bolts, spacer blocks, tie wires and clamps as approved by the Engineer shall be used but they must in no way impair the strength of concrete or cause stains or marks on the finished surface. Where there are chances of these fixtures being embedded, only mild steel or concrete of adequate strength shall be used. Alternatively, except in case of water retaining structures through rods and the tie bolts shall be sleeved with PVC conduits to allow retraction of the ties on removal of the shutters. Where required, the annulus of the conduits will be filled with expanding mortar to seal the void. Bolts passing completely through liquid retaining walls/slabs for the purpose of securing and aligning the formwork shall not be used.

The formwork shall be such as to ensure a smooth uniform surface free from honeycombs, air bubbles, bulges, fins and other blemishes. Any blemish or defect found on the surface of the concrete must be brought to the notice of the Engineer immediately and rectified as directed by him.

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For exposed interior and exterior concrete surfaces of beams, columns and wall, plywood or other approved form shall be thoroughly cleaned and tied together with approved corrosion- resistant devices. Rigid care shall be exercised in ensuring that all column forms are plumb and true and thoroughly cross braced to keep them so. All floor and beam centering shall be crowned not less than 8 mm in all directions for every 5 metres span. Unless specifically described on the drawings or elsewhere to the contrary, bevelled forms 25 mm by 25 mm shall be fixed in the formwork at all corners to provide chamfering of the finished concrete edges. The formwork should lap and be secured sufficiently at the lift joints to prevent bulges and offsets. Temporary openings for cleaning, inspection and for pouring concrete shall be provided at the base of vertical forms and at other places, where they are necessary and as may be directed by the Engineer. The temporary openings shall be so formed that they can be conveniently closed when required, during pouring operations without leaving any mark on the concrete. 3.20.2 Cleaning and Treatment of Forms All parts of the forms shall be thoroughly cleaned of old concrete, wood shavings, saw dust, dirt and dust sticking to them before they are fixed in position. All rubbish, loose concrete, chippings, shavings, saw dust etc. shall be scrupulously removed from the interior of the forms before concrete is poured. Compressed air jet and/or water jet along with wire brushes, brooms etc. shall be used for cleaning. The inside surface of the formwork shall be treated with approved non-staining oil based shutter release agent like "Separol/Sika form oil/Siparol Concentrate" before it is placed in position. Care shall be taken that oil or other compound does not come in contact with reinforcing steel or construction joint surfaces. They shall not be allowed to accumulate at the bottom of the formwork. The oiling of the formwork will be inspected just prior to placement of concrete and redone wherever necessary. 3.20.3 Design The formwork shall be so designed and erected that the forms for slabs and the sides of beams, columns and walls are independent of the soffits of		

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beams and can be removed without any strain to the concrete already placed or affecting the remaining formwork. Removing any props or re propping shall not be done except with the specific approval of the Engineer. If formwork for column is erected for the full height of the column, one side shall be left open and built up in sections, as placing of concrete progress. Wedges, spacer bolts, clamps or other suitable means shall be provided to allow accurate adjustment and alignment of the formwork and to allow it to be removed gradually without jarring the concrete. The design of formwork shall take into account all vertical and lateral loads that the forms will carry or be subjected to during the construction process. Besides weight and pressures of reinforced concrete and weight of the forms themselves, the design shall consider loading due to unsymmetrical placement of concrete; impact from dumping of concrete; movement of men and construction equipment; wind action and any other imposed load during construction. The contractor shall assess the magnitude of vertical live load to be taken for design of formwork duly considering his method, sequence and rate of pour of concrete. However, minimum design vertical live load to be considered shall be 750 kg/sqm excluding weight of concrete. 3.20.4 Inspection of Forms Casting of Concrete shall start only after the formwork has been inspected and approved by the Engineer. The concreting shall start as early as possible within 3 (three) days after the approval of the formwork and during this period the formwork shall be kept under constant vigilance against any interference. In case of delay beyond three days, a fresh approval from the Engineer shall be obtained. 3.20.5 Removal of Forms Before removing any formwork, the Contractor must notify the Engineer well in advance to enable him to inspect the concrete if he so desires. The Contractor shall record on the drawing or in any other approved manner, the date on which concrete is placed in each part of the work and the date on which the formwork is removed there from and have this record checked and countersigned by the Engineer regularly.		

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The Contractor shall be responsible for the safe removal of the formwork and any work showing signs of damage through premature removal of formwork or loading shall be rejected and entirely reconstructed by him. The Engineer may, however, instruct to postpone the removal of formwork if he considers it necessary. Forms for various types of structural components shall not be removed before the minimum periods specified herein and the removal after the minimum periods shall also be subject to the approval of the Engineer in each case.		

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TABLE – IV**SCHEDULE OF REMOVAL OF FORM**

		Ordinary Portland Cement Concrete				Rapid Hardening Portland Cement Concrete			
	Part of Structure	Temperature Deg.C				Temperature Deg.C			
		Above 40 Deg.- 20 Deg.-Below 40 Deg. 20 Deg. 5 Deg. 5 Deg.				Above 40 Deg.- 20 Deg. Below 40 Deg. 20 Deg. 5 Deg. 5 Deg.			
		Days	Days	Days	Days	Days	Days	Days	Days
(a)	Columns & Walls	2	1	1	Do not remove forms until site cured test specimen develop at least 50% of the specified 28 days strength	1	1	1	Do not remove forms until site cured test specimen develop at least 50% of the specified 28 days strength
(b)	Beam sides	3	2	3		2	1	1	
(c)	Slabs, 125mm	10	7	8		7	4	5	
(d)	Slabs over 125 thick and soffit of minor beams	18	14	16		12	8	9	
(e)	Soffit of main Beams	24	21	22		14	10	12	

Wherever exposed surfaces of concrete can be effectively sealed to prevent loss of water, the periods specified for temperature above 40 Deg.C can be reduced to those of the temperature range of 20 Deg.C to 40 Deg.C subject to approval of the Engineer.

Construction joints in beams, if required to be provided, will be located within the middle third of span according to clause 3.13.1(b) of this specification. In such cases, however, entire span of beam shall have to

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be kept supported by formwork till its removal for the portion of beam, cast at a later date, is due and so approved by the Engineer. If any type of cement other than ordinary portland cement and Rapid hardening portland cement is used the time of removal or forms shall be revised as approved by the Engineer such that the strength of this cement at the time of removal of forms match with strength of portland cement at the time of removal of form as mentioned above. This has to be supported by regular tests. 3.20.6 Tolerance The formwork shall be so made as to produce a finished concrete, true to shape, lines, levels, plumb and dimensions as shown on the drawings subject to the following tolerances unless otherwise specified in this Specification or drawings or directed by the Engineer: For (a) Sectional dimension : + 5 mm (b) Plumb : 1 in 1000 of height (c) Levels : + 3 mm before any deflection has taken place The tolerance given above are specified for local aberrations in the finished concrete surface and should not be taken as tolerances for the entire structure taken as a whole or for the setting and alignment of formwork, which should be as accurate as possible to the entire satisfaction of the Engineer. Any error, within the above tolerance limits or any other as may be specially set up by the Engineer, if noticed in any lift of the structure after stripping of forms, shall be corrected in the subsequent work to bring back the surface of the structure to its true alignment. 3.20.7 Re-use of Forms Before re-use, all forms shall be thoroughly scraped, cleaned, joints and planes examined and when necessary repaired, and inside surface treated as		

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specified hereinbefore. Formwork shall not be used/re- used if declared unfit or unserviceable by the Engineer. 3.20.8 Classification Generally, the 'ordinary' class formwork shall be used unless otherwise directed by the Engineer: (a) Ordinary : These shall be used in places where ordinary surface finish is required and shall be composed of steel and/or approved good quality partially seasoned timber. (b) Plywood : These shall be used in exposed surfaces, where a specially good finish is required and shall be made of approved brand of heavy quality plywood to produce a perfectly uniform and smooth surface conforming to the shape described in the drawing with required grain texture on the concrete. Re-use may only be permitted after special inspection and approval by the Engineer. He may also permit utilisation of used plywood for the 'ordinary' class, if it is still in good condition. (c) Ornamental: These shall be used where ornamental and curved surface are required and shall be made of selected best quality well seasoned timbers or of plywood, which can be shaped correctly. 3.21 <u>OPENING, CHASES, GROOVES, REBATES, BLOCKOUTS ETC.</u> The Contractor shall leave all openings, grooves, chases, etc. in concrete work as shown on the drawings or as specified by the Engineer. 3.22 Anchor Bolts, Anchors, Sleeves, Inserts, Hangers/Conduits/Pipe and Other misc. Embedded Fixtures. The Contractor shall build into concrete work all the items noted below and shall embed them partly or fully as directed and		

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secure the same as may be required. The materials, if required to be supplied by the Contractor, shall be as specified and be of best quality available according to relevant Indian Standards of approved manufacture and to the satisfaction of the Engineer. Exposed surfaces of embedded materials are to be painted with one coat of approved anti-corrosive paint and/or bituminous paint. If welding is to be done subsequently on the exposed surface of embedded material the paint shall be cleaned off the member to a minimum length of 50 mm beyond each side of the weld line. Necessary templates, jigs, fixtures, supports etc. shall be used as may be required or directed by the Engineer. Items to be embedded. (a) Inserts, hangers, anchors, frames around openings, manhole covers, frames, floor clips, sleeves conduits and pipes. (b) Anchor bolts and plates for machinery, equipment and for structural steel work. (c) Steel structural to be left embedded for future extension, special connection etc. (d) Lugs or plugs for door and window frames occurring in concrete work. (e) Flashing and jointing in concrete work. (f) Any misc. embedment and fixture as may be required. Correct location and alignment, as per drawings/instruction of all these embedded items shall be entirely the responsibility of the Contractor. 3.23 <u>EXPANSION AND ISOLATION JOINTS</u> 3.23.1 General Expansion and isolation joints in concrete structures shall be provided at specific places as per details indicated on the drawings. The materials and types of joints shall be as specified hereinafter. In case of liquid retaining		

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structures, additional precautions shall be taken to prevent leakage of liquids as may be specified on the drawings or as directed by the Engineer. All materials are to be procured from reliable manufacturers and must have the approval of the Engineer. Where it is the responsibility of the Contractor to supply the material, the Engineer may demand test certificates for the materials and/or instruct the Contractor to get them tested in an approved laboratory. Joints shall be formed true to line, level, shape, dimension and quality as per drawings and specifications. Prior approval of the method of forming the joints should be obtained from the Engineer before starting the work. 3.23.2 Bitumen Board/Expanded Polystyrene Board (a) Bitumen Board Bitumen impregnated fibre board of approved manufacturer as per IS: 1838 may be used as fillers for expansion joints. It must be durable and waterproof. It shall be compressible and possess a high degree of rebound. The dimensions of the board should be equal to that of the joint being formed. It should, preferably be manufactured in one piece, matching the dimension of the joint and not prepared by cutting to size smaller pieces from larger boards at site. At the exposed end, the joint shall be sealed with approved sealing compound to a depth of at least 25 mm after application of an approved primer. The sealing compound and the primer shall be applied as specified by the manufacturer. (b) Expanded Polystyrene Boards If required, commercial quality\of expanded polystyrene products commonly used for thermal insulations may also be used as filler material in expansion joints. The thickness may vary from 12 mm to 50 mm. The material will have to be procured from reliable manufacturers as approved by the Engineer. The method of installations will be similar to that recommended by the manufacturers for fixing on cold storage walls. A coat of Bitumen paint may have to be applied on the board against which concrete will be placed.		

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3.23.3 Joint Sealing Strips

Joint sealing strips may be provided at the construction, expansion and isolation joints as a continuous diaphragm to contain the filler material and/or to exclude passage of water or any other material into or out of the structure.

The sealing strips will be non-metallic like rubber or P.V.C.

Sealing strips will not have any longitudinal joint and will be procured and installed in largest practicable lengths having a minimum number of transverse joints. The material is to be procured from reputed manufacturers having proven records of satisfactory supply of joint strips of similar make and shape for other jobs. The jointing procedure shall be as per the manufacturer's recommendations, revised if necessary, by the Engineer. The Contractor is to supply all labour and material for installation including the material and tools required for jointing, testing, protection, etc. If desired by the Engineer, joints in rubber seals may have to be vulcanised.

Non - metallic sealing strips will be normally in Rubber or P.V.C. Rubber or P.V.C. joint seals can be of shape having any combination of the following features :

- (a) Plain
- (b) Central bulb
- (c) Dumb-bell or flattened ends
- (d) Ribbed and Corrugated Wings
- (e) V shaped

As these types of seals can be easily handled in very large lengths, transverse joints will be allowed only under unavoidable circumstances and with the specific approval of the Engineer.

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The method of forming these joints, laps etc. shall be as specified by the Manufacturer and/or as approved by the Engineer taking particular care to match the central bulbs and the edges accurately.

3.23.3.1 Rubber Sealing Strips

The minimum thickness of Rubber sealing strips shall be 3 mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings of items and/ or as directed by the Engineer. The material will be natural rubber and be resistant to corrosion, abrasion and tear and also to attacks from the acids, alkalis and chemicals normally encountered in service. The physical properties will be generally as follows. The actual requirements may be slightly different as decided by the Engineer:

(a)	Specific Gravity	:	1.1 to 1.15
(b)	Shore Hardness	:	65A to 75A
(c)	Tensile Strength	:	25 - 30 N/Sq.mm
(d)	Maximum Safe Continuous Temperature	:	75 Deg.C
(e)	Ultimate Elongation	:	Not less than 350%

3.23.3.2 P.V.C. Sealing Strips

The minimum thickness of P.V.C. sealing strips will be 3 mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings/schedule of items and/or as directed by the Engineer. The material should be of good quality Polyvinyl Chloride highly resistant to tearing, abrasion and corrosion as well as to chemicals likely to come in contact with during use. The physical properties will generally be as follows. The actual requirements, which will be directed by the Engineer, may vary slightly:

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(a) Specific Gravity : 1.3 to 1.35 (b) Shore Hardness : 60A to 80A (c) Tensile Strength : 10 - 15 N/Sq.mm (d) Maximum Safe Continuous Temperature : 70 Deg.C (e) Ultimate Elongation : Not less than 275% 3.23.4 Joint Sealing Compound When directed, the gap in expansion joints shall be thoroughly cleaned and bitumen compound lay as per manufacturer's specifications. The compound to be used shall be of approved manufacture and shall conform to the requirements of IS: 1834. Alternatively, when directed, the expansion Joints may be filled with joint sealing compound like "Sikalastic" or approved equivalent and shall be applied as per manufacturer's specification. 3.23.5 Isolation Joints Strong and tough alkathene or PVC sheet about 1 mm in thickness and as approved by the Engineer shall be used in isolation joints. It shall be fixed by an approved adhesive compound on the cleaned surface of the already set concrete, to cover it fully. Fresh concrete shall be laid against the sheet, care being taken not to damage the sheet in any way. 3.23.6 Rubber Pad Hard foundation quality rubber pads of required thickness and shapes shall be put below machine or other foundations as shown on the drawings or as directed by the Engineer. The rubber shall have a unit weight of 1500 Kg/Cu.m, a shore hardness-65A to 70A and be of best quality of approved manufacture, durable, capable of absorbing vibration and must be chemically inert in contact with moist or dry earth or any other deleterious material expected under normal conditions.		

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3.24 GROUTING UNDER MACHINERY OR STRUCTURAL STEEL BASES

If required, grouting under base plates of machines or structural steel etc. shall be carried out by the Contractor. In general, the mix shall be 1 (one) part cement and 1 (one) part sand and just enough water to make it flow as required. The areas to be grouted shall be cleaned thoroughly with compressed air jet and/or with water in locations where accumulated surplus water can be removed. Where directed by the Engineer, 6 mm down stonechips may have to be used in the mix. Surface to be grouted shall be kept moist for at least 24 hours in advance. The grout shall be placed under expert supervision, so that there is no locked up air. Edges shall be finished properly. If desired by the Engineer, admixtures like Aluminium powder; 'Ironite' etc. may have to be added with the grout in proportions to be decided by the Engineer. Admixture, if directed to be added, will be measured and paid separately.

Alternatively non-shrink, free flow, cementitious grout like "SikagROUT 214/ Ankor NSG" or approved equivalent specifically selected for the type of equipment to be located (vibrating, static etc.) may also be used for grouting as per manufacturer's specification with necessary approval of the Engineer.

3.25 PRECAST CONCRETE

The Specification for precast concrete will be similar as for the cast-in-place concrete described herein and as supplemented in this section. All precast work shall be carried out in a yard made for the purpose.

This yard shall be dry, properly levelled and having a hard and even as well as well drained surface to prevent excessive uneven settlement due to softening of soil during casting & curing. If the ground is to be used as a soffit former of the units, it shall be paved with concrete or masonry and provided with a layer of plaster (1:2 proportion) with smooth neat cement finish or a layer of M.S. sheeting. Where directed by the Engineer, casting will have to be done on suitable vibrating table. The yard, lifting equipment, curing tank, finished material storage space etc. Shall be designed such that the units are not lifted from the mould before 10 (Ten) days of curing and can be removed for erection after 28 (twenty eight) days

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of curing. The moulds shall preferably be of steel or of timber lined with G.I. sheet metal and must be rigid enough to prevent distortion during placing and compaction of the concrete. Other than normal curing by applying water through spray nozzles or perforated hose curing by high pressure steam, steam vapour or other accepted processes may also be employed to accelerate the hardening of the concrete and to reduce the curing time. Lifting hooks, where necessary or as directed by the Engineer, shall be embedded in correct position of the units to facilitate erection, even though they may not be shown on the drawings, and shall be burnt off and finished after erection. All members shall be indelibly marked with a unique identification mark on a surface which will not be permanently exposed to show on which production line they were manufactured, their type, the class of concrete, the data of casting and if they are of a symmetrical section the face which will be uppermost when the member is in its correct position after erection. Precast concrete units, when ready, shall be transported to site by suitable means approved by the Engineer. Care shall be taken to ensure that no damage occurs during transportation. All adjustments, levelling and plumbing shall be done as per instructions of the Engineer. The Contractor shall render all help with instruments, materials and men to the Engineer for checking the proper erection of the precast units. After erection and alignment, the joints shall be filled with grout or concrete as directed by the Engineer. If centerings have to be used for supporting the precast units, they shall not be removed until the joints have attained sufficient strength and in no case before 14 (fourteen) days. The joint between precast roof planks shall be pointed with 1:2 cement: sand mortar where called for in the drawings. 3.26 <u>WATERPROOFING OF CONCRETE STRUCTURE</u> 3.26.1 General Waterproofing of concrete structures shall be done by either suitable		

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extraneous treatment like applying waterproofing paints like "Sikatop Seal" fixing bitumen felts etc. or internally by suitable design of the concrete mix, addition of suitable admixtures conforming to IS: 2645 and equivalent American or British codes in the concrete or mortar at the time of mixing and/or installing water bars at the joints. The design, material and workmanship shall conform to the relevant I.S. Codes where applicable. The Engineer's approval of the materials shall be obtained by the Contractor before procurement. If desired by the Engineer, test certificates for the materials and samples shall be submitted by the Contractor. The materials shall be of best quality available indigenously, fresh clean and suitable for the duties called upon. 3.26.2 Water Bar/Seal/Special Treatment of Construction Joint Water bearing structures and underground structures may have water bar/seals installed at the joints. They may be rubber or P.V.C. The materials and installation will be as described under Clause 3.23.3. Construction joint should be provided as per clause 3.13.1 with or without water bar/Seal as shown on the drawing. In case of water bars being used at the construction Joint, fixing of the same has to be done carefully so that the water bar is not disturbed during concreting. The construction joint shall also be treated by any one of the following methods: (a) Method 1 A surface retarder in the form of a thixotropic gel shall be applied on the joint surface of the previous pour in case of joint on the wall and in case of floor the same shall be applied on the formwork against which previous pour of concreting shall be done. The retarder may be liquid or paste form depending on the type of formwork. The formwork shall be removed within 24 hours after concreting. Within 2 hours of striking of the formwork the retarder shall be washed off with strong water jet to make surface rough and clean. Then a rich cement mortar using cement, sand and aggregates (maximum size 8 mm) along with synthetic rubber emulsion type water resistant bonding agent shall be applied for a depth of 50 mm just before pouring the next stage of concreting in case of walls. The above bonding agent will be mixed with water which will be used for		

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making the cement mortar. The proportion of mixing of this bonding agent with water shall be as per manufacturer’s specification. In case of floor joint, however, after washing of retarder a solvent free two component epoxy resin bonding agent will be used at the joint before the next pour of concrete. The above bonding agent shall have the following properties after 28 days:

(i)	Compressive strength	:	55 to 60 N /Sq. mm
(ii)	Flexural Strength	:	25 to 30 N /Sq. mm.
(iii)	Tensile strength	:	15 N Sq. mm (approx)
(iv)	Bonding strength to concrete	to :	3 N / Sq. mm (approx)
(v)	Bonding strength to steel	:	20 N / Sq. mm (approx)

The whole operation shall be done as per manufacturer’s specification. The contractor shall provide manufacturer’s supervision.

(b) Method 2

One row of threaded nozzles at regular intervals not exceeding 1.5 m centre to centre shall be placed in concrete along the construction joint during casting. Injection of cement water together with a suitable waterproof expanding grouting admixture of approved quality shall be done through the nozzles after the construction joint in walls and slabs. The injection shall be done under pressure of approximately 2 to 4 Kg/Sq cm.

The nozzles shall be sealed off with suitable admixture after the injection is over. The whole operation shall be carried out as per manufacturer’s specification and supervision.

3.26.3 Waterproofing Admixtures

The waterproofing admixture for concrete and cement mortar / plaster shall conform to relevant IS code. The admixture shall not cause decrease of

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strength of concrete / plaster at any stage and it is free from chlorides and sulphates. The admixture shall not affect the setting time by more than 5 % The maximum permissible dosage of admixture will be 3% (three percent) by weight of cement but a lower dosage will always be preferred. The product shall be stored in strong moisture proof packing. However, in case of important structures where M25 or higher grade concrete is specified, the use of melamine based, high range water resistant concrete admixture shall be used to provide a waterproof concrete around 410 Kg/ Cm.m a melamine based super plasticizer will be preferable. (a) In concrete : The approved admixture shall be based on modified lignosulphonate like "Plastocrete - N/Super" or approved equivalent. The method of application and other details shall conform to the manufacturer's specification and/or as instructed by the Engineer. The Contractor shall have the services of the manufacturer's supervisor to supervise the work, if desired by the Engineer. (b) In Plaster : The concrete surface, to be plastered, shall be hacked to Engineer's satisfaction, cleaned thoroughly and kept wetted for 24 hours. The plaster shall be in cement sand mortar mixed in proportion varying from 1:1 to 1:4 by volume along with the approved waterproofing admixture like "Noleak CP/Sika Latex" or approved equivalent and laid in appropriate thickness and in layers not exceeding 15 mm/layer or as per manufacturer's specification. The additive shall be of quality and type approved by the Engineer. If desired by the Engineer, the Contractor shall have the work supervised by the manufacturer's supervisor. On completion, the plastered surface shall be cured continuously for a minimum period of 14 days like concrete.		

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3.26.4 Bituminous or Tar Coating on External Surface The surface to be waterproofed shall be rendered absolutely dry, clean and dust free. The surface shall be sand papered, cleaned and completely coated with hot coal tar pitch of approved manufacturer and quality as per IS:216 (not heated above 375 Deg.F) using not less than 2 Kg. per Sq.M. or with hot asphalt i.e., bitumen according to IS:73 (not heated above 400 Deg.F) using not less than 1.5 kg. per Sq.M. When the first coat has completely dried up and approved by the Engineer, the second coat shall be applied in the same manner using not less than 1.25 Kg. per Sq.M. in case of coal tar and 1 Kg. per Sq.M. in case of asphalt. Immediately after application of the second coat and before it is dried up, sand shall be spread on the surface to cover it completely. Sufficient time shall be allowed after spreading of sand before backfilling is done in order to allow the final coat to dry up completely. In place of hot application by coal tar/asphalt the coating of the outside surfaces of walls may be carried out using a ready to use liquid, bituminous emulsion/rubber protective coating of approved manufacturer. 3.26.5 Protective Coating on Inside Surface Two coats of cement based to components polymer modified flexible protective and waterproofing slurry having 1 mm thick for each coat shall be applied on the walls/floor after proper surface preparation as mentioned above. The slurry shall be applied by brush. 3.26.6 Bitumen Felt : Application for Tanking This specification shall cover laying the waterproof course on the outside and inside of the walls and bases of structures. The materials shall conform to IS: 1322, and the workmanship to IS: 1609. The bitumen felt shall be hessian base and/or fibre base as specified in Drawing/Schedule of Items. If required by the Engineer, tests as specified in relevant IS Codes shall be arranged by the Contractor. The Contractor shall execute this work in direct collaboration with one of the well known specialised approved by the Engineer.		

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Cleaning the surface, keeping it dry, providing necessary corner fillets and cement rendering and cutting chases, etc. shall be included in the rate for this item. If any protective brickwork on/against concrete sub-bases or walls are required, these will be paid extra under suitable items in the contract. A 20 (twenty) years' guarantee for satisfactory performances shall be given by the Contractor as well as his specialist sub-contractor jointly and severally, for this item of work. Free rectification of any defects noted in the work within this guarantee period will be carried out by the Contractor even if it is beyond the specified maintenance period of the contract as a whole.

3.26.7 Polyethylene Films : Application in Walls or base of Structures

Waterproof treatment shall be applied as outlined and as per sequence given hereunder:

- (a) the concrete surface shall be made smooth with 12 mm cement plaster 1:6
- (b) apply hot bitumen 80/100 grade (IS:73-1961) at the rate of 1.0 Kg/Sq.m minimum
- (c) lay black polyethelene film 250 micron (IS:2508-1977) with cut back bitumen adhesive in overlaps over hot bitumen surface, gently pressed, taking care not to puncture the film.

Alternatively, the overlaps shall be heat sealed by an electric iron having three parallel sealing bars. A long piece of plywood is to be placed below the polyethelene film to be heat sealed. On the plywood a rubber gasket is to be laid to provide a cushion for better welding of the film. On the rubber padding, a celophane tape is to be spread and on this the LDPE film, with 100 mm overlap, is to be stretched. On the overlapped film another celophane tape is to be placed to prevent the heat sealer from sticking to the LDPE film. After this, the electric iron is to be pressed on the overlap joint for sufficient time so as to allow perfect welding. The operation is to be repeated for subsequent lengths of joints. After heat sealing, the celophane tape is to be removed and the joints are to be tested for leaks.

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	(d) Lay 100 gm brown craft paper laminated with a layer of straight run bitumen. (e) Lay hot bitumen 80/100 grade (IS: 73-1961) at 1.0 Kg/Sq.m minimum. (f) Lay 250 micron polyethelene film as second layer similar to (c) above. (g) Lay second layer of 100 gm. brown craft paper laminated similar to (d) above. (h) Apply hot bitumen (straight run grade) to IS: 73-1961 at 1.0 Kg/Sq.m dusted with fine sand. (i) Protecting with a layer of 75 mm plain cement concrete M-100 or a layer of brick lay in cement mortar 1:6. In case of wall apply a 12 mm thick plaster as shown on the drawing or a protective brick wall in 1:6 cement mortars as shown on the drawing.	
3.27	<u>PROTECTIVE COATING ON CONCRETE SURFACE</u>	
3.27.1	On Foundation	
	The outside faces of foundation of important structures will be protected from adverse effect of soil/underground water, if shown on drawing or instructed by the Engineer, by using bitumen emulsion protective coating of approved manufacturer.	
3.28	<u>WATERPROOFING BY PRESSURE /CHEMICAL GROUTING</u> Where required, waterproofing for underground concrete structure shall be done by injecting high polymer based non-shrink waterproof grouting compound through nozzle under pressure as per manufacturer's recommendation. The pressure during injection shall not be less than 2.5 kg/Sq.cum and the thickness of epoxy resinous emulsion waterproof paint (to be applied on the external surface of walls/slabs) shall not be less than 700 microns.	

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4.0 <u>SAMPLING AND TESTING</u> 4.1 <u>GENERAL</u> The Contractor shall carry out all sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own cost unless otherwise specified in this specification. The Contractor shall get the specimens tested in a laboratory approved by the Engineer and submit to the Engineer the test results in triplicate within 3 (three) days after completion of the test. 4.2 <u>CEMENT</u> Representative samples will be taken from each consignment of cement received from the manufacturer/supplier for carrying out the tests for fineness (by hand sieving), setting time and compressive strengths. Soundness Tests may also be required to be carried out if required by the Engineer. The tests shall be carried out free of charge by the Owner if cement is supplied by him. In case the Contractor is directed to arrange for the supply of cement as per the terms and conditions of the Contract the tests shall be carried out by him. In case due to any circumstances, the agency of supply is changed in the middle of the Contract, the party who bore the original contractual obligation will carry on with the test, free of charge to the other, till the end of the job. No cement from a particular consignment/batch will be used on the works unless satisfactory 3 (three) days and 7 (seven) days test results for compressive strength are known. The Owner, Engineer and Contractor will jointly associate themselves with the tests irrespective of whether they are carried out by the Owner or the Contractor. These tests are of great importance as their results will have a bearing on the acceptance of concrete or otherwise as per the terms and conditions of the Contract. 4.3 <u>AGGREGATES</u> The Contractor shall carry out any or all the tests aggregates as may be required by the Engineer in accordance with IS: 2386 PARTS-I to VIII. The acceptance criteria of the samples tested shall be in accordance with the requirements of the relevant Indian Standards.		

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4.4 <u>WATER</u> Sampling and Testing of water being used for concrete works as per IS: 3550 will be carried out by the Contractor at regular intervals and whenever directed by the Engineer. The final acceptance criteria in case of doubt will be as per IS: 3025 & IS: 456. 4.5 <u>ADMIXTURE</u> 4.5.1 Air Entraining Agents (A.E.A) Initially, before starting to use A.E.A., relationship between the percentage of air entrained and the cube crushing strength vis-a-vis quantity of A.E.A. used for all types of concrete will be established by the Contractor by carrying out sufficiently large number of tests. After then, at regular intervals and whenever directed by the Engineer, the Contractor will check up the actual percentages of air entrained and corresponding crushing strengths to correlate with the earlier test results. 4.5.2 Other Admixtures Tests for establishing the various properties of any other admixtures which may be required to be added shall be carried out by the Contractor. 4.6 <u>CONCRETE</u> The sampling of concrete, making the test specimens, curing and testing procedure etc. shall be in accordance with IS: 516 and IS: 1199 the size of specimen being 15 cm cubes. Normally, only compression tests shall be performed but under special circumstances the Engineer may require other tests to be performed in accordance with IS: 516. Sampling procedure, frequency of sampling and test specimen shall conform to Clause 14 of IS: 456. To control the consistency of concrete from every mixing plant, slump tests and/or compacting factor tests in accordance with IS: 1199 and as mentioned in Clause 3.6 of this Specification shall be carried out by the		

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Contractor every two hours or as directed by the Engineer. Slumps corresponding to the test specimens shall be recorded for reference. The acceptance criteria of concrete shall be in accordance with Clause 15 of IS: 456. Concrete work found unsuitable for acceptance shall have to be dismantled and replacement is to be done as per specification by the Contractor. No payment for the dismantled concrete, the relevant formwork and reinforcement, embedded fixtures, etc. wasted in the dismantled portion shall be made. In the course of dismantling, if any damage is done to the embedded items or adjacent structures, the same shall be made good to the satisfaction of the Engineer. 5.0 <u>ACCEPTANCE CRITERIA</u> 5.1 <u>STANDARD DEVIATION</u> Standard deviation shall be based on test results and determination of Standard deviation shall conform to clause 16 of IS: 456. 5.2 <u>ACCEPTANCE CRITERIA</u> The strength requirements and acceptance criteria shall conform to Clause 16 of IS: 456. 5.3 <u>INSPECTION AND CORE TESTS</u> Inspection of concrete work immediately after stripping the formwork and core test of structures shall conform to Clause 17 of IS: 456. 5.4 <u>LOAD TEST</u> Load tests of structural members may be required by the Engineer, when the strength of test specimen results falls below the required strength, as per Load Test on Parts of Structures', Clause 17.6 of IS: 456. If load testing is decided by the Engineer, the member under consideration shall be subjected to a test load equal to 1.25 (one and a quarter) times the specified live load used for design and this load shall be maintained for a period of		

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24 (twenty four) hours before removal. The detailed procedure of the test is to be decided by the Engineer. Load tests shall not be made until the structure is at least 56 days old.

If the member shows evident failure, such changes as are necessary to make the structure adequately strong shall be made by the Contractor. Alternatively, if permitted under Statutory Regulations and at the discretion of the Engineer, the structure under test or a portion thereof may be retained as such without any modification by de-rating its load bearing capacity, provided the design criteria allows such de-rating.

A reinforced concrete beam, floor or roof shall be deemed to have passed the test if the maximum deflection at the end of 24 hours does not exceed the deflection given in Clause 17.6 of IS: 456.

The entire cost of load testing shall be borne by the Contractor. If a portion of the structure is found to be unacceptable, it shall be dismantled and replaced by a new structure as per specification.

If, in the course of dismantling, any damage is done to the embedded items and or other adjacent structures, the same will be made good by the Contractor to the satisfaction of the Engineer.

6.0 LIST OF I.S. CODES AND STANDARDS FOR REFERENCE

All work under this specification shall, unless specified otherwise, conform to the latest revisions and/or replacements of the following or any other India Standard Specifications and Codes of Practice. In case any particular aspect of work is not specifically covered by Indian Standard Specifications, any other standard practice, as may be specified by the Engineer, shall be followed :-

(a)	IS : 73	:	Indian Standard Specification for Paving Bitumen
(b)	IS : 216	:	Indian Standard Specification for Coal Tar Pitch
(c)	IS : 269	:	Indian Standard Specification for 33 grade Ordinary Portland Cement

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(d)	IS : 383	:	Indian Standard Specification for Coarse and Fine Aggregates from Natural Sources for Concrete
(e)	IS : 432	:	Indian Standard Specification for Mild Steel and Medium Tensile Steel Bars and Hard Drawn Steel Wire for concrete Reinforcement - Part 1 & 2
(f)	IS : 455	:	Indian Standard Specification for Portland Slag Cement
(g)	IS : 456	:	Indian Standard Code of Practice for Plain and Reinforced Concrete
(h)	IS : 457	:	Indian Standard Code of Practice for General Construction of Plain and Reinforced Concrete for Dams and other Massive Structures
(i)	IS : 516	:	Indian Standard Specification for Methods of Test for Strength of Concrete
(j)	IS : 737	:	Indian standard specification for wrought Aluminium and Aluminium Alloy sheet and strip for general Engineering purpose.
(k)	IS : 1199	:	Indian Standard Specification for Methods of Sampling and Analysis of Concrete
(l)	IS : 1200	:	Indian Standard Specification for Method of (Part-II) Measurement Cement Concrete Works.
(m)	IS : 1200	:	Indian Standard Specification for Method of (Part-V) Measurement of Formwork
(n)	IS : 1322	:	Indian Standard Specification for Bitumen Felts for waterproofing and Damp-proofing
(o)	IS : 1489	:	Indian Standard Specification for Portland-Pozzolona Cement-Part 1 & 2
(p)	IS : 1566	:	Indian Standard Specification for hard drawn steel wire fabric for concrete reinforcement.
(q)	IS : 1609	:	Code of Practice for Laying Damp-proof Treatment using Bitumen Felts

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(r)	IS : 1786	:	Indian Standard Specification for high strength deformed Bars & wires for Concrete Reinforcement
(s)	IS : 1791	:	Indian Standard Specification for Batch Type Concrete Mixers
(t)	IS : 1834	:	Indian standard specification for hot applied sealing compound for joint in concrete.
(u)	IS : 2062	:	Steel for general structural purpose.
(v)	IS : 2185	:	Indian Standard Specification for Hollow and solid / solid light wt. Cement Concrete Blocks - Part - 1 & 2
(w)	IS : 2210	:	Indian Standard Specification for Design of Reinforced Concrete Shell Structures and Folded Plates
(x)	IS : 2386	:	Indian Standard Specification for Methods of Test for Aggregates for Concrete - Part-I to VIII
(y)	IS : 2430	:	Indian standard specification for method of sampling of Aggregate for concrete.
(z)	IS : 2502	:	Indian Standard Code of Practice for Bending and Fixing of Bars for Concrete Reinforcement
(aa)	IS : 2505	:	Indian Standard Specification for Concrete Vibrators Immersion Type
(bb)	IS : 2506	:	Indian Standard Specification for Screed Board Concrete Vibrators
(cc)	IS : 2514	:	Indian Standard Specification for Concrete Vibrating Tables
(dd)	IS : 2645	:	Integral Cement water proofing compound
(ee)	IS : 2722	:	Indian Standard Specification for Portable Swing Weigh Batcher for Concrete (Single and Double Bucket type)
(ff)	IS : 2751	:	Code of Practice for Welding of Mild Steel Bars used for Reinforced Concrete Construction

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(gg)	IS : 2770	:	Indian Standard Specification for Method of Testing Bond in Reinforced Concrete. Part - 1 : Pull out Test
(hh)	IS : 3025	:	Indian Standard Specification for Methods of Sampling and Test (Physical and Chemical) for Water & waste water - art - 1 to 37
(ii)	IS : 3201	:	Indian Standard Specification for Design and Construction of Precast Concrete Trusses and purlins.
(jj)	IS : 3370	:	Indian Standard Specification for Code of Practice for Concrete Structures for Storage of Liquids Part 1 to 4
(kk)	IS : 3384	:	Indian standard specification for / Bitumen primer for use in waterproofing and Danp proofing
(ll)	IS : 3414	:	Code of practice for Design and Installation of joints in Buildings
(mm)	IS : 3550	:	Indian Standard Specification for Method of Test for Routine Control for Water used in Industry
(nn)	IS : 3558	:	Code of Practice for use of Immersion Vibrators for Consolidating Concrete
(oo)	IS : 3696	:	Safety Code for Part-1 : Scaffolding and Part 2: Ladders
(pp)	IS : 3812	:	Indian Standard Specification for Fly Ash for Use as Pozzolone & Admixture
(qq)	IS : 4031	:	Indian Standard Specification for Method of Tests for Hydraulic Cement - Part - 1 to 14
(rr)	IS : 4082	:	Indian Standard Specification for Recommendation on Stacking and Storag of Construction Materials at site
(ss)	IS : 4090	:	Indian Standard Specification for Design of Reinforced Concrete Archs

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(tt)	IS : 4634	: Indian Standard Specification for Method of Testing Performance of Batch-type Concrete Mixers	
(uu)	IS : 4656	: Indian Standard Specification for Form Vibrators for Concrete	
(vv)	IS : 4925	: Indian Standard Specification for Concrete Batching and Mixing Plant	
(ww)	IS : 4926	: Indian Standard Specification for Ready Mixed Concrete	
(xx)	IS : 4990	: Indian Standard Specification for Plywood for Concrete shuttering work	
(yy)	IS : 4991	: Indian Standard Specification for Blast Resistant Design of Structure for Explosion above ground	
(zz)	IS : 4995	: Indian Standard Specification for Design (Part-I of Reinforced Concrete Bins for the Storage & II) of Granular and Powdery Materials	
(aaa)	IS : 4998	: Indian Standard Specification for Design of (Part - I) Reinforced Concrete Chimneys	
(bbb)	IS : 5512	: Indian Standard Specification for Flow Table for use in Tests of Hydraulic Cement and Pozzolanic Materials	
(ccc)	IS : 5513	: Indian Standard Specification or Vicat Apparatus	
(ddd)	IS : 5515	: Indian Standard Specification for Compaction Factor Apparatus	
(eee)	IS : 5751	: Indian Standard Specification for Precast Concrete Coping Blocks	
(fff)	IS : 5816	: Indian Standard Specification for Method of Test for Splitting Tensile Strength of Concrete Cylinders	
(ggg)	IS : 5891	: Indian Standard Specification for Hand Operated Concrete Mixers	

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(hhh)	IS : 6452	:	Indian Standard Specification for High Alumina Cement for Structural Use
(iii)	IS : 6909	:	Indian Standard Specification for Supersulphated Cement
(jjj)	IS : 6923	:	Indian Standard Specification for Method of Test for performance of Screed Board Concrete Vibrators
(kkk)	IS : 6925	:	Indian Standard Specification for Method of Test for Determination of Water Soluble Chloride in Concrete Admixtures
(lll)	IS : 7242	:	Indian Standard Specification for Concrete Spreaders
(mmm)	IS : 7246	:	Indian Standard Specification for Table Vibrators for Consolidating Concrete
(nnn)	IS : 7251	:	Indian Standard Specification for Concrete Finishers
(ooo)	IS : 7320	:	Indian Standard Specification for Concrete Slump Test Apparatus
(ppp)	IS : 7861	:	Indian Standard Specification for (Part-I Recommended Practice for hot and cold & II) Weather Concreting
(qqq)	IS : 7969	:	Safety Code for Storage and Handling of Building Materials
(rrr)	IS : 8041	:	Indian Standard Specification for Rapid Hardening Portland cement
(sss)	IS : 8043	:	Indian standard specification for hydrophobic cement
(ttt)	IS : 8112	:	Indian Standard Specification for 43 grade Ordinary Portland Cement
(uuu)	IS : 8142	:	Indian Standard Specification for Determining Setting time of Concrete by Penetration Resistance

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(vvv) IS : 8989 : Safety Code for Erection of Concrete Framed Structures (www) IS : 9013 : Indian Standard Specification for Method of Making, Curing and Determining Compressive Strength of Accelerated - cured Concrete Test Specimens (xxx) IS : 9077 : Code of Practice for Corrosion Protection of Steel Rails in RB and RCC Construction (yyy) IS : 9103 : Indian Standard Specification for Admixtures for Concrete. (zzz) IS : 9417 : Recommendation for welding cold worked bars for reinforced concrete construction (aaaa) IS : 10262 : Recommended Guideline for concrete Mix Design (bbbb) IS : 12269 : Indian standard specification for 53 grade ordinary Portland cement (cccc) IS : 12330 : Indian standard specification for sulphate resisting Portland cement (dddd) IS : 12600 : Indian standard specification for low heat Portland cement		

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SECTION – 4

FABRICATION OF STRUCTURAL STEEL WORK

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1.0 <u>SCOPE</u> This specification covers supply of all raw steel materials, fabrication, testing, painting and delivery to site of structural steelwork including supply of all consumable stores and bolts, nuts, washers, electrodes and other materials required for fabrication and field connections of all structural steelwork in general covered under the scope of the contract. However, for any special structures such as rail & road bridges, steel chimney, tanks, transmission towers, furnace structures, etc., the relevant Indian Standard or IRC specification and Codes of Practices shall be given due consideration over & above this specification. 2.0 <u>GENERAL</u> 2.1 <u>WORK TO BE PROVIDED FOR BY THE CONTRACTOR</u> The work to be provided for by the bidder unless otherwise specified elsewhere in the contract, shall include, but not be limited to the following: 2.1.1 Preparation of complete detailed fabrication drawings and erection marking drawings required for all the structures covered under the scope of the contract based on contractor's design drawings approved by the Owner / Consultants. 2.1.2 To submit revised design with calculations and detailed fabrication drawings in case any substitution of the designed sections are to be made. 2.1.3 To submit design calculations for joints and connections developed by the contractor along with detailed fabrication drawings 2.1.4 Furnish all materials, labour, tools and plant and all consumables required for fabrication and supply, all necessary bolts, nuts, washers, tie rods and welding electrodes for field connections. The field connection materials supplied by the contractor shall be in adequate quantity to avoid delay in erection.		

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2.1.5	Furnish shop painting of all fabricated steelwork as per requirements of this Specification.	
2.1.6	Suitably mark, bundle and pack for transport all fabricated materials.	
2.1.7	Prepare and furnish detailed Bill of Materials, Drawing Office Despatch lists, Bolt List and any other list of bought out items required in connection with the fabrication and erection of the structural steelwork.	
2.1.8	Insure, load and transport all fabricated steelwork field connection materials to site.	
2.2	<u>WORK BY OTHERS</u> No work under this specification will be provided for by any agency other than the bidder, unless specifically mentioned otherwise elsewhere in the contract.	
2.3	<u>CODES AND STANDARDS</u> All work under this specification shall, unless otherwise specified in the contract, conform to the requirements of the latest revision and/or replacements of the following or any other relevant Indian Standard specifications and codes of practice. In case any particular aspect of the work is not specifically covered by any Indian Standard Specification, any other standard practice, as may be specified by the Engineer shall be followed:	
2.3.1	Relevant To Fabrication Of Structural Steel Work (a) IS : 800 : Code of practice for general construction in steel. (b) IS : 801 : Code of practice for use of cold formed light gauge steel structural members in general building Construction (c) IS : 806 : Code of practice for use of steel tubes in general building construction.	

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(d) IS : 808 : Dimensions for rolled steel beams, channels and angle Sections (e) IS : 812 : Glossary of terms relating to welding & cutting of Metals (f) IS : 813 : Scheme of symbols for welding (g) IS : 814 : Covered electrodes for metal arc welding of carbon and carbon manganese steel (h) IS : 815 : Classification coding of covered electrodes for metal arc welding of mild steel and low alloy high tensile steel. (i) IS : 816 : Code of practice for use of metal arc welding for general construction in mild steel (j) IS : 817 : Code of practice for training & testing metal arc welders (k) IS : 818 : Code of practice for safety and health requirements in electric and gas welding and cutting operations. (l) IS : 819 : Code of practice for resistance spot welding for light assemblies in mild steel. (m) IS : 822 : Code of practice for inspection of welds. (n) IS : 919 : Recommendations for limits and fits for engineering (part – 1 & 2) (o) IS : 1161 : Steel Tubes for structural purposes (p) IS : 1182 : Recommended practice for Radiographic Examination of fusion welded butt joints in steel plates` (q) IS : 1200 : Method of measurement of steel work and iron work (part – 8) (r) IS : 1239 : Mild steel tubes, tubulars and other wrought steel (Part – 1 & 2)			

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(s) IS : 1363 : Hexagon head bolts, screws and nuts of (Part - 1 to 3) product grade C (t) IS : 1364 : Hexagon head bolts, screws and nuts of (Part - 1 to 5) product grade A & B (u) IS : 1365 : Slotted counter sunk head screws (dia. 1.6 to 20 mm) (v) IS : 1367 : Technical supply conditions for threaded steel (part - 1 to 18) fasteners (w) IS : 1608 : Method for tensile testing of steel products. (x) IS : 1730 : Dimensions for steel plate, sheet and strip for structural and general engineering purposes. (y) IS : 1852 : Rolling and cutting tolerances for hot-rolled steel product. (z) IS : 1977 : Structural steel (Ordinary quality) (aa) IS : 2016 : Plain washer (bb) IS : 2062 : Steel for general structural purposes. (cc) IS : 2629 : Recommended practice for hot-dip galvanising of iron and steel (dd) IS : 2633 : Method for testing uniformity of coating on zinc coated articles (ee) IS : 3644 : Code of practice for ultrasonic pulse echo testing by contact and immersion method (ff) IS : 3757 : High Strength Structural Bolt (gg) IS : 4000 : High strength bolts in steel structure (hh) IS : 4759 : Specifications for hot-dip zinc coatings on structural steel and other allied products. (ii) IS : 4923 : Hollow steel sections for structural use		

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	(jj)	IS : 5334	: Code of practice for magnetic particle flaw detection of weld.
	(kk)	IS : 5369	: General requirements for plain washers and lock washer.
	(ll)	IS : 6005	: Code of practice for phosphating of iron and steel.
	(mm)	IS : 6649	: Specification for hardened and tempered washers for high strength structural bolts and nuts.
	(nn)	IS : 6623	: Specification for high strength structural nuts.
	(oo)	IS : 7215	: Tolerances for fabrication of steel structures.
	(pp)	IS : 7280	: Bare wire electrode for submerged arc welding.
	(qq)	IS : 8500	: Structural steel micro alloyed (medium & high strength quality).
	(rr)	IS : 8629	: Code of practice for protection of iron and (Part - I to III) steel structures from atmospheric corrosion.
	(ss)	IS : 9595	: Recommendation for metal arc welding of carbon manganese steels.
2.3.2	Painting		
	(a)	IS : 117	: Specification for ready mixed paint, brushing, finishing, exterior, semi-gloss, for general purposes
	(b)	IS : 128	: Specification for ready mixed paint, brushing, finishing, semi-gloss for general purposes, black
	(c)	IS : 1477 (Part - I & II)	: Code of practice for painting of ferrons metal in building.
	(d)	IS : 2074	: Ready mixed paint, air-drying red-oxide zinc chrome priming.

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(e) IS : 2339 : Specification for aluminium paints for general purposes in dual container. (f) IS : 2932 : Specification for enamel, synthetic exterior type - I. (g) IS : 2933 : Specification for enamel, synthetic exterior type - II.		
2.4	<u>CONFORMITY WITH DESIGNS</u> The bidder shall design all connections, supply and fabricate all steelwork and furnish all connection materials in accordance with the approved drawings and/or as instructed by the Engineer keeping in view the maximum utilization of the available sizes and sections of steel materials. The methods of painting, marking, packing and delivery of all fabricated materials shall be in accordance with the provisions of the contract and/or as approved by the Engineer. Provision of all relevant Indian Standard Specifications and Codes of Practice shall be followed unless otherwise specified in the contract.	
2.5	<u>MATERIALS TO BE USED</u>	
2.5.1	General All steel material shall be free from all imperfections, mill scales, slag intrusions, laminations, pittings, rusts etc. that may impair their strength, durability and appearance. All materials shall be tested quality only unless otherwise permitted by the Engineer and/or consultant. If desired by the Engineer, Test Certificates of materials supplied by the contractor in respect of each consignment shall be submitted in triplicate. Whenever the materials are required to be used from unidentified stocks, if permitted by the Engineer, a random, sample shall be tested at an approval laboratory from each lot of 50 tonnes or less of any particular section. The arc welding electrodes shall conform to be relevant Indian Standard codes of Practice and Specifications and shall be heavily coated type and the thickness of the coating shall be uniform and concentric. With each container of electrodes, the manufacturer shall furnish instructions giving recommended voltage and ampereage (Polarity in case of D.C. supply) for which the electrodes are suitable.	

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2.5.2

Steel

All steel materials to be used in construction within the purview of this specification shall comply with any of the following Indian Standard Specifications as may be applicable :

(a)

IS : 801

:

Cold formed light gauge steel structural member

(b)

IS : 806

:

Steel tubes in general building construction.

(c)

IS : 1161

:

Steel tubes for structural purpose.

(d)

IS : 1977 St-42-0

:

Structural steel (Ordinary quality)

(e)

IS : 2062

:

Steel for general structural purpose

(f)

IS : 8500

:

Structural steel-microalloyed (Ordinary & high strength quality)

In case of imported steel materials being used, these shall conform to specifications equivalent to any of the above as may be applicable.

2.5.3

Electrodes

All electrodes to be used under the Contract shall comply with any of the following Indian Standard Specifications as may be applicable:

(a)

IS : 814

:

Covered electrodes for metal arc welding structural steel

(b)

IS : 815

:

Classification and coding of covered electrodes for metal arc welding of mild steel and low alloy high tensile steel

(c)

IS : 7280

:

Base wire electrode for submerged arc welding

2.5.4

Bolts and Nuts

All bolts and nuts shall conform to the requirements of Indian Standard

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Specification IS:1367 - Technical Supply Conditions for Threaded Fasteners Materials for Bolts and nuts under the purview of this contract shall comply with any of the following Indian Standard Specifications as may be applicable (a) Mild Steel : All mild steel for bolts and nuts when tested in accordance with the following Indian Standard Specification shall have a tensile strength of not less than 44 Kg/mm² and a minimum elongation of 23 per cent on a gauge length of 5.6 /A, where 'A' is the cross sectional area of the test specimen : (i) IS:1367 : Technical supply conditions for threaded fasteners (ii) IS:1608 : Method for tensile testing of steel other than sheet, strip, wire and tube (b) High Tensile Steel : The material used for the manufacture of high tensile steel bolts and nuts shall have the mechanical properties appropriate to the particular class of steel as set out in IS:1367 or as approved by the Engineer 2.5.5 Washers Washers shall be made of steel conforming to any of the following Indian Standard Specifications as may be applicable under the provisions of the Contract : (a) IS : 1977 : Structural steel (Ordinary Quality) St-42-0 (b) IS : 2062 : Steel for general structural purpose (c) IS : 8500 : Structural steel – microalloyed (medium & high strength quality) (d) IS : 6623 : High Strength Structural Nuts (e) IS : 6649 : Hardened and tempered washers for high strength structural bolts & nuts.		

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2.5.6	Paints Paints to be used for shop coat of fabricated steel under the purview of this contract shall conform to the Indian Standard Specification IS:2074 - Ready mixed Paint, Air Drying, Red Oxide - Zinc Chromate Priming. In highly corrosive environment other type of primer such as epoxy resin based zinc rich primer (such as blast steel EZ1 of Shalimer Paints Ltd., may be necessary.	
2.6	<u>STORAGE OF MATERIAL</u>	
2.6.1	General All materials shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for the work. Any material which has deteriorated or has been damaged shall be removed from the contractor's yard immediately, failing which, the Engineer shall be at liberty to get the material removed. The Contractor shall maintain upto date accounts in respect of receipt, use and balance of all sizes and sections of steel and other materials. In case the fabrication is carried out in contractor's fabrication shop outside the plant site where other fabrication works are also carried out, all materials meant for use in this contract shall be stacked separately with easily identifiable marks.	
2.6.2	Steel The steel to be used in fabrication and the resulting cut-pieces shall be stored in separate stacks off the ground section-wise and lengthwise so that they can be easily inspected, measured and accounted for at any time. If required by the Engineer, the materials may have to be stored under cover and suitably painted for protection against weather.	
2.6.3	Electrodes The electrodes for electric arc welding shall be stored in properly designed racks separating different types of electrodes in distinctly marked	

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compartments. The electrodes shall be kept in a dry and warm condition if necessary by resorting to heating. 2.6.4 Bolts, Nuts and Washers Bolts, nuts and washers and other fastening materials shall be stored on racks off the ground with a coating of suitable protective oil. These shall be stored in separate gunny bags or compartments according to diameter, length and quality. 2.6.5 Paints Paints shall be stored under cover in air tight containers. Paints supplied in sealed containers shall be used up as soon as possible once the container is opened. 2.7 <u>QUALITY CONTROL</u> The Contractor shall establish and maintain quality control procedures for different items of work and materials to the extent he deems necessary to ensure that all work is performed in accordance with this specification. In addition to the Contractor's quality control procedures, materials and workmanship at all times shall be subjected to inspection by the Engineer or Engineer's representative. As far as possible, all inspection by the Engineer or Engineer's representative shall be made at the Contractor's fabrication shop whether located at Site or elsewhere. The Contractor shall co-operate with the Engineer or Engineer's representative in permitting access for inspection to all places where work is being done and in providing all necessary help in respect of tools and plants, instrument, labour and materials required to carry out the inspection. The inspection shall be so scheduled as to provide the minimum interruption to the work of the Contractor. Materials or workmanship not in reasonable conformance with the provisions of this Specification may be rejected at any time during the progress of the work. The quality control procedure shall cover but not be limited to the following items of work:		

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(a) Steel : Quality, manufacturer's test certificates, test reports of representative samples of materials from unidentified stocks if permitted to be used. (b) Bolts, Nuts & Washers : Manufacturer's certificate, dimension checks, material testing (c) Electrodes : Manufacturer's certificated, thickness and quality of flux coating. (d) Welders : Qualifying Tests (e) Welding sets : Performance Tests (f) Welds : Inspection, X-ray, Ultrasonic tests (g) Paints : Manufacturer's certificate, physical inspection reports (h) Galvanizing : Test in accordance with IS : 2633 – Method for testing uniformity of coating on Zinc Coated Articles and IS : 4759 – Specification for Hot-Dip Zinc coatings on Structural Steel and other allied products. 2.8 <u>STANDARD DIMENSIONS, FORMS AND WEIGHTS</u> The dimensions, forms, weights and tolerances of all rolled shapes bolts, nuts, studs, washers etc. and other members used in the fabrication of any structure shall, wherever applicable, conform to the requirements of the latest relevant Indian Standards, wherever they exist, or, in the absence of Indian Standards, to other equivalent standards. 2.9 <u>SHOP DRAWINGS</u> The Contractor shall submit to the Engineer the Schedule of Fabrication and delivery of structural steelwork for approval. He shall start to submit progressively for approval the shop drawings based on the approved		

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Design Drawings and before proceeding with the fabrication work, shall get the said shop drawings approved in accordance with the contract. The sequence of submission of shop drawings for approval shall match with the approved fabrication and delivery schedule. The approval for the shop drawings will be accorded only towards the general conformity with the design requirements as well as specification and will ensure the correctness of general arrangement for centreline dimensions and levels, Section sizes, and adequacy of connections including splice joints as to the no. of bolts, weld length, size of gusset/end plates. The correctness of all other details like cutting lengths, matching of holes, notch dimensions, match markings, bill of materials, bolt list etc. will be entirely the contractor's responsibility. The approval of the drawing however shall not relieve the contractor of his sole responsibility in carrying out the work correctly and fulfilling the complete requirements of contract documents. The shop drawings shall include but not be limited to the following: - Assembly drawings giving exact sizes of the sections to be used and identification marks of the various sections. - Dimensional drawings of base plates, foundation bolt location etc. - Details of all connections with supporting calculations. - Comparison sheets to show that the proposed alternative section, if any, are as strong as the original sections shown on the Design Drawings. - Complete Bill of Materials and detailed drawings of all sections as also their billing weights. - Any other drawings or calculations that may be required for the clarification of the works or substituted parts thereof. The shop drawings shall give all the necessary information for the fabrication, erection and painting of the steelwork in accordance with		

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the provisions of this Specification. Shop drawings shall be made in accordance with the best modern practice and with due regard to sequence, speed and economy in fabrication and erection. Shop drawings shall give complete information necessary for fabrication of various components of the steelwork, including the location, type, size and extent of welds. These shall also clearly distinguish between shop and field bolts and welds and specify the class of bolts and nuts. The drawings shall be drawn to a scale large enough to convey all the necessary information adequately. Notes on the shop drawings shall indicate those joints or groups of joints in which it is particularly important that the welding sequence and technique of welding shall be carefully controlled to minimize the locked -up stresses and distortion. Welding symbols used shall be in accordance with the requirements of the Indian Standard Specification - IS:813 - Scheme of symbols for Welding, and shall be consistent throughout. Weld lengths called for on the drawings shall mean the net effective length. The Contractor shall be responsible for and shall pay for any alterations of the work due to any discrepancies, errors or omissions on the drawings or other particulars supplied by him, whether such drawings or other particulars have been duly approved or not in accordance with the Contract. 3.0 <u>WORKMANSHIP</u> 3.1 <u>FABRICATION</u> 3.1.1 General All workmanship shall be equal to the best practice in modern structural shops, and shall conform to the provisions of the Indian Standard IS:800 - Code of Practice for use of Structural Steel in General Building Construction and other relevant Indian Standards.		

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3.1.2 Straightening Material Rolled materials before being laid off or worked, must be clean, free from sharp kinks, bends or twists and straight within the tolerances allowed by the Indian Standard Specification IS:1852 - Specification for rolling and cutting tolerance for hot-rolled steel products. If straightening is necessary, it may be done by mechanical means or by the application of a limited amount of localized heat. The temperature of heated areas, as measured by approved methods, shall not exceed 600 Deg. C. 3.1.3 Cutting Cutting shall be effected by shearing, cropping or sawing. Use of a mechanically controlled gas cutting torch may be permitted for mild steel only. Gas cutting of high tensile steel may also be permitted provided special care is taken to leave sufficient metal to be removed by machining, so that all metal that has been hardened by flame is removed. Gas cutting without a mechanically controlled torch may be permitted if special care is taken and done under expert hand, subject to the approval of the Engineer. To determine the effective size of members cut by gas, 3 mm shall be deducted from each cut edge. Gas cut edges, which will be subjected to substantial stress or which are to have weld metal deposited on them, shall be reasonably free from gouges. Occasional notches or gauges not more than 4 mm deep will be permitted. Gouges greater than 4mm, that remain from cutting, shall be removed by grinding. All re-entrant corners shall be shaped notch-free to a radius of at least 12 mm. Shearing, cropping and gas cutting shall be clean, reasonably square and free from any distortion. 3.1.4 Planning of edges Planning or finishing of sheared or cropped edges of plates or shapes or of edges gas-cut with a mechanically controlled torch shall not be required unless specifically required by design and called for on the drawings, included in a stipulation for edge preparation for welding or as may be required after the inspection of the cut surface. Surface cut with hand flame shall generally be ground, unless specifically instructed otherwise by the Engineer.		

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3.1.5 Clearances The erection clearance for cleated ends of members connecting steel to steel shall preferably be not greater than 2 mm at each end. The erection clearance at ends of beams without web cleats shall be not more than 3 mm at each end, but where, for practical reasons, greater clearance is necessary, suitably designed cleatings shall be provided. 3.2 <u>BOLTED CONSTRUCTION</u> 3.2.1 Holes Holes through more than one thickness of material for members, such as compound stanchions and girder flanges, shall be drilled after the members are assembled and tightly clamped or bolted together. Punching may be permitted before assembly, if the thickness of the material is not greater than the nominal diameter of bolt plus 3 mm subject to a maximum thickness of 16 mm provided that the holes are punched 3 mm less in diameter than the required size and reamed after assembly to the full diameter. Holes for rivets or black bolts shall be not more than 1.5 mm or 2.0 mm (depending on whether the diameter of the bolt is less or more than or equal to 25 mm) larger in diameter than the nominal diameter of the black bolt passing through them. Holes for turned and fitted bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject to a tolerance grade of H8 as specified in IS: 919. Parts to be connected shall be firmly held together by tacking welds or clamps and the holes drilled through all the thicknesses in one operation and subsequently reamed to size. Holes not drilled through all thickness in one operation shall be drilled to a smaller size and reamed out after assembly. Holes for bolts shall not be formed by gas cutting process.		

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3.2.2 Assemble Drifting to enlarge unmatching holes shall not generally be permitted. In case drifting is permitted to a slight extent during assembly, it shall not distort the metal or enlarge the holes. Holes that must be enlarged to admit the bolts shall be reamed. Poor matching of holes shall be cause for rejection. The component parts shall be so assemble that they are neither twisted not otherwise damaged, and shall be so prepared that the specified cambers, if any, are maintained. Bolted construction shall be permitted only in case of field connections if called for on the Drawings and is subjected to the limitation of particular connections as may be specified. In special cases, however, shop bolt connections may be allowed if directed by the Engineer. Washers shall be tapered or otherwise suitably shaped, where necessary, to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project out through the nut at least one thread. In all cases the bolt shall be provided with a washer of sufficient thickness under the nut to avoid any threaded portion of the bolt being within the thickness of the parts bolted together. In addition to the normal washer, one spring washer or lock-nut shall be provided for each bolt for connections subjected to vibrating forces or otherwise as may be specified on the Drawings. 3.3 <u>WELDED CONSTRUCTION</u> 3.3.1 General Welding shall be in accordance with relevant Indian Standards and as supplemented in the Specification. Welding shall be done by experienced and good welders who have been qualified by tests in accordance with IS:817.		

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3.3.2 Preparation of Material Surface to be welded shall be free from loose scale, slag, rust, grease, paint and any other foreign material except that mill scale which withstands vigorous wire brushing may remain. Joint surfaces shall be free from fins and tears. Preparation of edges by gas-cutting shall, wherever practicable, be done by a mechanically guided torch. 3.3.3 Assembling Parts to be fillet welded shall be brought in as close contact as practicable and in no event shall be separated by more than 4 mm. If the separation is 1.5 mm or greater, the size of the fillet weld shall be increased by the amount of the separation. The fit of joints at contact surfaces which are not completely sealed by welds, shall be close enough to exclude water after painting. Abutting parts to be butt-welded shall be carefully aligned. Misalignments greater than 3 mm shall be corrected and in making the correction the parts shall not be drawn into a sharper slope than two degrees (2 Deg.). The work shall be positioned for flat welding whenever practicable. 3.3.4 Welding Sequence In assembling and joining parts of a structure or of built-up members, the procedure and sequence of welding shall be such as will avoid needless distortion and minimize shrinkage stresses. Where it is impossible to avoid high residual stresses in the closing welds of a rigid assembly, such closing welds shall be made in compression elements. In the fabrication of cover-plated beams and built-up members, all shop splices in each component part shall be made before such component part is welded to other parts of the member. Long girders or girder sections may be made by shop splicing not more than three sub-sections, each made in accordance with this paragraph. When required by the Engineer, welded assemblies shall be stress relieved by heat treating in accordance with the provisions of the relevant Indian Standard or any other Standard approved by the Engineer.		

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3.3.5 Welding technique All complete penetration groove welds made by manual welding, except when produced with the aid of backing material not more than 8 mm thick with root opening not less than one-half the thickness of the thinner part joined, shall have the root of the initial layer gouged out on the back side before welding is started from that side, and shall be so welded as to secure sound metal and complete fusion throughout the entire cross section. Groove welds made with the use of the backing of the same material as the base metal shall have the weld metal thoroughly fused with the backing material. Backing strips need not be removed. If required, they may be removed by gouging or gas cutting after welding is completed, provided no injury is done to the base metal and weld metal and the weld metal surface is left flush or slightly convex with full throat thickness. Groove welds shall be terminated at the ends of a joint in a manner that will ensure their soundness. Where possible, this should be done by use of extension bars or run-off plates. Extension bars or run-off plates need not be removed upon completion of the weld unless otherwise specified elsewhere in the Contract. To get the best and consistent quality of welding, automatic submerged arc process shall be preferred. The technique of welding employed, the appearance and quality of welds made, and the methods of correcting defective work shall all conform to the relevant Indian Standards. 3.3.6 Temperature No welding shall normally be done on parent material at a temperature below (-) 5 Deg.C. However, if welding is to be undertaken at low temperature adequate precautions as recommended in relevant Indian Standard shall be taken. When the parent material is less than 40 mm thick and the temperature is between (-) 5 Deg. C and 0 Deg. C, the surface around the joint to a distance of 100 mm or 4 times the thickness of the material, whichever is greater, shall be preheated till it is handwarm. When the parent material is more than 40 mm thick, the temperature of the area mentioned above shall be in no case be less than 20 Deg.C. All requirements regarding preheating of the parent material shall be in		

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accordance with the relevant Indian Standard. 3.3.7 Peening Where required, intermediate layers of multiple-layer welds may be peened with light blows from a power hammer, using a round-nose tool. Peening shall be done after the weld has cooled to a temperature warm to the hand. Care shall be exercised to prevent scaling or flaking of weld and base metal from over peening. 3.3.8 Equipment These shall be capable of producing proper current so that the operator may produce satisfactory welds. The welding machine shall be of a type and capacity as recommended by the manufacturers of electrodes or as may be approved by the engineer. 3.4 <u>FINISH</u> Column splices and butt joints of compression members depending on contact for stress transmission shall be accurately machined and close-butted over the whole section with a clearance not exceeding 0.2 mm locally at any place. In column caps and bases, the ends of shafts together with the attached gussets, angles, channels etc., after welding together, should be accurately machined so that the parts connected butt over the entire surfaces of contact. Care should be taken that those connecting angles or channels are fixed with such accuracy that they are not reduced in thickness by machining by more than 2.0 mm. 3.5 <u>SLAB BASES AND CAPS</u> Bases and caps fabricated out of steel slabs, except when cut from material with true surface, shall be accurately machined over the bearing surface and shall be in effective contact with the end of the stanchion. A bearing face which is to be grouted direct to a foundation need not be machined if such face is true and parallel to the upper face. To facilitate grouting, holes shall be provided, where necessary, in stanchion bases for the escape of air.		

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3.6	<u>LACING BARS</u> The ends of lacing bars shall be neat and free from burrs.	
3.7	<u>SEPARATORS</u> Rolled section or built-up steel separators or diaphragms shall be required for all double beams except where encased in concrete, in which case, pipe separators shall be used.	
3.8	<u>BEARING PLATES</u> Provision shall be made for all necessary steel bearing plates to take up reaction of beams and columns and the required stiffeners and gussets whether or not specified in Drawings.	
3.9	<u>ARCHITECTURAL CLEARANCES</u> Bearing plates and stiffener connections shall not be permitted to encroach on the designed architectural clearances.	
3.10	<u>SHOP CONNECTIONS</u> (a) All shop connections shall be welded as specified on the Drawings. (b) Certain connections, specified to be shop connections, may be changed to field connections if desired by the Engineer for convenience of erection and the Contractor will have to make the desired changes.	
3.11	<u>CASTINGS</u> Steel castings shall be annealed.	
3.12	<u>SHOP ERECTION</u> The steelwork shall be temporarily shop-erected complete or as directed by the Engineer so that accuracy of fit may be checked before despatch. The	

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3.13 3.13.1	parts shall be shop-erected with a sufficient number of parallel drifts to bring and keep the parts in place. In case of parts drilled or punched using steel jigs to make all similar parts interchangeable, the steelwork shall be shop erected in such a way as will facilitate the check of interchange ability. <u>SHOP PAINTING</u> General Unless otherwise specified, steelwork which will be concealed by interior building finish need not be painted; steelwork to be encased in concrete shall not be painted. Unless specifically exempted, all other steelwork shall be given one coat of shop paint, applied thoroughly and evenly to dry surfaces which have been cleaned, in accordance with the following paragraph, by brush, spray, roller coating, flow-coating or dipping as may be approved by the Engineer. After inspection and approval and before leaving the shop, all steelwork specified to be painted shall be cleaned by hand-wire brushing or by other mechanical cleaning methods to remove loose mill scale, loose rust, weld slag or flux deposit, dirt and other foreign matter. Oil and grease deposits shall be removed by solvent. Steelwork specified to have no shop paint shall, after fabrication, be cleaned of oil or grease by solvent cleaners and be cleaned of dirt and other foreign material by through sweeping with a fibre brush. After completion of the precleaning, the metal surface shall immediately painted with red oxide zinc chromate primer conforming to IS : 2074. In highly corrosive environment, all steelwork shall be given a coat of shop paint, applied thoroughly and evenly to dry surfaces which have been cleaned by sand blasting to SA 2/1/2 grade minimum. The shop paint shall be epoxy resin based zinc rich primer such as Blast Steel EZ1 of Shalimer Paint Limited.	

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3.13.2 Inaccessible parts Surfaces not in contact, but inaccessible after assembly, shall receive two coats of shop paint, positively of different colours to prove application of two coats before assembly. This does not apply to the interior of sealed hollow sections. 3.13.3 Contact surfaces Contact surface shall be cleaned in accordance with Sub-clause 3.13.1 before assembly. 3.13.4 Finished surfaces Machine finished surfaces shall be protected against corrosion by a rust inhibiting coating that can be easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection. 3.13.5 Surfaces adjacent to field welds Unless otherwise provided for, surfaces within 50 mm of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done. 3.14 <u>GALVANIZING</u> 3.14.1 General Structural steelwork for switchyard or other structures as may be specified in the Contract shall be hot dip galvanized in accordance with the American Society for Testing and Materials Specification ASTM-A 123 or IS : 2629 - Recommended practice for Hot-Dip Galvanising of Iron and steel. Where the steel structures are required to be galvanized the field connection materials like bolts, nuts and washers shall also be galvanized.		

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3.14.2 Surface Preparation

All members to be galvanized shall be cleaned, by the process of pickling of rust, loose scale, dirt, oil, grease, slag and spatter of welded areas and other foreign substances prior to galvanizing. **Pickling shall be carried out by immersing the steel in an acid bath containing either sulphuric or hydrochloric acid at a suitable concentration and temperature.**

The concentration of the acid and the temperature of the bath can be varied, provided that the pickling time is adjusted accordingly.

The pickling process shall be completed by thoroughly rinsing with water, which should preferably be warm, so as to remove the residual acid.

3.14.3 Procedure

Galvanizing shall be carried out by hot dip process in a proper and uniformly heated bath. It shall meet all the requirements when tested in accordance with IS:2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS:4759 - Specification for Hot-dip zinc coatings on Structural Steel & other allied products.

After finishing the threads of bolts, galvanizing shall be applied over the entire surface uniformly. The threads of bolts shall not be machined after galvanizing and shall not be clogged with zinc. The threads of nuts may be tapped after galvanizing but care shall be taken to use oil in the threads of nuts during erection.

The surface preparation for galvanizing and the process of galvanizing itself, shall not adversely affect the mechanical properties of the materials to be galvanized. Where members are of such lengths as to prevent complete dipping in one operation, great care shall be taken to prevent warping.

Materials on which galvanizing has been damaged shall be acid stripped and re-galvanized unless otherwise directed, but if any member becomes damaged after having been dipped twice, it shall be rejected. Special care shall be taken not to injure the skin on galvanized surfaces during transport

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and handling. Damages, if occur, shall be made good in accordance with the provisions of this Specification or as directed by the Engineer.		
4.0	<u>INSPECTION, TESTING, ACCEPTANCE CRITERIA AND DELIVERY</u>	
4.1	<u>INSPECTION</u>	
Unless specified otherwise, inspection to all work shall be made by the Engineer or Engineer's representative at the place of manufacture prior to delivery. The Engineer or his representative shall have free access at all reasonable times to those parts of the manufacturer's works which are concerned with the fabrication of the steelwork under this Contract and he shall be afforded all reasonable facilities for satisfying himself that the fabrication is being done in accordance with the provisions of this Specification. The Contractor shall provide such labour, materials, electricity, fuel, water, stores, tools and plant, apparatus and instruments as may be required by the Engineer to carry out inspection and/or tests in accordance with the Contract. The Contractor shall guarantee compliance with the provisions of this Specification.		
4.2	<u>TESTING AND ACCEPTANCE CRITERIA</u>	
4.2.1	General	
The Contractor shall carry out sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own cost, unless otherwise specified in the Contract. The Contractor shall get the specimens tested in a laboratory approved by the Engineer and submit to the Engineer the test results in triplicate within 3 (three) days after completion of the test.		
4.2.2	Steel	
All steel supplied by the Contractor shall conform to the relevant Indian		

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Standards. Except otherwise mentioned in the Contract, only tested quality steel having mill test reports shall be used. In case unidentified steel materials are permitted to be used by the Engineer, random samples of materials will be taken from each unidentified lot of 50 M.T. or less of any particular section for tests to conform to relevant Indian Standards. All material shall be free from all imperfections, mill scales, slag intrusions, laminations, pittings, rusts etc. that may impair their strength, durability and appearance. 4.2.3 Testing Criteria for checking Lamination in raw steel plates All raw steel plate of thickness more than 20 mm supplied by the contractor shall be checked against lamination before procurement & prior to commencement of fabrication work in the following ways as directed by the Engineer. (a) Ultrasonic testing along the edge of specified points of the plates shall be carried out to delete lamination in the plates, if any. (b) If the results of the tests in (a) are not satisfactory, the whole area of the plates shall be checked by ultrasonic testing at specified nodal points formed at equidistant grid locations. The spacing of the grids shall be determined from tests in (a) or as directed by the Engineer. If the results of the above tests are not satisfactory, the plates shall not be taken up for fabrication work. Even after fabrication at shop, if the Engineer requires any ultrasonic testing to detect lamination of plates, the same shall be carried out by the Contractor. If the plates in the fabricated item is found to be laminated, the component will be rejected 4.2.4 Welding All electrodes shall be procured from reliable manufacturers with test certificates. The correct grade and size of electrode which has not deteriorated in storage shall be used. The inspection and testing of welding shall be performed in accordance with the provisions of the relevant Indian Standards or other equivalents. For every 50 tonnes of welded fabrication, the Engineer may ask for at least 1 (one) test-destructive or non-		

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destructive including X-ray, ultrasonic test or similar. In the event of further tests as may be desired by the Engineer, if the results are found to be unsatisfactory; and if the test shows no defect. In cases of the test results showing deficiency, the Engineer shall have option to reject or instruct any remedial measures to be taken.		
4.2.5	Bolts, nuts and washers All bolts, nuts and washers shall be procured from reputed manufacturer approved by the Engineer and shall conform to the relevant Indian Standards. If desired by the Engineer, representative samples of these materials may have to be tested in an approved laboratory and in accordance with the procedures described in relevant Indian Standards.	
4.2.6	Shop painting All paints and primers shall be of standard quality and procured from approved manufacturers and shall conform to the provisions of the relevant Indian Standards.	
4.2.7	Galvanizing All galvanizing shall be uniform and of standard quality when tested in accordance with IS:2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS:4759 -specification for Hot-Dip Zinc Coatings on Structural Steel & other allied products.	
4.3	<u>TOLERANCE</u> The tolerances on the dimensions of individual rolled steel components shall be as specified in IS:1852 - specification for rolling and Cutting Tolerances for Hot-rolled Steel Products. The tolerances on straightness, length etc. of various fabricated components (such as beams and girders, columns, crane gantry girder etc.) of the steel structures other than steel railway & road bridges, structures subjected to dynamic loading (like wind, seismic etc.) and thin walled construction (like box girders) shall be as specified in IS:7215 - Tolerances for Fabrication of Steel Structures.	

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4.4 <u>ACCEPTANCE</u> Should any structure or part of a structure be found not to comply with any of the provisions of this Specification, the same shall be liable to rejection. No structure or part of the structure, once rejected, shall be offered again for test, except in cases where the Engineer considers the defects rectifiable. The Engineer may, at his discretion, check the test results obtained at the Contractor's works by independent tests at an approved laboratory and should the items, so tested, be found to be unsatisfactory. When all tests to be performed in the Contractor's shop under the terms of this contract have been successfully carried out, the steelwork will be accepted forthwith and the Engineer will issue an acceptance certificate, upon receipt of which, the items will be shop painted, packed and despatched. No item to be delivered unless an acceptance certificate for the same has been issued. The satisfactory completion of these tests or the issue of the certificates shall not bind the Owner to accept the work, should it, on further tests before or after erection, be found not in compliance with the Contract. 4.5 <u>DELIVERY OF MATERIALS</u> 4.5.1 General The Contractor will deliver the fabricated structural steel materials to site with all necessary field connection materials in such sequence as will permit the most efficient and economical performance of the erection work the Owner may prescribe or control the sequence of delivery of materials, at his own discretion 4.5.2 Marking Each separate piece of fabricated steelwork shall be distinctly marked on all surfaces before delivery in accordance with the markings shown on approved erection drawings and shall bear such other marks as will further facilitate identification and erection.		

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4.5.3 Packing and Shipping

All projecting plates or edges and all ends of members of joints shall be stiffened, all straight members and plates, shall be bundled, all screwed ends and machined surfaces shall be suitably packed and all bolts, nuts, washers, and small loose parts shall be packed separately in order to prevent damage or distortion during shipping.

Shipping shall be strictly in accordance with the sequence stipulated in the agreed programme. Payment may be held up for items sent in advance of the sequence till they could be erected. The Contractor shall include and provide for in his rates, the freight and other charges for despatching the materials to the worksite and also for securely protecting and packing the materials to avoid loss or damage during transport by rail, road or water. All packing shall allow for easy removal and checking at site. Special precautions shall be taken against rusting, corrosion, breakage or damage otherwise of the materials. All parts shall be adequately braced to prevent damage in transit.

Each bundle, bale or package delivered under this contract shall be marked on as many sides as possible and such distinct marking (all previous irrelevant markings being carefully obliterated) shall show the following:-

- (a) Name and address of the consignee
- (b) Name and address of the consignor
- (c) Gross weight of the package in tonnes and its dimensions.
- (d) Identification marks and/or number of the package
- (e) Custom registration number, if required.

All markings shall be carried out with such materials as would ensure quick drying and indelibility.

Each component or part or piece of material when shipped, shall be indelibly marked and/or tagged with reference to assembly drawings and

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corresponding piece numbers.

Each packing case shall contain in duplicate in English a packing list pasted on to the inside of the cover in a water-proof envelope, quoting especially:

- (a) Name of the Contractor
- (b) Number and date of the Contract
- (c) Name of the office placing the contract
- (d) Nomenclature of stores
- (e) A schedule of parts or pieces, giving the parts or piece number with reference to assembly drawings and the quantity of each.

The shipping dimensions of each package shall not exceed the maximum dimensions permissible for transport over the Indian Railways/Roads.

After delivery of the materials at site, all packing materials shall automatically become the property of the Owner.

Notwithstanding anything stated hereinbefore, any loss or damage resulting from inadequate packing shall be made good by the Contractor. When facilities exist, all shipments shall be covered by approved Insurance Policy for transit at the cost of the Contractor.

The contractor shall ship the complete materials or part on board a vessel belonging to an agency approved by the Owner or on rail and/or road transport as directed. The Contractor shall take all reasonable steps to ensure correct appraisal of freight rates, weights and volumes and in no case will the Owner be liable to pay any warehouse, wharfage, demurrage and other charges.

If, however, the Owner has to make payment of any of the above mentioned charges, the amount paid will be deducted from the progressive bills of the Contractor.

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Necessary advice regarding the shipment with relevant details shall reach the Engineer at least a week in advance. 5.0 <u>INFORMATION TO BE SUBMITTED</u> 5.1 <u>WITH TENDER</u> The following information are required to be submitted with the Tender: (a) Progress Schedule The Contractor shall quote in his Tender a detailed schedule of progress of work and total time of completion, itemizing the time required for each of the following aspects of work. (i) Preparation and approval of shop drawings. (ii) Procurement of materials (iii) Fabrication and shipping of all anchor bolts (iv) Fabrication and shipping of main steelwork (v) Fabrication and shipping of steelwork for bunkers. Tanks and/or silos as applicable. (vi) Fabrication and shipping of all other remaining steel work including miscellaneous steelwork (vii) Final date of completion of all shipments. Time required for completion being one of the main criteria for selecting the successful bidder, it is desired that the bidder quotes the minimum time required by him for completing the work. (b) Shop Location of the Tenderer's fabrication workshop giving details of		

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equipment, manpower, the total capacity and the capacity that will be available exclusively for this contract shall be submitted (c) Matching Steel A rough indication of the quantities and details of matching steel sections required to start the work shall be furnished. 5.2 <u>AFTER AWARD</u> After award of the Contract the successful Tenderer is to submit the following: (a) Complete fabrication drawings, material lists, cutting lists, bolt lists, field welding schedules based on the design drawings in accordance with the approved schedule. (b) Monthly Progress Report with necessary photographs in six (6) copies to reach the Engineer on or before the 7th day of each month, giving the upto date status of preparation of detailed shop drawings, bill of materials, procurement of materials, actual fabrication done, shipping and all other relevant information. (c) Results of any test as and when conducted and as required by the Engineer. (d) Manufacturer's mill test report in respect of steel materials, bolts, nuts and electrodes as may be applicable.		

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SECTION – 5

ERECTION OF STRUCTURAL STEELWORK

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1.0 <u>SCOPE</u> This specification covers the erection of structural steelwork including receiving and taking delivery of fabricated structural steel materials arriving at Site and installing the same in position, painting and grouting the stanchion bases all complete as per Drawings, this Specification and other provision of the Contract. 2.0 <u>GENERAL</u> 2.1 <u>WORK TO BE PROVIDED FOR BY THE CONTRACTOR</u> The work to be provided for by the Contractor, unless otherwise specified in the Contract, shall include but not be limited to the following:- (a) The Contractor shall provide all construction and transport equipment, tools, tackle, consumables, materials, labour and supervision required for the erection of the structural steelwork. (b) Receiving, unloading, checking and moving to storage yard at Site including prompt attendance to all insurance matters as necessary for all fabricated steel materials arriving at Site. The Contractor shall pay all demurrage and/or wharf age charges etc. on account of default on his part. (c) Transportation of all fabricated structural steel materials from Site storage yard, handling, rigging, assembling, bolting, welding and satisfactory installation of all fabricated structural steel materials in proper location according to approved erection drawings and/or as directed by the Engineer. If necessary suitable temporary approach roads to be built for transportation of fabricated steel structures. (d) Checking center lines, levels of all foundation blocks including checking line, level, position and plumb of all bolts and pockets. Any defect observed in the foundation shall be brought to the notice of the Engineer. The Contractor shall fully satisfy himself regarding the correctness of the foundations before installing the fabricated steel structures on the foundation blocks.		

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(e) Aligning, plumbing, levelling, bolting, welding and securely fixing the fabricated steel structures in accordance with the Drawings or as directed by the Engineer. (f) Painting of the erected steel structures if required by the Contract. (g) All minor modifications of the fabricated steel structures as directed by the Engineer including but not limited to the following : (i) Removal of bends, kinks, twists etc. for parts damaged during transport and handling. (ii) Cutting, chipping, filling, grinding etc. if required for preparation and finishing of site connections. (iii) Reaming of holes for use of higher size bolt if required. (iv) Welding of connections in place of bolting for which holes are either not drilled at all or wrongly drilled during fabrication. Welding in place of bolting will be permitted only at the discretion of the Engineer. (v) Refabrication of parts damaged beyond repair during transport and handling or Refabrication of parts which are incorrectly fabricated. (vi) Fabrication of parts omitted during fabrication by error, or subsequently found necessary. (vii) Drilling of holes which are either not drilled at all or are drilled in incorrect location during fabrication. (viii) Carry out tests in accordance with this Specification if directed. 2.2 <u>WORK BY OTHERS</u> No work under this Specification will be provided for by any agency other than the Contractor unless specifically mentioned elsewhere in the Contract.		

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2.3 <u>CODES AND STANDARDS</u> All work under this Specification shall, unless specified otherwise, conform to the latest revisions and/or replacements of the following or any other Indian Standard Specification and codes of Practice of equivalent:- (a) IS-800 : Code of Practice for general construction in steel (b) IS-456 : Code of Practice for plain or reinforced concrete (c) IS-7205 : Safety Code for erection of Structural Steel work (d) IS-12843 : Tolerance for erection of Steel Structures 2.4 <u>CONFORMITY WITH DESIGNS</u> The Contractor will erect the entire fabricated steel structure, align all the members, complete all field connections and grout the foundations all as per the provisions of this specification and the design criteria detailed in the approved erection drawings and/or other stated document. All work shall conform to the provisions of the relevant Indian Standard Specifications and/or the instructions of the engineer. . Where specific Indian Standard is not available, the most stringent specification from the relevant American/German/British Standards shall be adopted. The testing and acceptance of the erected structures shall be in accordance with the provisions of this Specification and/or the instructions of the Engineer. 2.5 <u>MATERIAL</u> 2.5.1 General The Contractor will check the quantity, quality and the sizes of the fabricated materials and verify the adequacy of the same in accordance with the Drawings and Specifications. The Contractor shall make good any deficiency, if detected, either by repair or with fresh material as may be directed by the Engineer.		

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All consumables like oxygen and acetylene gas, paints, fuels, lubricants, oil, grease, cement, sand, aggregates and any other material that may be required for the execution of the works in accordance with the contract will be supplied by the contractor for erection work and will be deemed to have been included in this rates. 2.5.2 Materials to conform to Indian Standards All materials required to be supplied by the Contractor under this Contract shall conform to the relevant Indian Standard Specifications. 2.6 <u>STORAGE OF MATERIALS</u> 2.6.1 General All material shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for use in the works. Any material which has been deteriorated or damaged beyond repairs and has become unfit for use shall be removed immediately from the site, failing which, the Engineer shall be at liberty to get the materials removed by agency. 2.6.2 Yard The Contractor will have to establish a suitable yard in an approved location at site for storing the fabricated steel structures and other materials which will be delivered to him by the Owner according to the Contract. The yard shall have proper facilities like, drainage, lighting, suitable access for large cranes, trailers and other heavy equipments. The yard shall be fenced all around with security arrangement and shall be of sufficiently large area to permit systematic storage of the fabricated steel structures without overcrowding and with suitable access for cranes, trailers and other equipment for use in erection work in proper sequence in accordance with the approved programme of work. The Tendered should visit the site prior to submission of his Tender to acquaint himself with the availability of land and the development necessary by way of filling, drainage, access roads, fences, sheds etc. all of which shall be carried out by the Contractor as directed by the Engineer.		

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2.6.3 Covered Store All field connection materials, paints, cement etc. shall be stored on well designed racks and platforms off the ground in a properly covered store building to be built. 2.7 <u>QUALITY CONTROL</u> The contractor shall establish and maintain quality control procedures for different items of work and materials as may be directed by the Engineer to assure compliance with the provisions of the Contract and shall submit the records of the same to the Engineer. The quality control operation shall include but not be limited to the following items of work:- (a) Erection: Lines, levels, grades, plumbs, joint characteristics including tightness of bolts. (b) Grouting: Cleaning and roughness of foundation, quality of materials used for grouting, admixtures, consistency and strength of grout. (c) Painting : Preparation of surface for painting, quality of primers and paints, thinners, application and uniformity of coats. The Contractor shall salvage, collect and deliver all the packing materials to the Owner. 3.0 <u>WORKMANSHIP</u> 3.1 <u>ERECTION</u> 3.1.1 Plant and equipment The suitability and adequacy of all erection tools and plant and equipment proposed to be used shall be efficient, dependable, in good working condition and shall have the approval of the Engineer.		

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3.1.2 Method and sequence of erection The method and sequence of erection shall have the prior approval of the Engineer. The Erection shall arrange for most economical method and sequence available to him consistent with the Drawings and Specifications and such information as may be furnished to him prior to the execution of the Contract. 3.1.3 Temporary bracing Unless adequate bracing is included as a part of the permanent framing, the erector during erection shall install temporary guys and bracings where needed to secure the framing against loads such as wind or seismic forces comparable in intensity to that for which the structure has been designed, acting upon exposed framing as well as loads due to erection equipment and erection operations. If additional temporary guys are required to resist wind or seismic forces acting upon components of the finished structure installed by others during the course of the erection of the steel framing, arrangement for their installation by the erector shall be made. The responsibility of the Contractor in respect of temporary bracings and guys shall cease when the structural steel is once located, plumbed, levelled, aligned and grouted within the tolerances permitted under the specification and guyed and braced to the satisfaction of the Engineer. 3.1.4 Temporary floors for buildings It shall be the responsibility of the Contractor to provide free of cost planking and to cover such floors during the work in progress as may be required by any Act of Parliament and/or by-laws of state, Municipal or other local authorities. 3.1.5 Setting out Positioning and levelling of all steelwork, plumbing of stanchions and placing of every part of the structure with accuracy shall be in accordance		

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with the approved Drawings and to the satisfaction of the Engineer. Concrete foundations, where required, shall be made by other agencies. Anchor bolts and other anchor steel shall be embedded by other agencies. The Contractor shall check the positions and levels of the anchor bolts, etc. before concreting and get them properly secured against disturbance during pouring operations. He shall remain responsible for correct positioning. For heavy columns, etc. the Contractor shall set proper screed bars if desired by the Engineer, to maintain proper level. Each tier of column shall be plumbed and maintained in a true vertical position subject to the limits of tolerance allowable under this Specification. No permanent field connections by bolting or welding shall be carried out until proper alignment and plumbing has been attained. 3.1.6 Field bolting All relevant portions in respect of bolted construction of the Specification for Fabrication of Structural Steelwork applicable to the Project shall also be applicable for field bolting in addition to the following: Bolts shall be inserted in such a way so that they may remain in position under gravity even before fixing the nut. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible materials. When assembled, all joint surfaces, including those adjacent to the washers shall be free of scales except tight mill scales. They shall be free of dirt, loose scales, burns, and other defects that would prevent solid seating of the parts. Contact surfaces within friction-type joints shall be free of oil, paint, lacquer, or galvanizing. All high tensile bolts shall be tightened to provide, when all fasteners in the joint are tight, the required minimum bolt tension by any of the following methods. (a) Turn-of-nut method When the turn-of-nut method is used to provide the bolt tension, there shall first be enough bolts brought to a "snug tight" condition to ensure that the parts of the joint are brought into good		

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contact with each other. "snug tight" is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Following this initial operation, bolts shall be placed in any remaining holes in the connection and brought to snug tightness. All bolts in the joint shall then be tightened additionally by the applicable amount of nut rotation specified in Table-1 with tightening progressing systematically from the most rigid part of the joint to its free edges. During this operation there shall be no rotation of the part not turned by the wrench.

TABLE - I

SR. NO.	BOLTS LENGTH NOT Exceeding 8 x dia. or 200 mm	BOLT LENGTH Exceeding 8x dia. or 200 mm	REMARKS
(i)	1/2 turn	2/3 turn	Nut rotation is relative to bolt regardless of the element (nut or bolt) being turned. Tolerance on rotation – 30 over or under.

Bolts may be installed without hardened washers when tightening is done by the turn-of-nut method. However, normal washers shall be used.

Bolts tightened by the turn-of-nut method may have the outer face of the nut match-marked with the protruding bolt point before final tightening, thus affording the inspector visual means of noting the actual nut rotation. Such marks can be made by the wrench operator by suitable means after the bolts have been brought up snug tight.

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(b) Torque Wrench tightening

When torque wrenches are used to provide the bolt tensions, the bolts shall be tightened to the torques specified in TABLE - II. Nuts shall be in tightening motion when torque is measured. When using torque wrenches to install several bolts in a single joint, the wrench shall be returned to touch up bolts previously tightened, which may have been loosened by the tightening of subsequent bolts, until all are tightened to the required tension.

TABLE - II

SR. NO.	Nominal Bolt Diameter (mm)	Torque to be applied (Kg.M) for bolt class 8.8 of IS : 1367
(i)	20	59.94
(ii)	22	81.63
(iii)	24	103.73

NOTE:

The above torque values are approximate for providing tensions of 14.7 MT for 20 mm dia., 18.2 MT for 22 mm dia; and 21.2 MT for 24 mm dia. bolts under moderately lubricated condition. The torque wrench shall be calibrated at least once daily to find out the actual torque required to produce the above required tension in the bolt by placing it in a tension indicating device. This torques shall be applied for tightening the bolts on that day with the particular torque wrench.

In either of the above two methods, if required, for bolt entering and wrench operation clearances, tightening may be done by turning the bolt while the nut is prevented from rotating.

Impact wrenches if used shall be of adequate capacity and sufficiently supplied with air to perform the required tightening of each bolt in approximately ten seconds.

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Holes for turned bolts to be inserted in the field shall be reamed in the field. All drilling and reaming for turned bolts shall be done only after the parts to be connected are assembled. Tolerances applicable in the fit of the bolts shall be in accordance with relevant Indian Standard Specifications. All other requirements regarding assembly and bolt tightening shall be in accordance with this sub clause. 3.1.7 Field Welding All field assembly and welding shall be carried out in accordance with the requirements of the specification for fabrication work applicable to the project, excepting such provisions therein which manifestly apply to shop conditions only. Where the fabricated structural steel members have been delivered painted, the paint shall be removed before field welding for a distance of at least 50 mm on either side of the joints. 3.1.8 Holes, cutting and fitting No cutting of sections, flanges, webs, cleats, bolts, welds etc. shall be done unless specifically approved and/or instructed by the Engineer. The erector shall not cut, drill or otherwise alter the work of other trades, or his own work to accommodate other trades, unless such work is clearly specified in the Contract or directed by the Engineer. Wherever such work is specified the Contractor shall obtain complete information as to size, location and number of alterations prior to carrying out any work. 3.2 <u>DRIFTING</u> Correction of minor misfits and reasonable amount of reaming and cutting of excess stock from rivets will be considered as permissible. For this, light drifting may be used to draw holes together and drills shall be used to enlarge holes as necessary to make connections. Reaming, that weakens the member or makes it impossible to fill the holes properly or to adjust accurately after reaming shall not be allowed.		

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Any error in shop work which prevents the proper assembling and fitting of parts by moderate use of drift pins and reamers shall immediately be called to the attention of the Engineer and approval of the method of correction obtained. The use of gas cutting torches at erection site is prohibited. 3.3 Grouting of stanchion bases and bearings of beams and girders on stone, brick or concrete (Plain or reinforced)+ Grouting shall be carried out with Ordinary Cement grout as described below: The mix shall be one (1) part cement and one (1) part sand and just enough water to make it workable. The positions to be grouted shall be cleaned thoroughly with compressed air jet and wetted with water and any accumulated water shall be removed. These shall be placed under expert supervision, taking care to avoid air-locks. Edges shall be finished properly. If the thickness of grout is 25 mm or more, two (2) parts of 6 mm down graded stone chips may be added to the above noted cement-sand group mix, if required, by the Engineer or shown on the drawings. Admixtures like aluminium powder, "ironite" may be required to be added to the grout to enhance certain desirable properties of the grout. Alternatively, the grouting may be done with non-shrink high strength free flow cementitious grout (ready mixed) like "Sika grout - 214", or "Anchor NSG" or approved equivalent. No grouting shall be carried out until a sufficient number of bottom lengths of stanchions have been properly lined, levelled and plumbed and sufficient floor beams are tied in position. Whatever method of grouting is employed, the operation shall not be carried out until the steelwork has been finally levelled and plumbed, the stanchion bases being supported meanwhile by steel wedges, and immediately before grouting, the space under steel shall be thoroughly cleaned.		

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3.4 <u>PAINING AFTER ERECTION</u> Field painting, if required to be done by the erection Contractor, shall only be done after the structure is erected, levelled, plumbed, aligned and grouted in its final position, tested and accepted by the Engineer. However, touch up paintings, making good any damaged shop painting and completing any unfinished portion of the shop coat shall be carried out by the erection Contractor to the Owner. The materials and specification for such painting in the field shall be in accordance with the requirements of the specification for fabrication of structural steelwork applicable for the project. Painting shall not be done in rainy or foggy weather or when humidity is such as to cause condensation on the surfaces to be painted. Before painting of steel, which is delivered unpainted, is commenced, all surfaces to be painted shall be dried and thoroughly cleaned from all loose scale and rust. All field bolts, welds and abrasions to the shop coat shall be spot painted with the same paint used for the shop coat. Where specified, surfaces which will be in contact after site assembling shall receive a coat of paint (in addition to the shop coat, if any) and shall be brought together while the paint is still wet. Surface which will be inaccessible after field assembly shall receive the full specified protective treatment before assembly. Bolts and fabricated steel members which are galvanized or otherwise treated and steel members to be encased in concrete shall not be painted. The specification for paint and workmanship shall be in accordance with the requirements of the specification for fabrication of structural steelwork applicable to the project. The number of coats and the shades to be used shall be as specified or as directed by the Engineer. 3.5 <u>STAINLESS STEEL PLATE LINING IN BUNKER HOPPER</u> The hopper portion of the coal bunkers shall be lined with stainless steel plates of 3 mm thickness. The stainless steel shall be of AISI-316 quality. The		

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work includes supply, fabrication, welding and fixing of stainless steel lining plate to bunker M.S. plate as per drawing. The stainless steel liner shall be fixed to the Bunker hopper by plug welding using special electrodes (such as, Inox-CW coding AWS-310-16 ISMBOS- 311 or Inox-D2 coding AWSE-309-16, ISMB 04-311 manufactured by Advani Oerlikon Ltd). Such plug welding shall be done by drilling 21.5 mm dia. holes at 300 mm centre to centre both ways. The plug welding shall be ground flush with the lining plate. 3.6 <u>FINAL CLEANING UP</u> Upon completion of erection and before final acceptance of the work by the Engineer, the Contractor shall remove all false work, rubbish and all Temporary Works resulting in connection with the performance of his work. 3.7 <u>SAFETY MEASURES DURING ERECTION</u> The safety measures to workmen and supervisors during all types of erection work (e.g., use of lifting appliances, slingning, welding, gas cutting, etc.) should be taken as per IS: 7205. When any statutory provisions exist, the same shall be complied with in addition to the provisions contained in the above code. 4.0 <u>TESTING AND ACCEPTANCE CRITERIA</u> 4.1 <u>GENERAL</u> Loading tests shall be carried out on erected structures, if required by the Engineer, to check adequacy of fabrication and/or erection. Any structure or a part thereof found to be unsuitable for acceptance as a result of the test shall have to be dismantled and replaced with suitable member. In course of dismantling, if any damage is done to any other parts of the structure or to any fixtures, the same shall be made good by the Contractor responsible, to the satisfaction of the Engineer. The structure or structural member under consideration shall be loaded with its actual dead load for as long a time as possible before testing and the tests shall be conducted as indicated in the following Sub-clauses 4.1.1, 4.1.2		

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and 4.1.3. The method of testing and application of loading shall be as approved by the Engineer. 4.1.1 Stiffness Test In this test, the structure or member shall be subjected, in addition to its actual dead load, to a test load equal to 1.5 times the specified superimposed load, and this loading shall be maintained for 24 hours. The maximum deflection attained during the test shall be within the permissible limit. If, after removal of the test load, the member or structure does not show a recovery of at least 80 per cent of the maximum strain or deflection shown during 24 hours under load, the test shall be repeated. The structure or member shall be considered to have sufficient stiffness, provided that the recovery after this second test is not less than 90 percent of the maximum increase in strain or deflection recorded during the second test. 4.1.2 Strength Test The structure or structural member under consideration shall be subjected, in addition to its actual dead load, to a test load equal to the sum of the dead load and twice the specified superimposed load, and this load shall be maintained for 24 hours. In the case of wind load, a load corresponding to twice the specified wind load shall be applied and maintained for 24 hours, either with or without the vertical test load for more severe condition in the member under consideration or the structure as a whole. Complete tests under both conditions may be necessary to verify the strength of the structure. The structure shall be deemed to have adequate strength if, during the test, no part fails and if on removal of the test load, the structure shows a recovery of at least 20 per cent of the maximum deflection or strain recorded during the 24 hours under load. 4.1.3 Structure of same design Where several structures are built to the same design and it is considered unnecessary to test all of them, one structure, as a prototype, shall be fully tested, as described in previous Sub-clauses, but in addition, during the first application of the test load, particular note shall be taken of the strain or		

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deflection when the test load 1.5 times the specified superimposed load has been maintained for 24 hours. This information is required as a basis of comparison in any check test carried out on samples of the structure. When a structure of the same type is selected for a check test, it shall be subjected, in addition to its actual dead load, to a superimposed test load, equal to 1.5 times the specified live load, in a manner and to an extent prescribed by the Engineer. This load shall be maintained for 24 hours, during which time, the maximum deflection shall be recorded. The check test shall be considered satisfactory, provided that the maximum strain or deflection recorded in the check test does not exceed by more than 20% of the maximum strain or deflection recorded at similar load in the test on the prototype. 4.1.4 Repair for subsequent test and use after strength tests An actual structure which has passed the "Strength Test" as specified in Sub-clause 4.1.2 hereinbefore and is subsequently to be erected for use shall be considered satisfactory for use after it has been strengthened by replacing any distorted members and has subsequently satisfied the 'Stiffness Test' as specified in Sub-clause 4.1.1. Here in before. 4.2 <u>TOLERANCES</u> Some variation is to be expected in the finished dimensions of structural steel frames. Unless otherwise specified, such variations are deemed to be within the limits of good practice when they are not in excess of the cumulative effect of detailed erection clearances, fabricating tolerances for the finished parts and the rolling tolerances for the profile dimensions permitted under the Specifications for fabrication of structural steelwork applicable to this Project and as specified below: 4.2.1 For Buildings Containing Cranes			
	Component	Description	Variation Allowed
4.2.1.1	Main columns	(a) Shifting of column axis at foundation level with respect to building line	

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		(i) In longitudinal direction (ii) In lateral direction	3.0 mm 3.0 mm
		(b) Deviation of both major column axis from vertical between foundation and other member connection levels : (i) For a column upto and including 10M height	3.5 mm from true vertical
		(i) For a column greater than 10M but less than 40M height	3.5 mm from true vertical for any 10M length measured between connection levels, but not more than 7.0 mm per 30 m length.
		(c) For adjacent pairs of columns across the width of the building prior to placing of truss.	9 mm on true span.
		(d) For any individual column deviation of any bearing or resting level from levels shown on drawings.	3.0 mm
		(e) For adjacent pairs of columns either across the width of building or longitudinally level difference allowed between bearing or seating level supposed to be at the	3 mm

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	Component	Description	Variation Allowed
		same level.	
4.2.1.2	Trusses	(a) Deviation at centre of span of upper chord member from vertical plane running through centre of bottom chord.	1/1500 of the span or not greater than 10 mm whichever is the least.
		(b) Lateral displacement of top chord at centre of span from vertical plane running through centre of supports.	1/250 of depth of truss or 20 mm whichever is the least.
4.2.1.3	Crane Girders & Tracks	(a) Difference in levels of crane rail measured between adjacent columns.	2.0 mm
		(b) Deviation to crane rail gauge	3.0 mm
		(c) Relative shifting of ends of adjacent crane rail in plan and elevation after thermit welding.	1.0 mm
		(d) Deviation of crane rail axis from centre line of web.	3.5 mm
4.2.1.4	Setting of Expansion gaps	At the time of setting of the expansion gaps, due regard shall be taken of the ambient temperature above or below 30 °C. The coefficient of expansion or contraction shall be taken as 0.000012 per °C per unit length.	
4.2.2	For Building without Cranes The maximum tolerances for line and level of the steel work shall be 3.0 mm on any part of the structure. The structure shall not be out of plumb		

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more than 3.5 mm on each 10M section of height and not more than 7.0 mm per 30 M section. These tolerances shall apply to all parts of the structure unless the drawings issued for erection purposes state otherwise.		
4.3	<u>ACCEPTANCE</u> Structures and members which have passed the tests and conform to all requirements specified in the foregoing Sub-clause 4.1, 4.1.1, 4.1.2, 4.1.3 and 4.1.4 and other applicable provisions of this Specification and are within the limits of tolerances specified in Sub-clause 4.2 and/or otherwise approved by the Engineer shall be treated as approved and accepted for the purpose of fulfilment of the provisions of this Contract.	
5.0	<u>INFORMATION TO BE SUBMITTED</u>	
5.1	<u>BEFORE TENDER</u> Along with the Tenders the Tenderers will be required to submit the following information:	
5.1.1	Tentative Programme The Tendered shall submit a tentative programme based on the information available in the Tender Document and visit to Site indicating the structure wise erection schedule proposed to be maintained by the Contractor to complete the job in time in accordance with the Contract.	
5.1.2	Constructional Plant and Equipment, Tools, Temporary Works & Manpower A detailed list of all Constructional Plant & Equipment like cranes, derricks, winches, welding sets, erection tools etc. along with their make, model, present condition and location available with the Tenderer which he will be able to employ on the job to maintain the progress of work in accordance with the Contract shall be submitted along with the Tender. The total number of each category of experienced personnel like fitters, welders, riggers etc. that he will be able to employ on the job shall also be	

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indicated. 5.1.3 Erection yard A site plan showing the layout and location of the erection yard proposed to be established by the Tenderer shall be attached with the Tender indicating the storage space for fabricated steel materials, site-fabrication and repair shop, covered stores, offices, locations of erection equipments and other facilities. The Engineer shall have the right to modify the arrangement and location of the proposed yard to suit site conditions and the Contractor shall comply with the same without any claim whatsoever. 5.2 <u>AFTER AWARD OF THE CONTRACT</u> After award of the contract, the Contractor shall submit the following:- 5.2.1 Detailed Programme The Contractor shall submit a detailed erection programme for completion of the work in time in accordance with the Contract. This will show the target programme, with details of erection proposed to be carried out in each fortnight, details of major equipment required and an assessment of required strength of various categories of workers in a proforma approved by the Engineer. 5.2.2 Fortnightly Progress Report The Contractor shall submit fortnightly progress reports in triplicate to the Engineer showing along with necessary photographs, 125 mm x 90 mm size, and all details of actual achievements against the target programme specified in Sub-clause 5.2.1 above. Any shortfall in the achievement in a particular fortnight must be made up within the next fortnight. Along with this report, the Contractor shall also furnish details of fabricated materials in hand at site and the strength of his workers.		

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<u>CONTENT</u> <table><tr><td><u>CLAUSE. NO.</u></td><td><u>DESCRIPTION</u></td></tr><tr><td>1.0</td><td>SCOPE</td></tr><tr><td>2.0</td><td>GENERAL</td></tr><tr><td>3.0</td><td>EXECUTION</td></tr><tr><td>4.0</td><td>TESTING AND ACCEPTANCE CRITERIA</td></tr><tr><td>5.0</td><td>INFORMATION TO BE SUBMITTED</td></tr></table>			<u>CLAUSE. NO.</u>	<u>DESCRIPTION</u>	1.0	SCOPE	2.0	GENERAL	3.0	EXECUTION	4.0	TESTING AND ACCEPTANCE CRITERIA	5.0	INFORMATION TO BE SUBMITTED
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1.0 <u>SCOPE</u> This specification covers plain and reinforced cement concrete work, steel flues and insulation work, painting and protective treatment work, connected with construction of RCC single flue Stack. 2.0 <u>GENERAL</u> 2.1 <u>WORK TO BE PROVIDED FOR BY THE CONTRACTOR</u> Work to be provided by the Contractor, unless specified otherwise, shall include but shall not be limited to the following: (a) Furnish all labour, supervision, services, insurance, material, power, Furnish all labour, supervision, services, insurance, material, power, construction equipment, approaches, transportation etc. required for the entire work. (b) Design and prepare working drawings for formworks, scaffoldings, supports, staging hoisting arrangement for men and material etc. and submit them for approval. (c) Prepare and submit for approval, as per approved schedule, detailed drawings for RCC work in shell, platforms at various levels, roof and ground floor and bending schedules for reinforcement bars, showing the positions and details of spacers, chairs, supports, hangers, openings etc. (d) Prepare detailed fabrication and erection marking drawings for steel flues including flue expansion compensators, steel flue supports and restraint arrangements along with fittings and accessories and submit them for approval. (e) Prepare and submit for approval detailed shop drawings, with list of materials and material specifications for Load Bearing Insulation Blocks and Lateral Restraint Insulation Blocks.		

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(f) Prepare and submit for approval detailed schemes for operations like material handling, placement of concrete erection of steel flues, fixing of insulations, installation, dismantling and maintenance of flue expansion compensator etc. and for items like approaches, services etc. (g) Design and submit for approval mix proportions for concrete to be adopted on job. (h) Furnish samples and submit for approval the results of tests for various properties of the following materials : (i) Ingredients of concrete, (ii) Concrete, (iii) Acid/Chemical Resistant Tiles, (iv) Castable refractories, (v) Insulation materials, (vi) Paints. (vii) S/S liner. (i) Provide all incidental items not specified or shown on drawings in particulars but reasonably implied or necessary for successful completion of the work in accordance with drawings and specifications. (j) Produce, if directed by the Engineer, a guarantee, in approved proforma, for satisfactory performance, for a specified period, of material manufactured by specialist firms.		

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2.2 <u>WORK BY OTHERS</u> No work under this specification will be provided for by agency other than the Contractor for this Contract unless specifically mentioned otherwise in the Contract. 2.3 <u>CODES AND STANDARDS</u> All works under this Specification, unless specified otherwise, shall conform to the latest revisions/replacements of the following Indian Standard Codes, Criteria, Specifications, along with those mentioned therein. In case any particular aspect of work is not covered by Indian Standards, other standard specification, as may be specified by the Engineer, shall be followed. "IS Specification" shall mean Codes, Criteria etc. of ISI. <table border="0"> <tr> <td>(a)</td> <td>IS:6</td> <td>: Moderate heat duty fireclay refractories, Group-A.</td> </tr> <tr> <td>(b)</td> <td>IS:104</td> <td>: Ready mixed paint, brushing, zinc chrome, priming.</td> </tr> <tr> <td>(c)</td> <td>IS:158</td> <td>: Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting for general purposes.</td> </tr> <tr> <td>(d)</td> <td>IS:195</td> <td>: Specification for fire clay mortar for laying fireclay refractory bricks.</td> </tr> <tr> <td>(e)</td> <td>IS:269</td> <td>: Ordinary and low heat Portland cement.</td> </tr> <tr> <td>(f)</td> <td>IS:383</td> <td>: Coarse and fine aggregates from natural sources for concrete.</td> </tr> <tr> <td>(g)</td> <td>IS:432</td> <td>: Mild steel and medium tensile steel bars.</td> </tr> <tr> <td>(h)</td> <td>IS:456</td> <td>: Code of practice for plain and reinforced concrete.</td> </tr> <tr> <td>(i)</td> <td>IS:516</td> <td>: Methods of test for strength of concrete.</td> </tr> <tr> <td>(j)</td> <td>IS:732</td> <td>: Code of practice for electrical wiring installations (System Voltage not exceeding</td> </tr> </table>			(a)	IS:6	: Moderate heat duty fireclay refractories, Group-A.	(b)	IS:104	: Ready mixed paint, brushing, zinc chrome, priming.	(c)	IS:158	: Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting for general purposes.	(d)	IS:195	: Specification for fire clay mortar for laying fireclay refractory bricks.	(e)	IS:269	: Ordinary and low heat Portland cement.	(f)	IS:383	: Coarse and fine aggregates from natural sources for concrete.	(g)	IS:432	: Mild steel and medium tensile steel bars.	(h)	IS:456	: Code of practice for plain and reinforced concrete.	(i)	IS:516	: Methods of test for strength of concrete.	(j)	IS:732	: Code of practice for electrical wiring installations (System Voltage not exceeding
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(z)	IS:1526	:	Sizes and shapes for firebricks (230 mm. series).
(aa)	IS:1554	:	Cables.
(bb)	IS:1566	:	Hard-drawn steel wire fabric for concrete reinforcement.
(cc)	IS:1608	:	Methods for tensile testing of steel products.
(dd)	IS:1730	:	Dimensions for steel plate, sheet and strip for structural and general engineering purposes.
(ee)	IS:1731	:	Dimensions for steel flats for structural and general engineering purposes.
(ff)	IS:1786	:	Cold-twisted steel bars for concrete reinforcement.
(gg)	IS:1791	:	Batch type concrete mixers.
(hh)	IS:1893	:	Criteria for Earthquake Resistant Design of Structures.
(ii)	IS:1947	:	Flood light.
(jj)	IS:1977	:	Structural steel (ordinary quality).
(kk)	IS:2062	:	Weldable structural steel.
(ll)	IS:2074	:	Ready mixed paint, red oxide - zinc chrome priming.
(mm)	IS:2309	:	Code of practice for the protection of buildings and allied structures against lightning.
(nn)	IS:2386 (Part-I)	:	Methods of test for aggregates for concrete. Particle size and shape.
(oo)	IS:2386 (Part-II)	:	Estimation of deleterious materials and organic impurities.

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(pp)	IS:2386 (Part-III)	:	Specific gravity, density, voids, absorption and bulking.
(qq)	IS:2386 (Part-IV)	:	Mechanical properties.
(rr)	IS:2386 (Part-V)	:	Soundness.
(ss)	IS:2386 (Part-VI)	:	Measuring mortar making properties of fine aggregate.
(tt)	IS:2386 (Part-VII)	:	Alkali aggregate reactivity.
(uu)	IS:2386 (Part-VIII)	:	Petrographic examination.
(vv)	IS:2502	:	Code of practice for bending and fixing of bars for concrete reinforcement.
(ww)	IS:2505	:	Concrete vibrators, immersion type.
(xx)	IS:2506	:	Screed board concrete vibrators.
(yy)	IS:2633	:	Methods of testing uniformity of coating on zinc coated articles.
(zz)	IS:2722	:	Portable swing weighbatchers for concrete (single and double bucket type).
(aaa)	IS:2750	:	Steel scaffoldings.
(bbb)	IS:2751	:	Code of practice for welding of mild steel bars used for reinforced concrete construction.
(ccc)	IS:2950	:	Code of practice for design and construction of raft foundations.
(ddd)	IS:3025	:	Methods of sampling and test (Physical and Chemical) for water used in industry.
(eee)	IS:3043	:	Code of Earthing.
(fff)	IS:3144	:	Methods of Test for Mineral Wool Thermal Insulation Material.
(ggg)	IS:3346	:	Method for the determination of thermal conductivity of thermal insulation materials (two slab, guarded hot- plate method).

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(hhh) IS:3495 : Method of test for clay building bricks. (Part-I to IV) (iii) IS:3550 : Methods of test for routine control for water used in industry. (jjj) IS:3558 : Code of practice for use of immersion vibrators for consolidating concrete. (kkk) IS:3677 : Unbonded rock and slag wool for thermal insulation. (lll) IS:4014 (Part-I&II) : Code of practice for steel tubular scaffolding. (mmm) IS:4031 : Method of physical tests for hydraulic cement. (nnn) IS:4457 : Ceramic Unglazed Vitreous acidresistant tiles. (ooo) IS:4634 : Method for testing performance of batch-type concrete mixers. (ppp) IS:4687 : Gland packing asbestos. (qqq) IS:4832 : Chemical Resistant mortars. (rrr) IS:4860 : Acid-resistant bricks. (sss) IS:4990 : Plywood for concrete shuttering work. (ttt) IS:4998 : Criteria for design of reinforced concrete chimneys. (Part-I) (uuu) IS:5410 : Cement paint, colour as required. (vvv) IS:5445 : Long fluted machine reamers with Morse taper shanks. (www) IS:5495 : Sizes and shapes for firebrick (300 mm. and higher series). (xxx) IS:6911 : Stainless Steel plate, sheet and strip. (yyy) IS:8112 : High strength ordinary portland cement.			

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(zzz) IS:8183 : Bonded Mineral Wool. (aaaa) IS:9595 : Recommendation for Metal Arc Welding of Carbon and Carbon Manganese steels. NEPA NO. 78 Code of protection against lightning. The Indian Electricity Rules. The requirements of Department of Civil Aviation, Govt. of India. 2.4 CONFORMITY WITH DRAWINGS AND SPECIFICATIONS The contractor shall carry out all the work in strict accordance with the drawings stamped "Released for Construction" and specification issued to him and as per Contractor's detailed drawings approved by the Consulting Engineer. Prior to concreting, the Contractor shall prepare a check list on a set format of all items of work involved, and inform the Engineer well in advance so that the Engineer shall have the opportunity of satisfying himself if the works mentioned in the format are done according to drawings and specification, and he can allow the Contractor in writing to start pouring of concrete. The entire operation of concreting shall be carried on as per specification, to the complete satisfaction of the Engineer. No deviation from the drawings will be allowed unless otherwise directed by the Engineer in writing. For Load Bearing Thermal Insulation block assembly and lateral restraint insulation block assembly, Contractor shall design sizes of all components of the blocks and details of their connections supply and fabricate the same in accordance with the approved shop drawings prepared by him. For steelwork and metal work, the Contractor shall design all connections, inserts for scaffolding, supply and fabricate all steelwork and metal work and furnish all connection materials in accordance with approved shop drawings prepared by him and/or as instructed by the Engineer, keeping in view the maximum utilisation of the available sizes and shapes for metal components.		

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2.5 <u>MATERIALS TO BE USED</u> 2.5.1 General Requirement All materials, whether to be incorporated in the work or to be used temporarily for the construction, shall conform to the relevant IS specifications unless stated otherwise and shall be of the quality approved by the Engineer. 2.5.2 Cement Portland Cement shall be as per the requirements laid down in IS: 269. 2.5.3 Coarse Aggregate Coarse aggregate shall be graded crushed or broken stone from approved sources, free from impurities and shall be screened free of dust and other deleterious matter. It shall conform to IS: 383 or IS: 515 and shall be washed clean, if necessary. The maximum size of coarse aggregate for stack superstructure shall be 25 mm down graded, unless otherwise stated (vide serial 5(b) of clause 3.03.06). Grading for a particular size shall conform to relevant IS Codes and shall be such as to produce a dense concrete of specified proportion and strength and shall be of consistency that will work readily into position without segregation. 2.5.4 Fine Aggregate Fine aggregate shall be river or pit sand, free from any clay, earth, vegetable matters, salt or other impurities and shall be clean and fit for use, to the satisfaction of the Engineer. Sand acceptable for the work shall normally have a grading falling within the limits of one of the three grades, mentioned in the relevant IS Specifications. 2.5.5 Water The water for both mixing and curing of concrete shall be clean, free from oil, acid, alkali, organic or other deleterious substances. Contractor shall test the water as and when required by the Engineer.		

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2.5.6 Reinforcement Mild steel or Medium or High Tensile steel deformed bars specified for reinforcement shall conform to the latest relevant IS Specifications and shall be of tested quality under ISI Certification Scheme. The reinforcement shall be free from any oil, foreign material or mill or rust scales. 2.5.7 Steel Flue 2.5.7.1 All mild steel material to be used in construction of steel flue shall comply with IS:2062, IS:1239, IS:1367, IS:1608, IS:800 and with other relevant IS Specifications. The ultimate tensile strength of this steel shall not be less than 410 N/Sq.mm. 2.5.7.2 Stainless steel liners shall be fabricated using materials conforming to the requirements of relevant IS Specifications and/or AISI 316L or BS:1449 Part-2. Grade of Stainless steel shall be equivalent to BS:1449 (Part-2) 316 S.12. 2.5.7.3 Materials to be used for fabrication of Flue expansion compensator shall be suitable for the flue gas temperature and shall be acid resisting. The Expansion compensator shall comprise several layers of materials given below in order from the gas side. (a) Two layer of insulation, each consisting of heavy weight texturized glass cloth impregnated with graphite suspension, having an approximate weight of 1.00 Kg/Sq.m (b) A continuous filament glass cloth coated both sides with a fluoro-elastomer having an approximate weight of 1.5 Kg/Sq.m. (c) Two layers of PTFE (Poly Tetra Fluoro-Ethylene) film of minimum thickness 0.15 mm each. (d) A layer of glass felt of minimum thickness 10 mm and an approximate weight of 1.5 Kg/Sq.M.		

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2.5.8 Stainless steel Liners Stainless steel liners shall be provided with a minimum of 5 m above the roof Top. The portion of liner with stainless steel shall be provided with a grade of steel conforming to the requirements of AISI 316 or equivalent and the minimum thickness of the stainless steel liner shall be 8mm. The individual cans of the liners shall be jointed together by butt welding internally all round for full strength, after connecting the flanged portion of the cans with high tensile treaded fasteners conforming to IS: 1367. The bidder shall test all welds in the presence of the OWNER to meet the following requirements: (a) The bidder shall test at random at least 10% of the butt welds by radiographic/ultrasonic testing method. (b) At least 10% of the fillet welds shall be tested at random by dye penetration tests. (c) 10% of the root welds for butt-welding shall be tested at random by dye penetration tests. All tests shall be conducted in the presence of the ENGINEER IN CHARGE. If any test fails, the weld shall be cut out, remade and retested to the Engineer's satisfaction. 2.5.9 Paints Paints to be used for shop coat of fabricated steel shall conform to the IS: 2074. Paint for treatment of outside face of Chimney with Cement water proof paint shall conform to IS: 5410. 2.5.10 Acid Resistant Tiles and Castable Refractories		

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Acid resistant tiles to be provided over roof of stack should conform to IS: 4457. Matching mortars to be used for tiles. Castable refractories shall be of hydraulic setting, rapid hardening type. It shall have refractory properties similar to Fire bricks conforming to IS:6, Group-A and working temperature shall be upto 1350 Deg.C. 2.5.11 Insulations 2.5.11.1 Thermal Insulation The insulation shall be semi-rigid, resin bonded type, in the form of slabs and shall conform to IS: 8183. Blanket type insulation shall not be used. The density of insulation shall not be less than 64 kg/cu.m for resin bonded glass wool insulation and 100 kg/cu.m for resin bonded rock wool. The insulation thickness shall be determined based on the maximum ambient temperature, surface air velocity worked out based on the draught of ventilation air in the annular space between the flue liner and chimney shell, insulation surface emissivity of 0.3 and the insulation cold face maximum temperature not exceeding 55C. The draught of air in the annular space shall be the natural draught created by the heating of air by the flue liner and the air being vented out through the openings in the chimney shell. The increase in the annulus air temperature due to the rising heated air shall be taken into account while calculating the insulation thickness. The insulation thickness shall not be less than 100 mm, in any case, and shall be provided in two layers with the second layer of insulation covering the joints of the first layer. The insulation shall be wrapped on the outer-most surface with galvanised wire mesh. 2.5.11.2 At Load Bearing and Side Restraints of Flues Load bearing insulation assembly to have (i) a properly machined mild steel plate with recess at its top for seating PTFE (Poly Tetra Fluoro Ethylene) sheets conforming to BS:5400 (ii) saddle plate (MS) in the middle having stainless steel plate fixed at its bottom surface and lead/elastomeric sheet at top, and (iii) top plate formed of two numbers insulation blocks each made of minimum 50mm thick rigid, non-combustible asbestos fibre reinforced lime-silica board (SINDANYO BLOCKS NATURAL GRADE CS-51) bonded to mild steel plates at top and bottom. For side restraints assembly of insulation blocks of SINDANYO Natural Grade CS-51 and stainless steel		

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plate shall be used. All stainless steel in these assemblies shall conform to AISI-316L and Mild steel to IS-2062. SINDANYO BLOCKS shall be suitable for operation at 320 Deg.C and shall primarily satisfy the following physical properties : (a) Minimum compressive stress prior to onset of compression yield of not less than 12 N/Sq.mm. (b) Minimum shear strength of 30 N/Sq.mm when tested in accordance with BS:3497-1979. (c) Thermal conductivity shall not exceed 0.67 W/m Deg.C at a mean temperature of 200 Deg.C and its coeff. of linear expansion not to exceed 1.2×10^{-5} per Deg.C. (d) Adhesive used for bonding purposes shall be of material with equivalent high temperature properties as approved by the Engineer. It may be of "Fortafix Fiborclad Adhesive" as manufactured by Fortafix Ltd., England. 2.6 <u>STORAGE OF MATERIALS</u> 2.6.1 General All materials shall be so stored as to prevent deterioration and intrusion of foreign matter and to ensure the preservation of their quality and characteristics for the work. Any material, which is deteriorated or is damaged or is otherwise, considered defective by the Engineer, shall not be used for construction and shall be removed from site immediately, failing which the Engineer shall be at liberty to get the materials removed. The Contractor shall maintain an upto date accounts of receipt, issue and balance of all materials issued by the Owner. 2.6.2 Cement Contractor shall store cement in water-tight and properly designed stores so that the Cement can be kept dry and the stock can be handled in rotation. The doors of stores shall be at least 30 cm. above G.L. Deteriorated cement		

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shall be removed immediately from the site. Not more than ten bags of cement shall be stacked one above the other.		
2.6.3	Aggregate	
Different materials shall be transported, handled and stored separately in such a manner as to prevent damage, deterioration or contamination. Stock piles of fine and coarse aggregates shall be allowed to drain, so that aggregates do not contain too much water.		
2.6.4	Reinforcement	
Reinforcement shall be stored preferably under cover and stacked off ground in size and grade-wise separate stacks for easy identification.		
2.6.5	Steel, Metal and Fittings	
All steel, metal and fittings to be used for fabrication and erection shall be stored sectionwise and lengthwise in separate stacks, off ground, so that they can be handled, inspected, measured and accounted for easily at any time. If required by the Engineer, the materials may have to be stored in a covered shed.		
2.6.6	Paints	
Paints shall be stored under cover, in air-tight containers. Paints supplied in sealed containers shall be used as soon as possible once the container is opened. Left over paints shall be kept in air-tight containers.		
2.6.7	Steel Flue	
Fabricated pieces of steel (flue) liner shall be stored systematically for ease of handling.		
2.6.8	Insulation Material	
All insulation materials like bearing insulation blocks, restraint insulation blocks, glass or mineral wool, asbestos ropes etc. shall be stored in packing		

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boxes, under covered shed, avoiding their coming in contact with objectionable matter. 2.7 <u>QUALITY CONTROL</u> Contractor shall establish and maintain quality control for different items or work and materials as may be directed by the Engineer to assure compliance with contract requirement and submit to the Engineer records of the same. The Contractor shall submit all records and test results in original to the Engineer for his approval, if so desired by him. The quality control operation shall include but shall not be limited to the following items of work: <table border="0"> <tr> <td>(a)</td> <td>Cement</td> <td>: Test to satisfy relevant IS Specifications if supplied by the Contractor.</td> </tr> <tr> <td>(b)</td> <td>Aggregate</td> <td>: Physical, Chemical and Mineralogical qualities, grading, moisture contents and impurities.</td> </tr> <tr> <td>(c)</td> <td>Water</td> <td>: Impurities Test.</td> </tr> <tr> <td>(d)</td> <td>Reinforcement</td> <td>: Material tests or certificates to satisfy relevant IS Specification if supplied by the Contractor.</td> </tr> <tr> <td>(e)</td> <td>Structural</td> <td>Material tests or certificate to satisfy Steelrelevant IS Specification if supplied by the Contractor.</td> </tr> <tr> <td>(f)</td> <td>Steel flue</td> <td>Material tests or certificate to satisfy relevant IS Specification if supplied by the Contractor.</td> </tr> <tr> <td>(g)</td> <td>Stainless</td> <td>Material tests or certificate to satisfy Steel relevant IS Specification if supplied by the Contractor.</td> </tr> <tr> <td>(h)</td> <td>Acid Resistant</td> <td>Compressive and tensile strength, acid tiles & mortar resistance and water absorption test.</td> </tr> </table>			(a)	Cement	: Test to satisfy relevant IS Specifications if supplied by the Contractor.	(b)	Aggregate	: Physical, Chemical and Mineralogical qualities, grading, moisture contents and impurities.	(c)	Water	: Impurities Test.	(d)	Reinforcement	: Material tests or certificates to satisfy relevant IS Specification if supplied by the Contractor.	(e)	Structural	Material tests or certificate to satisfy Steelrelevant IS Specification if supplied by the Contractor.	(f)	Steel flue	Material tests or certificate to satisfy relevant IS Specification if supplied by the Contractor.	(g)	Stainless	Material tests or certificate to satisfy Steel relevant IS Specification if supplied by the Contractor.	(h)	Acid Resistant	Compressive and tensile strength, acid tiles & mortar resistance and water absorption test.
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(i) Mortar Compressive and tensile strength, adhesion and acid resistance test. (j) Insulation Thermal conductivity, density, heat and acid resistance tests. Bearing capacity will be tested for bearing/restraint insulation blocks. 3.0 <u>EXECUTION</u> 3.1 <u>CONCRETE</u> 3.1.1 Trial Mix, Grades of Concrete At least three weeks before commencing any concreting in the work the Contractor shall make trial mixes using samples of coarse aggregates, sand, water and cement, typical of those to be used in the work. A clean dry mixer shall be used for mixing and the first batch shall be discarded. For guidance in designing the mix, standard tables for maximum allowable water-cement ratio, minimum cement content, maximum proportion of aggregates and limits of consistency may be used by the Contractor. The Contractor's design mix shall fall within limits of the following tables: (a) Strength requirements of concrete: Table-2 of IS: 456-2000. (b) Concrete Mix Proportion: Table-3 of IS: 456-2000. (c) Minimum cement content/Cu.m. of finished concrete shall be as per Table 5 of IS 456-2000. (d) Limit of consistency: Refer Table in Item 3.1.4 of this specification. (e) Cement/Total Aggregate Ratio: As per the following table.		

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MIX PROPORTIONS (BY WEIGHT) EXPECTED TO GIVE DIFFERENT DEGREES OF WORKABILITY WITH DIFFERENT VALUES OF WATER - CEMENT RATIO (FOR GUIDANCE) CEMENT/TOTAL AGGREGATES RATIOS						
Sr.No.	Workability	Water /Cement Ratio	Ratio by Weight of Cement to Gravel Aggregate		Ratio by Weight of Cement To Crushed Stone Aggregate	
			20 mm.Size	38 mm.Size	20 mm.Size	38 mm.Size
(a)	Very Low	0.4	01:04.8	01:05.3	01:04.5	1:05
	Slump	0.5	01:07.2	01:07.7	01:06.5	01:07.4
	0-25 mm.	0.6	01:09.4	1:10	01:07.8	01:09.6
		0.7	1:10	1:12	01:08.7	01:10.6
(b)	Low	0.4	01:03.9	01:04.5	01:03.5	1:04
	Slump	0.5	01:05.5	01:06.7	1:05	01:05.5
	25-50 mm.	0.6	01:06.8	01:07.4	01:06.3	1:07
		0.7	1:08	01:08.5	01:07.4	1:08
(c)	Medium	0.4	01:03.5	01:03.8	01:03.1	01:03.6
	Slump	0.5	01:04.8	01:05.7	01:04.2	1:05
	50-100 mm.	0.6	1:06	01:07.3	01:05.2	01:06.2
(d)	High	0.4	01:03.2	01:03.5	01:02.9	01:03.3
	Slump	0.5	01:04.4	01:05.2	01:03.9	01:04.6
	100-175 mm.	0.6	01:05.4	01:06.7	01:04.7	01:05.7
		0.7	01:06.2	01:07.4	01:05.5	01:06.5

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NOTE-1: Notwithstanding anything mentioned above, the cement / Total aggregate ratio is not to be increased beyond 1:9 without specific permission of the Engineer. It should be noted that such high aggregate cement ratios will be required for concretes of very low slump and high water-cement ratios which may be required to be used in mass concrete work only. NOTE-2: The above figures are for guidance only, the actual cement/ aggregate ratios are to be worked out from the specific gravities of coarse aggregates and sand being used and from trial mixes. For each grade of concrete, a set of eighteen cubes shall be made. Of these not more than six may be made on any day and further, of the six cubes made in one day not more than two cubes may be made from any single batch. Nine of these cubes each representing a different batch of concrete shall be tested at the age of seven days and remaining at twenty eight days. The making of the cubes, their curing, storing, transporting and testing shall be in accordance with the relevant IS Specifications. The test shall be carried out in laboratory approved by the Engineer. If the average strength of the concrete cubes falls below the requirement, the method described above shall be repeated till acceptable results are obtained. The method may have to be repeated whenever there is a significant change in the quality of any of the ingredients for concrete, at the discretion of the Engineer. 3.1.2 Batching of Concrete For controlled concrete, only weigh batching shall be allowed. All concrete ingredients, except water, shall be batched by weight, using an approved make of weigh batcher. Batching shall be accurate to 1/2 Kg. The batcher shall be tested for accuracy of calibration, first before commencement of work and at least once a fortnight or as directed by the Engineer thereafter. Water shall be batched by weight or by volume measures, as approved by the Engineer. 3.1.3 Mixing of Concrete Materials for concrete shall be emptied in rotation into the mixer. When all the ingredients are in the drum, the drum will rotate for one minute for dry mixing. After that water shall be added in measured quantities in the		

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manner specified. The mixer shall then rotate for at least two minutes, or at least forty revolutions or until there is apparent uniform distribution of the materials and till the mass is uniform in colour. The entire content of the drum shall be discharged before the ingredients for the succeeding batch are fed into the drum. The mixer shall be thoroughly cleaned to the satisfaction of the Engineer, before a different quality of concrete is put through the mixer and also at the end of day's work. 3.1.4 Workability of Concrete The degree of workability necessary to allow the concrete to be well consolidated and to be worked into the corners of formwork and around the reinforcement and embedments, and to give the required surface finish shall depend on the type and nature of structure and shall be based on experience and tests. 15 mm. to 40 mm. slump in chimney works shall be adopted subject to Engineer's approval unless stated otherwise (vide serial 1(d) of clause no. 3.3.6). The usual limits of consistency for various types of structure are given below:		

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LIMITS OF CONSISTENCY				
Sr. No.	Degree of Workability	Slump in mm. with Standard Concrete		Use for which Concrete is suitable
		Min.	Max.	
(a)	Very Low	0	15	Large mass concrete work with heavy compaction equipment.
(b)	Medium	35	65	Deep and wide RCC structures with congestion of reinforcement and inserts.
(c)	High	65	100	Very narrow and deep RCC structures with congestion due to reinforcement and inserts.
NOTE: The above table is for guidance only. Notwithstanding anything mentioned above, the slump to be obtained for work in progress shall be as per direction of the Engineer. With the permission of the Engineer, for any grade of concrete, if the water has to be increased in special cases, cement shall also be increased proportionately, to keep the ratio of water to cement same, as adopted in trial mix design, for each grade of concrete. The workability of concrete shall be checked at frequent intervals by slump tests. Alternatively, where facilities exist or if required by the Engineer, the compacting factor test, in accordance with IS:1199, shall be carried out. 3.1.5 Placing and Compaction of Concrete Concreting shall proceed in a manner directed by the Engineer; concrete shall be placed in forms as soon as possible but in no case later than twenty minutes, after mixing.				

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The height of any single lift of concrete, for different structural members, shall be decided by the Engineer. The concrete shall be placed in the forms gently and not dropped from a height which may cause segregation of aggregates. Each layer of concrete shall be compacted fully before the succeeding layer is placed and separate batches shall follow each other so closely that the succeeding layer shall be placed and fully compacted before the layer immediately below has taken an initial set. The concrete, after placing, shall be consolidated only by power driven vibrators. The vibrators shall be of a make and size, approved by the Engineer. In using the vibrator, the standard practice and the Engineer's directions, shall be followed. Vibration shall begin as soon as one batch of concrete has been placed and shall continue till the entire section being poured has been thoroughly consolidated. To secure even and dense surfaces, free from aggregate pockets, vibration shall be supplemented by tamping or rodding by hand in the corners of forms and along the form surfaces while the concrete is plastic, without damaging or endangering the stability of the formwork. A sufficient number of spare vibrators including petrol vibrators shall be kept readily accessible to the place of deposition of the concrete to assure adequate vibration in case of breakdown of those in use. 3.1.6 Curing of Concrete Curing of exposed surface of concrete shall commence immediately after the concrete has set. Exposed sides shall be covered with canvas etc. immediately after stripping of forms, and curing shall be continued for a period of not less than 14 days, reckoned from the date and hour of completion of concreting. All surfaces of the pour shall be kept wet with water at all times after concreting and till the curing period is over. The Contractor shall plan and employ proper equipment and sufficient labour considered adequate by the Engineer under able supervisor for curing.		

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3.1.7	Construction Joints In concreting the chimney shell one full ring lift shall be completed in a day's pour. Before the formwork for the following pour starts the horizontal surface of the Chimney shell shall be chipped, cleaned and washed with water, and when the formwork is complete, the surface shall be cleaned and washed again and covered with 1:2 sand cement slurry before fresh concrete is placed. The horizontal construction joints shall be so arranged and made that they are regular and neat. No vertical joint shall be allowed. No separate payment shall be allowed to the Contractor for forming joints or chipping and cleaning them or cover with slurry prior to concreting. The number of construction joint shall be kept minimum and the spacing should not exceed three (3) meters. The Contractor shall submit to the Engineer, any proposal of providing construction joints to facilitate his work, for the study and approval of the Engineer well in advance.	
3.1.8	Ordinary Concrete Ordinary concrete like lean concrete shall be of nominal mix as per relevant clauses of IS: 456.	
3.2	<u>REINFORCEMENT</u>	
3.2.1	Bending of Reinforcement All bars shall be carefully and accurately bent by the Contractor in accordance with approved Drawings and bar bending schedules. Special care shall be taken to ensure correct lengths of laps. The bars shall not be bent or straightened in any manner that will injure the bars or impair the bond between reinforcement & concrete. Bends and hooks are to be provided as laid down in the IS: 2502.	
3.2.2	Placing All reinforcement shall be placed and maintained in the position shown in the drawings. Contractor shall provide approved type of cover blocks to suit the requirement of the Drawings. Where reinforcement is to be provided on two faces of the shell, the Contractor shall provide adequate number of separators, with the approval of the Engineer. Any additional	

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support to the reinforcing cage, if required at the time of concreting, shall also be provided, to the satisfaction of the Engineer. Lapping of reinforcement as specified in the drawings or as directed by the Engineer, shall be provided. Laps shall be staggered and too many laps shall be avoided. Welded laps shall be provided only when directed or approved by the Engineer.		
3.2.3	Fixing of Reinforcement 18 SWG annealed steel wire shall be used as binding wire. Bar crossing one another and contact laps shall be bound with this wire twisted tight to make the skeleton or network rigid so that the reinforcement is not displaced during placing of concrete.	
3.3	<u>FORMS</u> Construction by Slip-form Method Slip-form construction shall be for construction of the wind shield. Type of Slip-form proposed should be indicated in the offer with sketches, drawings and construction statement as explained hereinafter. Number, type and capacities of jacks, the control system and achievable rate of progress in mm/hour should also be indicated. The chosen scheme shall be of a past proven design. A certified performance record of the scheme should be submitted with the offer to guarantee workability of the scheme both from execution time and safety point of view. The Tenderer should furnish a brief but comprehensive statement indicating the planning & programme and method of work to be followed, for the approval of Owner at the time of submitting Tender. This statement shall include the following items:	
3.3.1	Type and description of Slip-form equipment and its accessories.	
3.3.2	Design of scaffolding and staging.	
3.3.3	Description of materials including admixtures to be used for construction.	
3.3.4	Manpower planning, construction spaces required, standby arrangement.	

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3.3.5 Rate of Slip-forming. 3.3.6 Proposed workability requirement of concrete and type of cement & admixture to be used. 3.3.7 Quality assurance programme. 3.3.8 Method of Transportation of material 3.3.9 Method of curing and rectification of defects. 3.3.10 Planned interruption, if proposed, and activities during planned interruption. Treatment of construction joint. 3.3.11 Contingency solution for unplanned interruptions. 3.3.12 Time of completion. While selecting the Contractor, due consideration will be given to the merit of the above mentioned statement proposed by the Tenderer. Notwithstanding what have been specified in earlier clauses, following guide lines are being presented which should be kept in view by intending Tenderers, while quoting for Slip-form method of construction: (a) Care to be taken to prevent dragging of concrete alongwith upward movement of the shuttering. For this purpose following steps are advisable: (i) Shutter plates have to be smooth and should be thoroughly clean. Before fixing them in position all the surfaces which will be coming in contact with concrete to have a coat of epoxy paint. (ii) In areas where concrete thickness is 750 mm or more rate of pouring should be such that minimum slipping of shuttering is 100 mm per hour.		

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(iii) Mix design should be so done that it will be self-lubricant at the contact face of shutter and concrete and thus reduce friction. Suitable cement of approved manufacturer (conforming to relevant I.S. Specification) may be used for the purpose. An optimum ratio of coarse/fine aggregate should be established to suit the purpose depending on availability of aggregates. (iv) Mix design also should be so done that it has a slump of 50 mm at the point where concrete is placed under an ambient temperature of around 40 Deg.C. This will also keep vibration by needle vibrators to required minimum. Slump should not drop down to zero in less than 45 minutes. Suitable retarding agent and plasticizer of approved manufacture may be added in mix to achieve this purpose. These admixtures to be properly identified by preliminary tests both for performance and for compatibility with particular type of cement proposed to be used. Additional steps like spraying of water over the shutters and keeping down the temperature of coarse aggregates by continuous spraying of water over those may be resorted to if ambient temperature is more than 40 Deg.C. (b) Care must be taken to prevent twist, which predominantly occurs in the initial stages because of low slipping rate, in the horizontal plane of Slip-form assembly. A thorough check on this aspect must be kept at every 15 minutes interval. One person should exclusively be assigned this work together with rectifying any defect. (c) Every endeavour has to be made so as not to occur any tilt in the shutter assembly. To achieve this following steps need be taken: (i) Performance of jacks has to be closely observed and any defective one needs immediate replacement. Difference in levels of opposite jacks at any instant of time should not exceed 5 mm.		

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(ii) Loading on Slip-form truss/yokes has to be fairly equal. (iii) Sleeve through which jacking rod passes has to be of sufficient length so that later gets an uniform clearance and does not get any chance to tilt. Sleeve should have a minimum wall thickness of 3.25 mm and should be such that jacking rod gets a maximum clearance of 1 mm to 1.5 mm all- round. (d) For taper walled chimneys overlapping of shutters which are kept to effect the tapering, needs careful attention otherwise these may be filled with concrete slurry. (e) In designing the mix following aspects should be borne in mind : (i) Cement used should have an initial setting time of not less than 50 minutes (ii) Coarse and fine aggregates should be well graded and rounded aggregates offer better performance in Slip-form technique. These help to keep down water/cement ratio and also offers better lubrication between concrete and shutter surface. 40 mm down size of coarse aggregates should preferably be used unless reinforcement detailing calls for lesser size aggregates. (iii) From the point of view of creep, shrinkage as well as initial setting property of concrete, cement content should not preferably be more than 400 Kg. per Cu.M of concrete. (iv) Minimum compressive strength (after 4 to 6 hours of mixing) of concrete immediately below the shutter as slipform proceeds should be between 0.1 to 0.2 Newton/ Sq.mm. (v) It is advisable to use cement from a single source during the entire operation of slipform technique since once the system starts, there might not be any time left for conducting trial mixes if the source of procurement of cement changes.		

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(f) Large diameter vibrator needles should not be used for vibrating concrete. Sizes of these needles should preferably be restricted to 25 mm diameter and to 40 mm diameter - only in exceptional cases. At least two nos. standby vibrator units should always be maintained on top of working deck at all time during the entire period of slipform operation. (g) It is preferable to have membrane curing compounds sprayed on fresh surfaces emerging out of shutter panels for ensuring proper curing at great heights. In case such spraying is not envisaged then elaborate arrangement has to be made for adequate supply of water both on inside and outside vertical surfaces with spraying arrangement, necessary length of pipelines and pump of adequate head to serve the purpose. It is always advisable to have a stand-by pump for effective utilisation of the system. (h) If Slipforming is carried out in summer, rate of slipping should be around 400 mm per hour. If lesser value is contemplated appropriate retarders should be specified. (i) Exact number and capacity of jacks as well as spacing of yoke frames are to be determined taking into account various loadings including self weight of the system, dead and live loads on working and other platforms, horizontal load on formwork, wind load etc. It is desirable that jacking system, based on which the entire slipform system works, should consist of jacks 3 Tonne/ 6 Tonne capacity and a hydraulic pump with necessary pipe connections. Spacing of yoke legs should preferably be kept within 2 metres to prevent overloading on jacks and consequent failure resulting in twist of the formwork. Jacking rods should be of 25 mm diameter for 3 Tonne Jacks and 32 mm diameter for 6 Tonne Jacks.		

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(j) At least 30% spare jacks and jacking rods should be kept ready during the entire operation. It is obligatory to maintain spare hydraulic pump alongwith a set of loose pipes in perfect working condition on top of working deck. (k) In sections where thickness is 500 mm or more it is prudent to go in for two nos. of jacks for each slipform yoke. (l) For effective utility of this technique following areas need careful attentions at the very conceptual stage: (i) Detailed quality assurance programme. (ii) Advance Planning and preparations. (iii) Arrangement for on site supervision and adequate access facilities. (m) Construction methods including description and types of different equipment proposed to be used, structural arrangement and analysis of the system, description and type of different materials, planned interruptions, description and frequency of various checks and tests for Slipform technique as well as for material, method of preparing, transporting and pouring of concrete, solution for probable defects during slipping, sequence of operations during planned interruptions etc. should be prepared beforehand by executing agency and to be approved by Engineer before starting the actual work. (n) Placing and binding of reinforcement is also a very critical item and needs special attention. From practical considerations not more than two or three layers of horizontal steel can be tied at a time and this causes a definite limitation in placement of reinforcement. Vertical reinforcements should be kept vertical by providing suitable holders within the slipform system. (o) It is desirable to have a break of at least one day for every two weeks of continuous operation. Such break should be utilised for various maintenance activities, removal of jack rods etc.		

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(p) Numbers and locations of hoists for lifting concrete, reinforcement and other materials have to be planned well in advance. Capacity of hoists should be such as to match with hourly requirement of concrete and reinforcement. If felt necessary one hoist may be exclusively earmarked for transporting concrete. For movement of personnel supervising the work a separate hoist must be arranged for. (q) The system being operative round the clock it is obligatory to have adequate lighting arrangement both on various platform levels as well as on ground below. Arrangement has to be made for facilitating continuous upward movement of the entire system alongwith slipform. (r) Winches for lifting men and material and mixers, if located within unsafe area around chimney, should be protected by adequate shelter from possible damage. (s) Proper tele-communication system has to be established between the personnel working on top of Chimney and control room below. (t) A small laboratory should be maintained at site for testing different materials like cement, coarse and fine aggregates. A cube testing machine may also be installed at site for getting quick feed back results. Apart from using plumb bobs, level and theodolite instruments for survey purpose arrangement should also be kept for lasers. (u) In case of interruption in the course of slipping of formwork following measures should be taken : (i) Provision of a key and additional reinforcement at the junction of new and old concrete.		

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(ii) Slipform system should be brought up freely to have a minimum overlap of 100 mm or so over previously cast concrete. (iii) Washing of old concrete surface with compressed air and water jet and thereafter pouring a layer of neat cement grout. (iv) Clearing of shuttering panels of loose materials, concrete etc. by compressed air and applying a coat of epoxy paint, if felt necessary by Engineer. (v) Neatly finishing the interface of old or new concrete as soon as it comes out of shutter panel. (v) It is preferable to suspend the construction work under high wind condition. (w) It is of utmost importance that for effective implementation of this system an Engineer fully conversant with Slipform technique with enough experience in planning and control of formwork should be in overall command of the site and he should be ably supported by well trained mid level supervisory staff, skilled workers and operators. (x) Operation of slipform method of construction is a continuous one and it demands continuous/intermediate inspection of accuracies in line, level, dimensions and position and immediate rectification of any noticed deviation. All these ask for personnel of high quality having constant vigilance over the construction activity. (y) While all the activities in effective implementation of the work needs utmost care keeping safety of men and material in mind it is obligatory that all activities should be carried out under the guidance of a qualified and trained safety Engineer. Safety measures as listed below must be adhered to but should not be limited to only these: (i) Safety helmets and belts to be provided to all supervising staff and workers.		

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(ii) Safety nets to be provided below both inside and outside atforms as instructed by Engineer. (iii) Handrailing and toe guard to be provided around all openings and platforms. (iv) Regular maintenance of equipment, checking of hoists, scaffoldings etc. (v) Passenger hoist must have multiple ropes with adequate factor of safety. (vi) Emergency lights, coloured lamps to be provided in accordance with relevant Indian Standards and as supplemented in the Specification and to be operative in case of sudden power failure Emergency standby generator must be kept ready during the entire period of slipform method of construction. (vii) Emergency vehicles, first aid facilities must be kept ready during the entire period of work. (z) Permissible construction tolerances should be limited to the following: (i) Variation in wall thickness : (-) 5 mm, (+) 25 mm (ii) Variation from Design : (+_) 25 mm or (+_) 2.5 mm per 3 m dia. Whichever is larger, but in no case more than (+_) 5 mm. 3.4 <u>STEEL FLUES</u> 3.4.1 General		

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Fabrication and erection of Steel Flues shall conform to "Technical Specification for Fabrication and Erection of Structural Steelworks" furnished in this Specification.		
3.4.2	Fabrication Plates out of which flues will be fabricated, should be bent to the required shape on an appropriate machine. No smithy process shall be adopted for the purpose. Plates are to be prevented from distorting by more than the tolerances specified during transportation, storage, handling, erection and jointing. All components should be correctly located and brought into correct alignment and level within specified erection tolerances, before adjacent pieces are jointed or secured.	
3.4.3	Assembly Flue would be assembled from its Component "Cans" near to ground level within the wind-shield. Incomplete flue would be hung only from the flue support platform during assembly, and progressively hoisted to enable connection of further cans at its lower end. Upon completion of the initial sectional length, this length will be hoisted and supported in its final position at the flue support floor as indicated in the drawing. It is envisaged that flue will be assembled and hoisted in three sectional lengths; site joints between sectional length being located just above a steel floor level. Joints between individual cans should be flanged and bolted on outside and to have sealed welded joints on inside in accordance with clause 3.3.section-4 "Welded Construction" under Technical Specifications" for Fabrication of structural steel work. The Contractor shall submit a drawing showing proposals for erection and indicating locations of all site joints which should be kept to minimum.	
3.4.4	Flue Expansion Compensator For installation of Expansion Compensators, the manufacturer's instruction should form the basis of the Contractor's method. This method, in a statement, should be submitted to the Engineer for approval. Once approved it has to be followed throughout the installation sequence. Expansion Compensators should be prevented from distortion during	

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transportation, handling, erection and jointing, by more stringent tolerances than specified by the manufacturer. 3.4.5 Tolerances Permissible tolerances in the fabrication and erection of steel flues are given below: (a) Internal diameter shall not : ± 12 mm vary by more than (b) Centre of any section shall : 10 mm in any 15 metre height not be eccentric from vertical centre line by more than (c) Centre of any section at : $(h/2500 + 10)$ mm, not be height 'h' is in mm. above vertical centre where line by GL shall more than (d) Local deviation from a true circular form should not exceed the shell thickness (Measurement should be made from a segmental circular template having radius of flue shown in drawing and a chord length equal to 0.15 of that radius). (e) Peaking or stepping at welded horizontal seams shall not exceed 4 mm. (Measurement shall be made with a straight edged template long enough to contact the straight shell on either side of the peaked area). 3.4.6 Erection Erection of Steel Flues and C.I. Chimney caps shall be done as per requirement of IS: 800. The Contractor shall submit to the Engineer a programme of erection for his approval. All plant, equipment, tools, tackle and any other accessories required for the erection shall be provided by the Contractor. Storing and handling of fabricated materials for erection, setting out of members, providing temporary supports, bracing, fasteners, bolts,		

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nuts etc. shall be the responsibility of the Contractor and shall be taken into account in quoting the rate. 3.5 <u>INSULATION AND PROTECTIVE TREATMENT</u> 3.5.1 Acid and Heat Resistant Paint Top 50 meters of the outside face of R.C.C. windshield, horizontal surface at the top of windshield and inside face of the windshield or as specified in the drawing shall receive a protective treatment of four coats of acid and heat resistant black impregnated bitumastic paint. The quality and type of the paint shall have the prior approval of the Engineer. For this, a small area shall be painted and a sample of paint shall be shown to the Engineer. The surface to be painted shall be prepared and primary coat, if required as per the paint manufacturer's specification and direction of the Engineer, shall be applied. The paint shall conform, unless otherwise stated, to the requirement of IS: 158. Necessary samples, test certificates and manufacturer's literature shall be submitted to the Engineer for his approval. The surface to be painted shall be completely dry before the paint is applied and the drying time between consecutive coats shall not be less than 5 hours. The overall combined thickness of paint shall be a minimum of 150 microns. 3.5.2 Synthetic enamel Paint The outside face of the Chimney shell, unless specified otherwise, shall be painted with Synthetic enamel paint. The quality shall be approved by the Engineer. Necessary samples shall be submitted to the Engineer for his approval. The surface of the shell shall be prepared as per paint manufacturer's specification. In addition, care shall be taken that the surface is free from stain, honey comb and any rough and uneven surface. The joints between two shuttering and two lifts of shuttering shall be so prepared that any unevenness, if by chance exists, shall be removed. If one coat of paint is not sufficient to give the required finish, the Contractor shall repaint the surface, until the Engineer is satisfied with the workmanship. The paint shall conform, unless otherwise stated, to IS: 5410. Necessary samples, test certificates and manufacturer's literature shall be submitted to the Engineer for approval.		

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3.5.3 Insulation and Packing All insulation material should be of dimension and type, shown in the drawing. Load bearing insulations at supports and side restraints of Steel liners should be an assembly of M.S. Plates, Stainless Steel Plates, PTFE (Poly Tetra Fluoro Ethylene) sheets and or/asbestos fibre reinforced boards (SINDANYO BLOCKS). Insulation to be fixed on outer surface of steel flues should be made of glass or mineral wool. (a) Load Bearing Insulation Block Load bearing assembly should consist of three units and be fabricated according to approved drawings. It would be fabricated from mild steel units with a stainless steel sheet bearing plate and load bearing insulation blocks as indicated in drawing. The first unit is bolted to the supporting beam. It consists of a M.S. base plate with bolt holes on which a machined M.S. plate is welded. This plate is provided with recess for PTFE sheet (conforming to BS : 5400) to seat, being lubricated with silicon grease. The second unit also consists of a M.S. plate having adequate size & thickness as shown in drawing. While one surface of the plate is provided with a stainless steel bearing plate the other surface has a thin layer of lead/elastomeric sheet. The side having stainless steel surface is placed on PTFE surface of First unit. The third unit consists of two layers of load bearing insulation blocks each having a minimum thickness of 50 mm and factory bonded to top & bottom M.S. plates. These are separated by 100 mm. long load bearing insulation dowels as shown in the drawing. These plates are in turn welded to two additional M.S. plates. Of the two surfaces thus created one shall be welded to bracket assembly while the other should rest on the lead sheet of second unit. Bearing assembly, thus formed, should be levelled by using suitable M.S. shims. Support arrangement typically consists of flue support shoe (a part of flue), flue support bracket connected to the shoe by precision bolted		

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connection. The bracket in turn is welded to the bearing assembly, which in turn is bolted to available supporting beams. Support brackets and bearing assembly are welded to locally thickened area of flue. These support the flue on support platform at suitable locations indicated on the drawing. The arrangement described above should cater for easy and smooth thermal movements of linear element. Suitable restraint brackets and M.S. stop plates need be provided as shown in drawings to prevent excessive movement and thus keeping different units of bearing assembly in proper position. (b) Insulation Block at Lateral Restraints At flue restraint platforms, necessary restraint arrangement with load bearing insulation blocks and stainless steel bearing plates fixed to the insulation blocks should be provided as indicated in drawings. Restraint and support brackets need be provided for the bottom supported portion of the flue which rests on the support platform provided at the base to cater for bearing and restraint requirements. (c) Glass or Rock Wool Insulation thickness shall be determine as is specified in clause 2.5.11 Thicker layer shall be put as first layer around the flue on its exterior surface. The insulation on the flue shall be fixed using chicken G.I. wire mesh, G.I. wire ties, insulation retaining studs, washers etc. All joints shall be staggered. The insulation shall be tightly secured to the exterior surface of the flue by impaling on the studs and fixing in place by means of 63mm round or square metal plated speed washers. 20 gauge galvanized wire netting shall be wrapped continuously over the entire exterior of insulation. The wire mesh shall be 25mm hexagonal pattern conforming to IS:1566. All joints in the mesh shall be tapped a minimum of 150 mm tied by 16 gauge soft annealed wire at 300 mm spacings. Lacing at joints shall not be used. The Contractor		

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before application of insulation, shall take prior approval of actual fixing arrangement from the Engineer. The insulation shall be able to sustain structural vibrations and shall not settle under such conditions during erection, construction & operation. The insulation shall be suitably tied to prevent dislocation under adverse conditions. (d) Vermiculite Concrete Vermiculite concrete shall be made by mixing exfoliated vermiculite, portland cement and water. It shall be of Grade-B, having a density of 210 Kg./Cu.M. The vermiculite aggregate size shall be maximum 6 mm. The mix shall be 1cement and 8 vermiculite by volume. 3.6 <u>ACID-PROOF/CHEMICAL RESISTANT PROTECTION TO ROOF SLAB</u> Acid-Proof/Chemical Resistant tiles bedded on acid proof/chemical resistant mortar shall be provided for the protection of roof slab. The intervening space between the tiles shall also be filled up by chemical resistant/acid-proof epoxy mortar grouts. The mortar shall be used immediately after mixing. Tiles shall be made of clay, feldspar or quartz and vitrified at a high temperature in ceramic kilns. These should be unglazed, free from deleterious materials and should conform to IS: 4457. Iron oxide in the raw materials used, shall not exceed 2 percent. They should show a fine grained, dense and homogenous fracture when broken. They shall be sound, true to shape, flat and free from flaws and other manufacturing defects. Dimensions of the tiles shall be 198.5 x 198.5 x 35 mm. Depth of the groove on the underside shall not be more than 3 mm. Compressive and tensile strengths of the tiles shall not be less than 70 N/Sq.mm and 3.5 N/Sq.mm respectively. 3.7 <u>FLUE ACID DRAINS AND MANHOLES</u> Flue acid drainage system, where provided, will comprise of collection sumps, dilution manholes, conveying pipes including connection to main drainage system.		

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Stainless steel pipes, bends, collection sumps, fixing straps, bolts etc. conforming to the relevant Indian Standards (or in absence of which British Standard BS: 3605) shall be used in work. Pipes should be cut and joined as per manufacturer's instructions so as to leave the surface clean and square to the axis of pipe. Manhole should be constructed as per drawing. However, for general guidance it may be noted that pit of required dimensions should be excavated, lean concrete (1:2:4 mix) of required thickness to be laid, Acid-proof/Chemical resistant brick masonry in 1:4 acid resistant cement mortar of necessary thickness be built and both sides plastered by 12mm thick acid proof plaster (1:3 mix) having waterproof admixtures. Manholes should be covered by reinforced concrete slab on which a heavy duty (HD) manhole cover with frame having diameter 560mm and total weight 255 Kg (140 Kg for manhole and 115 Kg for cover) is to be fixed. For additional safety another inner cover or other approved methods may be adopted. The manhole cover shall be distinctively coded to indicate the type of drainage involved. Inside manholes necessary channels and benchings finished smooth by neat cement in cement concrete (1:2:4) and foot rungs made from 20mm round bars at 300mm centres and staggered should be provided. Rungs should project 100mm from wall face and be embedded 200mm inside cement concrete block made in that location of brick work. These foot rests shall be painted with coal tar in the projected portions and cement slurry in the embedded part. Joint of any pipe with brick work shall be rendered perfectly leak proof. Pipes and fittings in the connection pipe to the main drainage system shall be vitrified clayware conforming to relevant IS and laid to the line and level indicated in the drawings. 3.8 <u>ROOF DRAINAGE</u> 3.8.1 General Rainwater outlets and down comers to run along inner face of stack wall, shall be made of standard cast iron rainwater pipes conforming to IS:1230.		

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3.8.2	The brackets used to hold the pipes alongside the walls shall be wrought iron clevis type, split ring type or of perforated strap iron as approved by the Engineer. Each vertical pipe shall hang freely on its bracket fixed just below the socket. Suitable spacer blocks are to be kept in between the pipe and wall surface for fixing the pipe. All bends and junctions shall be provided with water tight clean-outs. Pipe Joints All joints between pipes, pipes and fittings and manholes shall be gas-tight when above ground and water tight when under ground. Method of pipe cutting and jointing shall be as per instruction of the pipe and fittings manufacturer or as approved by the Engineer. However following guidelines may be followed in absence of any instruction available from the manufacturer. Socket and Spigot pipes shall be joined by cast lead joints. Spigot of the following pipe should be centred in the socket of the preceding pipe by tightly caulking in sufficient turns of tarred gasket or hemp yarn to have unfilled half the depth of socket. After the gasket or hemp yarn has been caulked tightly, a jointing ring shall be placed round the barrel and tightened against the face of the socket to prevent air lock. Molten lead shall then be placed round the barrel and tightened against the face of the socket. Thereafter molten lead should be poured in to fill the remainder of the socket and caulked with suitable tools tight round the joint to make up for shrinkage of the molten metal on cooling and should be finished 3mm behind the socket face. If any joint is suspected to be damaged it has to be opened out & redone. Joints in cast iron pipes with special jointing arrangements like "Tyton" joints etc. shall follow the instructions of the manufacturer. 4.0 <u>TESTING AND ACCEPTANCE CRITERIA</u> 4.1 <u>GENERAL</u> The Contractor shall carry out all sampling and testing in accordance with the relevant IS Specifications and as supplemented herein, for the following items or any other item as may be required by the Engineer unless otherwise	

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specified in this specification. The Contractor shall get the specimens tested in laboratory, approved by the Engineer and shall submit to him, the original test results in triplicate, within seven days after the completion of the test. Engineer may present himself while such tests are being carried out. 4.2 <u>CEMENT</u> Representative samples shall be taken as per the relevant IS Specification from each consignment of Cement received from the Purchaser/Manufacturer/Supplier for carrying out the tests for fineness (by hand sieving), setting time, compressive strength and soundness tests, and the Contractor shall carry out the above tests as per relevant Indian Standard. If the cement is supplied by the Contractor the test shall be carried out by him. The Contractor shall carry out any or all the tests on aggregates as may be required by the Engineer, in accordance with IS:2386 Parts-I to VIII. The acceptance criteria of the samples tested shall be in accordance with the requirements of the relevant IS specifications. 4.3 <u>WATER</u> Sampling and testing of water being used for concrete works shall be carried out as per IS: 3550, by the Contractor, at regular intervals and whenever directed by the Engineer. The final acceptance criterion in case of doubt shall be as per IS: 3025. 4.4 <u>CONCRETE</u> The Contractor shall take cubes for works test as per requirement laid down in IS: 516 regularly from the day's pour. The number of test cubes to be taken shall be as per IS: 456. The Engineer may also use his discretion in deciding the rate of cubes to be taken. The acceptance criteria is to meet the requirement of IS: 456. If the cube test results indicate that some portions of the work is below the required strength, the Engineer may order demolition of that portion of work which is below strength and ask the Contractor to rebuild, provided a satisfactory method of load testing is not possible. Such testing or demolishing and rebuilding shall be carried out by the Contractor.		

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4.5	<u>STEEL FLUE</u> All site and shop welded joints shall be inspected and tested in accordance with clause 4.00.00 of Technical specification for Fab. and Erection of structural steel work.	
4.6	<u>INSULATIONS</u> The insulating materials shall be tested for its stipulated characteristics and properties in accordance with the latest editions of IS:3144 and IS:3346 and/or as directed by the Engineer.	
5.0	<u>INFORMATION TO BE SUBMITTED</u>	
5.1	<u>WITH TENDER</u>	
	The following technical information are required with the tender:	
	(a) Source and arrangement of processing of aggregates proposed to be adopted.	
	(b) Type of plant and equipment proposed to be used.	
	(c) Names of firms with which association is sought for to execute the special items of work e.g. flue expansion compensator, load bearing insulation blocks etc. in the contract.	
	(d) Types of formwork proposed to be used. All details as per clause no. 3.03.06 to be submitted, if slip form method is proposed to be used.	
	(e) Shop proposed for fabrication of steel (flue) liners. Detailed write-up on procedure of erection of complete liner system including details of equipment proposed for the same.	
	(f) For insulating material tests to be offered for inspection & tests for which test certificates will be submitted. A drawing showing the details of fixing insulation on the flues at bearings, lateral restraints and exterior surface.	

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(g) Proposal for lifting of men and material in constructing the chimney. 5.2 <u>AFTER AWARD</u> The following information and data including samples where necessary, shall be submitted by the Contractor, progressively during the execution of the Contract. 5.2.1 Programme of Execution and requirement of Materials Within 30 days of the award of the Contract, the Contractor will submit a Master Programme for completion of the work giving month wise requirement of materials, particularly mentioning in details the materials which are to be supplied by the Owner and for the procurement of which the help of the Owner is required as per the terms & conditions of the Contract. In case the Contractor proposes to take on hire any machinery or tools and plants from the Owner, the detailed phased out programme of such hire is also to be submitted. The master programme may have to be reviewed and updated by the Contractor quarterly or at more frequent intervals as may be directed by the Engineer depending on the exigencies of the work. Detailed day to day programme of every month is to be submitted by the Contractor before the commencement of the month. 5.2.2 Samples Samples of all materials proposed to be used shall be submitted as directed by the Engineer, in sufficient quantities, for approval. All samples shall be submitted well in advance of starting work at site. Approved samples will be preserved by the Engineer for future reference. The approval of the Engineer shall not, in any way, relieve the Contractor of his responsibility of supplying material of specified quality.		

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5.2.3 Design Mix Design mix as per details of this specification giving proportions of ingredients, sources of aggregates and cement along with accompanying test results of trial mixes as per relevant IS Specifications shall be submitted to the Engineer, for his approval, before it can be used on the work. 5.2.4 Detail Drawings Following items shall be provided by the Contractor which are to be approved by the Owner and Consultant. (a) Detail drawings and designs of form work including scaffolding to be used. If slipform method of construction is adopted, then detail drawings showing all the arrangements for slipform technique including methods for reducing internal diameter and providing required slopes on outer diameter. (b) Detail drawings and bar bending schedules for concrete components. (c) Shop drawings for structural steel and metal work, including inserts etc. The Contractor shall submit his proposal for testing site and shop joints provided in steel members. (d) Detail drawings for templates and temporary supports for embedments. (e) Category wise requirements of MS, tor and structural steel including GI flats of various sizes for procurement. (f) Detailed drawings of steel flues indicating details of joints, supports and restraints including insulation blocks, and details of expansion compensator. (g) Detailed drawing of hoisting arrangement for men and material satisfying statutory regulations laid down for safety purpose.		

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5.2.5 Reports Following Test Reports shall be furnished by the Contractor: (a) Mill Test Report for cement and reinforcing steel if the materials are supplied by the Contractor. (b) Inspection Report of bought out items. (c) Inspection Report of formwork and reinforcement, insulations etc. (d) Reports of tests of various material and concrete. (e) Radiographic tests on welded joints in steel flues. (f) Any other data or report or test result required by the relevant IS Specifications and if required by the Engineer for satisfactory quality control of the workmanship.		

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1.0 <u>SCOPE</u> This specification covers all work required for the construction of road including box-cutting, edging, preparation of sub-base, water bound macadam, bituminous macadam, wearing course etc. excluding toppings and shall include all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work. Notwithstanding the provisions of the technical specification, all road works shall be carried out as per IRC / MORT&H specification This specification also includes all work required for drainage including road side RCC drain, RCC culverts, pipe-culverts, drainage pipes, manholes etc. and all other incidental items. 2.0 <u>GENERAL</u> 2.1 <u>WORK TO BE PROVIDED FOR BY THE CONTRACTOR.</u> The work to be provided for by the Contractor, unless specified otherwise, shall include but not be limited to the following: (a) Furnish all labour, supervision, services, materials, equipment, tools and plants, transportation etc. required for the work. (b) Submit for approval detailed schemes of all operations required for executing the work e.g. material handling, placement, services, approaches etc. (c) To carry out and submit to the Engineer results of tests whenever required by the Engineer to assess the quality of work. 2.2 <u>WORK TO BE PROVIDED FOR BY OTHERS</u> No work under this specification will be provided for by any agency other than the Contractor unless specifically mentioned elsewhere in the Contract.		

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2.3 <u>CODES AND STANDARDS</u> All work under this specification, unless specified otherwise, shall conform to the latest revision and/or replacements of the following or any other relevant I.S. Specifications and Codes of Practice. (a) Specification for road and bridge works of Ministry of Road Transport & Highways (Fourth Revision). Published by the IRC, New Delhi-2001. (b) IRC-19 Standard specifications and Code of Practice for Water Bound Macadam. (c) IRC: SP-11 Hand Book of Quality Control for Construction of Roads and Runways. (d) IS: 456 Indian Standard Code of Practice for Plain and Reinforced Concrete. (e) IS: 2212 Code of Practice for Brickwork. (f) IS: 783 Code of Practice for Laying of Concrete Pipes. (g) IRC: 36 Recommended Practice for Construction of Earthen embankments for Road Works. (h) IRC: 37 Guidelines for the design of Flexible pavements (i) Other specifications mentioned elsewhere in this specification. In case any particular aspect of work is not covered specifically by Indian Standard Specification, any other standard practice as may be specified by the Engineer shall be followed.		

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2.4 <u>CONFORMITY WITH DESIGNS</u> The contractor shall carryout the work as per the drawings issued to him and/or contractor's drawings which are approved by the Engineer and/or the Engineer's instructions. 2.5 <u>MATERIALS TO BE USED</u> 2.5.1 General All materials required for the work shall be of best commercial variety and as approved by the Engineer. Material to be used in the work shall conform to the specifications mentioned on the drawings, the requirements laid down in MORT&H Specification and specification for relevant items of work carried under these specifications. 2.6 <u>QUALITY CONTROL</u> The Contractor shall establish and maintain quality control for the various aspects of the work, method, materials and equipment used. All works performed shall conform to the lines, grades, cross sections and dimensions shown on the drawings or as directed by the Engineer. Permitted tolerances for road works are described hereinafter 2.6.1 Horizontal Alignments Horizontal alignments shall be reckoned with respect to the centre line of the carriageway as shown on the drawings. The edges of the carriageway as constructed shall be correct within a tolerance of 25mm there from the corresponding tolerance for edges of the roadway and lower layers of pavement shall be 40 mm. 2.6.2 Surface Regularity of Sub grade and Pavement Courses The surface regularity of completed sub-bases, base courses and wearing surfaces in the longitudinal and transverse directions shall be within the tolerances indicated in Table-I.		

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The longitudinal profile shall be checked with a 3 metre long straight edge, at the middle of each traffic lane along a line parallel to the centre of the road. The transverse profile shall be checked with a set of three camber boards at intervals of 10 metres. 2.6.3 Longitudinal Profile The levels of the sub grade and different pavement courses as constructed, shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings or as directed by the Engineer, beyond tolerances mentioned below:		

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TABLE 1.**TOLERANCES IN SURFACE LEVELS (Table 900-1 of MORT&H)**

1.0	Sub grade	+ 20 mm
2.0	Sub-base + 10 mm :	- 25 mm
(a)	Flexible pavement	-20 mm
(b)	Concrete pavement (Dry lean concrete or Rolled concrete)	+6 mm - 10 mm
3.0	Base-course for flexible pavement	
(a)	Bituminous course	+ 6 mm - 6 mm
(b)	Other than bituminous	+ 10 mm
	(i) Machine laid	- 10 mm, + 15 mm
	(ii) Manually laid	- 15 mm
4.0	Wearing course for flexible pavement :	
(a)	Machine laid	+ 6 mm - 6 mm
(b)	Manually laid	+10 mm -10 mm
5.0	Cement concrete pavement	+ 5 mm - 6 mm *

* This may not exceed - 8 mm at 0- 30 cm from the edges.

Provided, however, that the negative tolerance for wearing course shall not be permitted in conjunction with the positive tolerance for base course, if the thickness of the former is thereby reduced by more than 6 mm for flexible pavements and 5 mm for concrete pavements.

For checking compliance with the above requirement for subgrade, sub-base and base courses, measurements of the surface levels shall be taken on a grid of points placed at 6.25 m longitudinally and 3.5 m transversely. For any 10 consecutive measurements taken longitudinally or transversely, not more than one measurement shall be permitted to exceed the tolerance as above, this one measurement being not in excess of 5 mm above the permitted tolerance.

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TABLE 2**MAXIMUM PERMITTED NUMBER OF SURFACE IRREGULARITIES****(Table 900-2 of MORT & H)**

Sr.No	Irregularity	Surfaces of Carriageways and paved shoulders				Surfaces of laybys, Service areas and all bituminous base courses			
		4mm		7mm		4mm		7mm	
1.0	Length (m)	300							
2.0		75							
3.0	National Highways/ Expressways*	20	2	9	2	1	40	18	4
4.0	Roads of lower category*	40	18	4	2	60	27	6	3

*Category of each section of road as described in the Contract.

The maximum allowable difference between the road surface and underside of a 3 m straight-edge when placed parallel with, or at right angles to the centre line of the road at points decided by the Engineer shall be:

- (a) for pavement surface (bituminous and cement concrete) : 3 mm
- (b) for bituminous base courses : 6 mm
- (c) for granular sub-base/base courses : 8 mm
- (d) for sub-bases under concrete pavements : 10 mm

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TABLE -3

PERMITTED TOLERANCES OF SURFACE REGULARITY FOR PAVEMENT COURSES

Sr. No.	Type of Construction	Longitudinal Profile with 3 metre straight edge				Cross Profile	
		Maximum Permissible undulation mm	Maximum number of undulations permitted in any 300 metres length exceeding mm				Maximum permissible variation from specified profile under camber template. mm
			18	12	10	6	
1	2	3	4	5	6	7	8
1.0	Earthen subgrade	25	30	-	-	-	15
2.0	Granular subbase	15	-	30	-	-	12
3.0	Water Bound Macadam with oversize metal (40-90 mm size	15	-	30	-	-	12
4.0	Water Bound Macadam with normal size metal (20-50 mm and 40-63mm size), Bituminous Penetration Macadam	12	-	-	30	-	8
5.0	Surface dressing ** (two coat) over WBM (20-50 mm or 40-63 mm size metal), Bituminous penetration macadam or built-up spray grout	12	-	-	20	-	8

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Sr. No.	Type of Construction	Longitudinal Profile with 3 metre straight edge					Cross Profile
		Maximum Permissible undulation mm	Maximum number of undulations permitted in any 300 metres length exceeding mm				Maximum permissible variation from specified profile under camber template. mm
			18	12	10	6	
6.0	Open graded premix carpet mixseal surfacing	10	-	-	-	30	6
7.0	Bituminous macadam	10	-	-	-	20***	6
8.0	Semi-dense carpet	10	-	-	-	20***	6
9.0	Asphaltic Concrete	8	-	-	-	10***	4

NOTES :

- 1.0 **For surface dressing in all other cases, the standards of surface evenness will be the same as those for the surface receiving the surface dressing.
- 2.0 *** These are for machine laid surfaces. If laid manually due to unavoidable reasons, tolerance upto 50 percent above these values in this column may be permitted at the discretion of the Engineer. However, this relaxation does not apply to the values of maximum undulation for longitudinal and cross profiles mentioned in columns 3 and 8 on the table.
- 3.0 Surface evenness requirements in respect of both the longitudinal and cross profiles should be simultaneously satisfied.

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2.7 <u>RECTIFICATION</u> Where the surface regularity of subgrade and the various pavement courses fall outside the specified tolerances, the Contractor shall be liable to rectify these in the manner described below and to the satisfaction of the Engineer. 2.7.1 Subgrade: Where the surface is high, it shall be trimmed and suitably compacted. Where the same is low, the deficiency shall be corrected by scarifying the lower layer and adding fresh material and recompacting to the required density. The degree of compaction and the type of material to be used shall conform to the requirements of Clause 305 of MORT&H. 2.7.2 Granular sub-base: Same as at (i) above, except that the degree of compaction and the type of material to be used shall conform to the requirements of Clause 401 of MORT&H. 2.7.3 Water Bound Macadam/Wet Mix Macadam Sub-base/Base: Where the surface is high or low, the top 75 mm shall be scarified, reshaped with added material as necessary and recompacted to Clause 404. This shall also apply to wet mix macadam to Clause 406 of MORT&H. 2.7.4 Bituminous Constructions: For bituminous construction other than wearing course, where the surface is low, the deficiency shall be corrected by adding fresh material over a suitable tack coat if needed and recompacting to specifications. Where the surface is high, the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications. For wearing course, where the surface is high or low, the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications. In all cases where the removal and replacement of a bituminous layer is involved, the area treated shall not be less than 5 m in length and not less than 3.5 m in width. Tolerance in wearing course shall not be permitted in conjunction with the positive tolerance for base course if the thickness of the former is thereby reduced by more than 6 mm.		

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2.8 <u>QUALITY CONTROL TESTS DURING CONSTRUCTION</u> As per Clause 903 of MORT&H specification. 3.0 <u>EXECUTION</u> 3.1 <u>SHOULDER CONSTRUCTION</u> 3.1.1 Description This work shall consist of constructing shoulders on either side of the pavement, in accordance with the requirements of this specification and in conformity with the lines, grades and cross-sections shown on the drawings or as directed by the Engineer. 3.1.2 Materials Shoulder may be of selected earth or granular material conforming to the requirements of (MORT&H specification) embankment construction or granular sub-base construction respectively. 3.1.3 Construction Operations Shoulder The sequence of operations shall be such that the construction of paved shoulder is done in layers each matching the thickness of adjoining pavement layer. Only after a layer of pavement and corresponding layers in paved and earth shoulder portion have been laid and compacted, the construction of next layer of pavement and shoulder shall be taken up. Where the materials in adjacent layers are different, these shall be laid together and the pavement layer shall be compacted first. The corresponding layer in paved shoulder portion shall be compacted thereafter, which shall be followed by compaction of earth shoulder layer. The adjacent layers having same material shall be laid and compacted together.		

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Compaction requirement of earthen shoulder shall be as per latest MORT&H specification. In the case of bituminous course, work on shoulder (earthen/hard/paved), shall start only after the pavement course has been laid and compacted. During all stages of shoulder (earthen/hard/paved) construction, the required crossfall shall be maintained to drain off surface water. Regardless of the method of laying, all shoulder construction material shall be placed directly on the shoulder. Any spilled material dragged on to the pavement surface shall be immediately removed, without damage to the pavement, and the area so affected thoroughly cleaned. 3.2 <u>KERB</u> 3.2.1 Material Kerb, if required for construction of footpath, shall consist of precast concrete blocks with a concrete grade of M-15. The blocks shall be 100 mm wide and of suitable length. The depth of blocks unless otherwise mentioned elsewhere, shall be 375 mm considering 225 mm height of footpath from the road level. 3.2.2 Laying The Kerb shall be laid by cutting trenches 150 mm deep. The width of the trench shall be minimum and just sufficient to insert the kerbs. The inside faces of the Kerbs shall be in plumb and the gap between the block shall not be more than 10 mm. The kerbs shall be thoroughly packed with a mixture of stone chips (50%) and moorum (50%) at the outside face. The laying and packing shall be done in a proper workmanlike manner acceptable to the Engineer. 3.3 <u>SUB-BASE (GRANULAR SUB-BASE)</u> 3.3.1 Description		

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This work shall consist of laying and compacting well-graded material on prepared sub grad in accordance with the requirements of these specifications. The material shall be laid in one or more layers as shown on the drawings and according to lines, grades and cross sections shown on the drawings or as directed by the Engineer. 3.3.2 Materials The materials to be used for the work shall be natural sand, moorum, gravel, crushed stone, crushed slag, crushed concrete, brick metal, laterite, kanker etc. or combinations thereof depending upon the grading required. The material shall be free from organic or other deleterious constituents and conform to one of the three gradings given in Table 4. While the gradings in Table 4 are in respect of close-graded granular sub-base materials, one each for maximum particle size of 75 mm, 53 mm and 26.5 mm, the corresponding gradings for the coarse-graded materials for each of the three maximum particle sizes are given at Table 5. The grading to be adopted for a project shall be as specified in the Contract.		

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TABLE 4**GRADING FOR CLOSE-GRADED GRANULAR SUB-BASE MATERIALS****(TABLE 400-1 of MORT&H)**

Sr. No.	IS Sieve	Per cent by weight passing the IS sieve		
		Grading I	Grading II	Grading III
	Designation			
1.0	75.0 mm	100	-	-
2.0	53.0 mm	80-100	100	-
3.0	26.5 mm	55-90	70-100	100
4.0	9.50 mm	35-65	50-80	65-95
5.0	4.75 mm	25-55	40-65	50-80
6.0	2.36 mm	20-40	30-50	40-65
7.0	0.425 mm	10-25	15-25	20-35
8.0	0.075 mm	3-10	3-10	3-10
9.0	CBR Value (Minimum)	30	25	20

Note :

- The material passing 425 micron (0.425 mm) sieve for all the three gradings when tested according to IS : 2720 (Part 5) shall have liquid limit and plasticity index not more than 25 and 6 percent respectively.

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3.3.3 Physical Requirements The fraction of material passing 20 mm sieve shall give a CBR value as specified in Table-II when tested in accordance with IS:2720 (Part XVI) after preparing the samples at maximum dry density and optimum moisture content corresponding to IS:2720 (Part VII) and soaking the same in water for 4 days. The material shall have a 10 per cent fines value of 50 kN or more (for sample in soaked condition) when tested in compliance with BS: 812 (Part III). The water absorption value of the coarse aggregate shall be determined as per IS: 2386 (Part 3); if this value is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS: 383. For Grading II and III materials, the CBR shall be determined at the density and moisture content likely to be developed in equilibrium conditions which be taken as being the density relating to a uniform air voids content of 5 percent 3.3.4 Spreading and Compacting Immediately prior to the laying of sub-base, the sub grade already finished shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water, if necessary, and rolled with one pass of 8-10 tonne smooth wheeled roller. The sub-base material shall be spread on the subgrade with the help of a drag spreader, motor grader or other approved means. The thickness of loose layers shall be so regulated that the maximum thickness of the layer after consolidation does not exceed 150 mm. The sub-base material of grading specified in the Contract shall be spread on the prepared subgrade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation or other means as approved by the Engineer. Manual mixing shall be permitted only where the width of laying is not adequate for mechanical operations, as in small-sized jobs. The equipment used for mix-in-place construction shall be a rotavator or similar approved		

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equipment capable of mixing the material to the desired degree. If so desired by the Engineer, trial runs with the equipment shall be carried out to establish its suitability for the work. Moisture content of the loose material shall be checked in accordance with IS:2720 (Part II) and suitably adjusted by sprinkling additional water from a hose line, truck mounted water tank or other approved means so that at the time of compaction it is from 1 percent above to 2 percent below the optimum moisture content corresponding to IS:2720 (Part VIII). While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means if so directed by the Engineer until the layer is uniformly wet. Immediately thereafter, rolling shall be started with 8 to 10 tonne smooth wheeled rollers or other approved plant. Rolling shall commence at the edges and progress towards the centre longitudinally except that on super elevated portions it shall progress from the lower to the upper edge parallel to the centre line of the pavement. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. During rolling, the grade and camber shall be checked and any high spots or depressions which become apparent corrected by removing or adding fresh material. Rolling shall be continued till the density achieved is at least 95% of the maximum dry density for the material determined as per IS:2720 (Part VII). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction plant and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted. 3.4 <u>WATER BOUND MACADAM SUB-BASE/BASE COURSE</u> 3.4.1 Description Water bound macadam shall consist of clean, crushed aggregates mechanically interlocked by rolling,, and bonded together with screenings, binding material, where necessary and water, laid on a prepared subgrade		

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or sub-base, as the case may be, and finished in accordance with the requirements of MORT&H Specifications and in conformity with the lines, grades and cross-sections shown on the drawings or otherwise directed by the Engineer.

3.4.2 Materials

(a) Coarse Aggregates

Coarse aggregates shall be either crushed or broken stone, crushed slag, overburnt (Jhama) brick aggregates or any other naturally occurring aggregates such as kankar and laterite of suitable quantity. The aggregates shall conform to the physical requirements set forth in Table 5.

TABLE 5 (Table 400-6 of MORT&H)

**PHYSICAL REQUIREMENTS OF COARSE AGGREGATES FOR WATER BOUND
MACADAM FOR SUB-BASE/BASE COURSES**

Sr. No.	Test	Test Method	Requirements
1.0	* Los Angeles Abrasion value	IS : 2386 (part – 4)	40 per cent (Max)
	OR * Aggregate Impact value	IS : 2386 (part-4) or IS : 5640**	30 per cent (Max)
2.0	Combined Flakiness and Elongation Indices (Total) ***	IS : 2386 (Part-1)	30 per cent (Max)

* Aggregate may satisfy requirements of either of the two tests.

** Aggregates like brick metal, kankar, laterite etc. which get softened in presence of water shall be tested for Impact value under wet conditions in accordance with IS : 5640.

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*** The requirement of flakiness index and elongation index shall be enforced only in the case of crushed broken stone and crushed slag. (b) Crushed or Broken Stone Crushed or broken stone shall be hard, durable and free from excess of flat, elongated, soft and disintegrated particles, dirt and other objectionable matter. (c) Grading Requirements of Coarse Aggregates The coarse aggregates shall conform to one of the gradings given in Table 6, provided, however, the use of Grading No. 1 shall be restricted to sub-base courses only. <u>TABLE 6 (Table 400-8 of MORT&H)</u> <u>GRADING REQUIREMENTS OF COARSE AGGREGATES</u>			
Grading No.	Size Range	IS Sieve Designation	Per cent by weight passing
1.0	90 mm to 45 mm	125 mm	100
		90 mm	90-100
		63 mm	25-60
		45 mm	0-15
		22.4 mm	0-5
2.0	63 mm to 45 mm	125 mm	100
		90 mm	90-100
		63 mm	25-75
		45 mm	0-15
		22.4 mm	0-5
3.0	53 mm to 22.4 mm	63 mm	100
		53 mm	95-100

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		45 mm	65-90																																
		22.4 mm	0-10																																
		11.2	0-5																																
	Note : The compacted thickness for a layer with Grading 1 shall be 100 mm while for layer with other Grading e.g. 2 & 3, it shall be 75 mm.																																		
(d) Screenings Screenings to fill voids in the coarse aggregate shall generally consist of the same material as the coarse aggregate. However, where permitted, predominantly non-plastic material such as moorum or gravel (other than rounded river borne material) may be used for this purpose provided liquid limit and plasticity index of such material is below 20 and 6 respectively and fraction passing 75 micron sieve does not exceed 10 percent. Screenings shall conform to the grading set forth in Table7. <u>TABLE 7</u> <u>GRADINGS FOR SCREENINGS (Table 400-8 of MORT&H)</u> <table><tr><th>Grading Classification</th><th>Size of Screenings</th><th>IS Sieve Designation</th><th>Per cent by weight passing the IS Sieve</th></tr><tr><td>A</td><td>13.2 mm</td><td>12.2 mm</td><td>100</td></tr><tr><td></td><td></td><td>11.2 mm</td><td>95-100</td></tr><tr><td></td><td></td><td>5.6 mm</td><td>15.35</td></tr><tr><td></td><td></td><td>180 micron</td><td>0-10</td></tr><tr><td>B</td><td>11.2 mm</td><td>11.2 mm</td><td>100</td></tr><tr><td></td><td></td><td>5.6 mm</td><td>90-100</td></tr><tr><td></td><td></td><td>180 micron</td><td>15.35</td></tr></table>				Grading Classification	Size of Screenings	IS Sieve Designation	Per cent by weight passing the IS Sieve	A	13.2 mm	12.2 mm	100			11.2 mm	95-100			5.6 mm	15.35			180 micron	0-10	B	11.2 mm	11.2 mm	100			5.6 mm	90-100			180 micron	15.35
Grading Classification	Size of Screenings	IS Sieve Designation	Per cent by weight passing the IS Sieve																																
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		5.6 mm	15.35																																
		180 micron	0-10																																
B	11.2 mm	11.2 mm	100																																
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(e) Binding Material Binding material to be used for water bound macadam as a filter material meant for preventing ravelling, shall comprise of a suitable material approved by the Engineer having a Plasticity Index (PI) value of less than 6 as determined in accordance with IS : 2720 (Part-5). The quantity of binding material where it is to be used, will depend on the type of screenings. Generally, the quantity required for 75 mm compacted thickness of water bound macadam will be 0.06-0.09 m³/10m² and 0.08-0.10m³/10m² for 100 mm compacted thickness. The above mentioned quantities should be taken as a guide only, for estimation of quantities for construction etc. Application of binding materials may not be necessary when the screenings used are of crushable type such as moorum or gravel. 3.4.3 Construction Operations (a) Preparation of Base The sub-grade/sub-base to receive the water bound macadam coarse shall be prepared to the specified grade and camber and made free of dust and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm surface is obtained if necessary by sprinkling water. (b) Inverted Choke If the water bound macadam is to be laid directly over the subgrade, without any other intervening pavement course, a 25 mm course of screenings (Grading B) shall be spread on the prepared subgrade before application of the coarse aggregates is taken up.		

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(c) Spreading Coarse Aggregate The coarse aggregates shall be spread uniformly upon the prepared surface in such quantities that the thickness of the compacted layer is 100 mm for grading 1 and 75-100 mm for gradings 2 and 3 for each layer. The spreading shall be done from stockpiles along the side of the roadway or directly from vehicles. In no case shall the aggregate be dumped in heaps directly on the surface prepared to receive the aggregate nor shall hauling over uncompacted or partially compacted base be permitted. The surface of the aggregates spread shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregate as may be required. No segregation of large or fine particles shall be allowed and the coarse aggregate as spread shall be of uniform gradation with no pockets of fine material. The coarse aggregate shall not normally be spread more than 3 days in advance of the subsequent construction operations. (d) Rolling Immediately following the spreading of the coarse aggregate, rolling shall be started with three wheeled power rollers of 80 to 100 kN capacity or tandem or vibratory rollers of approved type. The weight of the roller shall depend upon the type of the aggregate and be indicated by the Engineer. Except on super elevated portions where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the centre. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inwards parallel to the centre line of the road, in successive passes uniformly lapping preceding tracks by at least one half width.		

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Rolling shall continue until the aggregates are thoroughly keyed and the creeping of aggregates ahead of the roller is no longer visible. During rolling slight sprinkling of water may be done, if necessary. Rolling shall not be done when the subgrade is soft or yielding or when it causes a wave-like motion in the subgrade or sub-base course. The rolled surface shall be checked transversely and longitudinally with templates and any irregularities corrected by loosening the surface, adding or removing necessary amounts of aggregate and re-rolling until the entire surface conforms to desired camber and grade. In no case shall the use of screenings be permitted to make up depressions. (e) Applications of Screenings After the coarse aggregate has been rolled, screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screenings are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregate. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers either by the spreading motion of hand shovels or by mechanical spreaders, or directly from trucks. Trucks operating for spreading the screenings shall be so driven as not to disturb the coarse aggregate. The screenings shall be applied at a slow and uniform rate (in three or more applications) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms, hand-brooms or both. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregate. These operations shall continue until no more screenings can be forced into the voids of the coarse aggregate.		

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The spreading, rolling and brooming of screenings shall be carried out in only such lengths of the road which could be completed within one day's operation. (f) Sprinkling and Grouting After the screenings have been applied, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings into voids and to distribute them evenly. The sprinkling, sweeping and rolling operations shall be continued, with additional screenings applied as necessary, until the coarse aggregate has been thoroughly keyed, well-bonded and firmly set in its full depth and a grout has been formed of screenings. Care shall be taken to see that the base or subgrade does not get damaged due to the addition of excessive quantities of water during construction. (g) Application of Binding Material After the application of screenings, the binding material where it is required to be used shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water, the resulting slurry swept in with hand brooms, or mechanical brooms to fill the voids properly, and rolled during which water shall be applied to the wheels of the rollers if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling of voids, forms a wave ahead of the wheels of the moving roller. (h) Setting and Drying After the final compaction of water bound macadam course, the road shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings or binding material as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam has set. The Engineer shall have the discretion to stop hauling traffic from using the completed		

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water bound macadam course if in his opinion it would cause excessive damage to the surface. 3.5 <u>TACK COAT</u> 3.5.1 Description The work shall consist of application of a single coat of low viscosity liquid bituminous material to an existing road surface preparatory to another bituminous construction. 3.5.2 Materials Binder : The binder used for tack coat shall be bitumen of a suitable grade as directed by the Engineer and conforming to IS:73, 217 or 454, IS: 8887 of a type and grade as specified in the Contract or as directed by the Engineer as applicable, or any other approved cutback. 3.5.3 Construction Operations 3.5.3.1 Preparation of Base The surface on which the tack coat is to be applied shall be clean and free from dust, dirt and any extraneous material. Immediately before the application of the tack coat, the surface shall be swept clean with a mechanical broom and high pressure air jet, or by other means as directed by the Engineer. 3.5.3.2 Application of Binder Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer and sprayed on the base at the rate specified below. The rate of spread in terms of straight-run bitumen shall be 5 kg. per 10 square metre area for an existing bitumen treated surface and 10 kg per 10 square metre area for an untreated water bound macadam surface. The binder shall be supplied uniformly with the aid of sprayers.		

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The application of tack coat shall be at the rate specified in the Contract, and shall be applied uniformly. The normal range of spraying temperature for a bituminous emulsion shall be 20 degree Celsius - 70 degree Celsius and for a cutback 50 degree Celsius – 80 degree Celsius if RC-70/MC-70 grade is used. The method of application of the tack coat will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar, and speed of forward movement. The contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified. The tack coat shall be applied just ahead of the on-coming bituminous construction. 3.6 <u>BITUMINOUS MACADAM BINDER COURSE</u> 3.6.1 Description This work shall consist of construction, in a single course, of 75 mm thickness of compacted crushed aggregates premixed with a bituminous binder, laid immediately after mixing, on a base prepared previously in accordance with the requirements of these Specifications, and in conformity with the lines, grades and cross sections shown on the drawings or directed by the Engineer. 3.6.2 Materials 3.6.2.1 Binder The Binder shall be straight run bitumen of a suitable grade as directed by the Engineer complying with IS: 73. 3.6.2.2 Aggregates The aggregates shall consist of crushed stone, crushed gravel (shingle) or other stones. They shall be clean, strong, durable, of fairly cubical shape and free of disintegrated pieces, organic and other deleterious matter, and adherent coats. The aggregates shall preferably be hydrophobic and of low porosity. The aggregates shall satisfy the physical requirements set forth in Table-8		

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TABLE-8**PHYSICAL REQUIREMENTS OF AGGREGATES OF BITUMINOUS MACADAM**

Sr. No	Test	Test method	Requirements	
1.0	Los Angeles Abrasion *	IS:2386 (Part IV)	35% Maximum	
2.0	Aggregate Impact Value *	-do-	30%	"
3.0	Flakiness Index	IS:2386 (Part I)	35%	"
4.0	Stripping Value	IS:6241	25%	"
5.0	Water Absorption	IS:2386 (Part III)	2%	"

Aggregates may satisfy requirements of either of the two tests. The aggregates for bituminous macadam for different thicknesses shall conform to the grading A or B given in Tables 9 & 10.

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TABLE-9

**AGGREGATES GRADING FOR 75 MM COMPACTED THICKNESS OF
BITUMINOUS MACADAM**

Sr. No.	Sieve Designation	Percent by weight passing the sieve	
		Grading A	Grading B
(a)	63 mm	100	
(b)	50 mm	90-100	
(c)	40 mm	35-65	100
(d)	25 mm	20-40	70-100
(e)	20 mm	-	50-80
(f)	12.5 mm	5-20	-
(g)	4.75 mm	-	10-30
(h)	2.36 mm	-	5-20
(i)	75 micron	0-5	0-4

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TABLE 10

**AGGREGATES GRADING FOR 75 MM COMPACTED THICKNESS OF
BITUMINOUS MACADAM**

Sr. No.	Sieve Designation	Percent by weight passing the sieve	
		Grading A	Grading B
(a)	50 mm	100	
(b)	40 mm	90-100	
(c)	25 mm	50-80	100
(d)	20 mm	-	70-100
(e)	12.5 mm	10-30	-
(f)	10 mm	-	35-60
(g)	4.75 mm	-	10-30
(h)	2.36 mm	-	5-20
(i)	75 micron	0-5	0-4

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3.6.2.3 Fine aggregates Fine aggregates shall consist of crushed or naturally occurring material, or a combination of the two, passing 2.36 mm sieve and retained on 75 micron sieve. They shall be clean, hard, durable, dry and free from dust, and soft or friable matter, organic or other deleterious matter Fine aggregates shall consist of crushed or naturally occurring material, or a combination of the two, passing 2.36 mm sieve and retained on 75 micron sieve. They shall be clean, hard, durable, dry and free from dust, and soft or friable matter, organic or other deleterious matter 3.6.2.4 Proportioning of Materials The binder content for premixing shall be 3.5 and 4.0 percent by weight of the total mix for aggregate grading A and B respectively, except when otherwise directed by the Engineer. The quantities of aggregates to be used shall be sufficient to yield the specified thickness after compaction. 3.6.2.5 Variation in Proportioning of Materials The Contractor shall have the responsibility for ensuring proper proportioning of materials and producing a uniform mix. A variation in binder content of 0.3 percent by weight of total mix shall, however, be permissible for individual specimens taken for quality control tests. 3.6.3 Construction Operations 3.6.3.1 Weather and Seasonal Limitations Bituminous macadam shall not be laid during rainy weather or when the base course is damp or wet. 3.6.3.2 Preparation of Base The base on which bituminous macadam is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross sections as		

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directed by the Engineer. The surface shall be thoroughly swept and scraped clean and free from dust and foreign matter. 3.6.3.3 Tack Coat A tack coat shall be applied over the base. 3.6.3.4 Preparation and Transport of Mix Hot mix plant of adequate capacity shall be used for preparing the mix. The temperature of binder at the time of mixing shall be in the range 150 Deg.- 165 Deg.C and that of aggregates in the range 125 Deg. - 150 Deg.C, provided that the difference in temperature between the binder and aggregate at no time exceeds 25 Deg.C. Mixing shall be thorough to ensure that a homogenous mixture is obtained in which all particles of the aggregates are coated uniformly. The mixture shall be transported from the mixing plant to the point of use in suitable vehicles. The vehicles employed for transport shall be clean and be covered over in transit if so directed by the Engineer. 3.6.3.5 Spreading The mix shall be spread immediately after mixing by means of a self propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mix to the specified lines, grade and cross sections. However, in restricted locations and in narrow widths, where the available plants cannot operate in the opinion of the Engineer, he may permit manual laying of the mix. The temperature of mix at the time of laying shall be in the range 110 Deg. - 135 Deg.C. In multilayer construction, the longitudinal joint in one layer shall offset that in the layer below by about 150 mm. However, the joint in the topmost layer shall be at the centre line of the pavement.		

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Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material. 3.6.3.6 Rolling After the spreading of mix, rolling shall be done by 8 to 10 tonne power rollers or other approved plant. Rolling should start as soon as possible after the material has been spread. Rolling shall be done with care to keep from unduly roughening the pavement surface. Rolling of the longitudinal joint shall be done immediately behind the paving operation. After this, the rolling shall commence at the edges and progress towards the centre longitudinally except that on super-elevated portions it shall progress from the lower to the upper edge parallel to the centre line of the pavement. The initial or breakdown rolling shall be done as soon as it is possible to roll the mixture without cracking the surface or having the mix pick up on the roller wheels. The second or inter mediate rolling shall follow the break down rolling as closely as possible and be done while the paving mix is still at a temperature that will result in maximum density. The final rolling shall be done while the material is still workable enough for removal of roller marks. When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding fresh material. The rolling shall then be continued till the entire surface has been rolled to compaction, there is no crushing of aggregate and all roller marks have been eliminated. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. The roller wheels shall be kept damp if necessary to avoid the bituminous material from sticking to the wheels and being picked up. In no case shall fuel lubricating oil be used for this purpose. Rolling operations shall be completed in every respect before the temperature of the mix falls below 80 Deg.C.		

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Rollers shall not stand on newly laid material while there is a risk that it will be deformed thereby. The edges along and transverse of the bituminous macadam laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of appropriate binder before the new mix is placed against it. The bituminous macadam shall be provided with final surfacing without any delay. If there is to be any delay, the course shall be covered by a seal coat before allowing any traffic over it. 3.7 <u>OPEN-GRADED PREMIX CARPET</u> 3.7.1 Description This work shall consist of laying and compacting an open-graded carpet of 2 cm thickness in a single course composed of suitable small sized aggregates premixed with a bituminous binder on a previously prepared base, to form a wearing course, in accordance with the requirements of these specifications. 3.7.2 Materials 3.7.2.1 Binder The binder shall be bitumen of a suitable grade, as directed by the Engineer, and satisfying the requirements of IS:73, 217, 454 or other approved cutback as applicable. 3.7.2.2 Aggregates The aggregates shall consist of angular fragments of clean, hard, tough and durable rock of uniform quality throughout. They shall be obtained by crushing rock, gravel or river shingle and be free of elongated and flaky pieces, soft and disintegrated materials, and vegetable or other deleterious matter. They shall preferably be hydrophobic type. The aggregates shall satisfy the quality requirements set forth in Table 8 except that the Flakiness Index shall be limited to a maximum of 30. 3.7.2.3 Proportioning of Materials		

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TABLE-11**QUANTITIES OF MATERIALS REQUIRED FOR 10 SQ.M OF ROAD****SURFACE FOR 2 CM THICK OPEN-GRADED PREMIX CARPET**

Sr. No.		
1.0	Aggregates of Carpet	
	(a) Stone chippings - 12 mm size; passing 20 mm sieve and retained on 10 mm sieve	0.18 Cu.m
	(b) Stone chippings - 10 mm size; passing 12.5 mm sieve and retained on 6.3 mm sieve	0.09 Cu.m
		Total : 0.27 Cu.m
2.0	Binder for premixing (quantities in terms of straight run bitumen	
	(a) For 0.18 Cu.m of 12 mm size stone chippings at 52 kg per Cu.m.	9.5 kg
	(b) For 0.09 Cu.m of 10 mm size stone chippings at 56 kg per Cu.m	5.1 kg
		Total: 14.6 Kg.

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3.7.3 Construction Operation 3.7.3.1 Weather and Seasonal Limitations Open-graded premix carpet shall not be laid during rainy weather or when the base course is damp or wet or when the atmospheric temperature in shade is 16 Deg.C or below. 3.7.3.2 Preparation of Base The underlying base on which the bituminous carpet is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross section in accordance with Table I as directed by the Engineer. The surface shall be well cleaned by removing caked earth and other foreign matter with wire brushes, sweeping with brooms and finally dusting with sacks as necessary. 3.7.3.3 Tack Coat A tack coat complying with clause 3.5 shall be applied over the base preparatory to laying of the carpet. Application of tack coat shall, however, not be necessary when the laying of carpet follows soon after the provision of a bituminous course. 3.7.3.4 Preparation of Premix Mixers of approved type shall be employed for mixing the aggregates with the bituminous binder. The binder shall be heated to the temperature appropriate to the grade of bitumen approved by the Engineer, in boilers of suitable design avoiding local overheating and ensuring a continuous supply. The aggregates shall be dry and suitably heated to a temperature as directed by the Engineer before these are placed in the mixer. After about 15 seconds of dry mixing, the heated binder shall be distributed over the aggregates at the rate specified.		

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The mixing of binder with chippings shall be continued until the chippings are thoroughly coated with the binder. The mix shall be immediately transported from the mixer to the point of use in suitable vehicles or wheel barrows. The vehicles employed for transport shall be clean and be covered over in transit if so directed. 3.7.3.5 Spreading and Rolling The premixed material shall be spread on the road surface with rakes to the required thickness and camber or distributed evenly with the help of a drag spreader, without any undue loss of time. The camber shall be checked by means of camber boards and inequalities evened out. As soon as sufficient length of bituminous material has been laid rolling shall commence with 6 to 8 tonne power rollers, preferably of smooth wheel tandem type, or other approved plant. Rolling shall begin at the edges and progress toward the centre longitudinally, except that on the super elevated portions it shall progress from the lower to upper edge parallel to the centre line of the pavement When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding premixed materials. Rolling shall then be continued until the entire surface has been rolled to compaction and all the roller marks eliminated. In each pass of the roller, preceding track shall be overlapped uniformly by at least 1/3 width. The roller wheels shall be kept damp to prevent the premix from adhering to the wheels and being picked up. In no case shall fuel/lubricating oil be used for this purpose. Rollers shall not stand on newly laid material while there is a risk that it will be deformed thereby. The edges along and transverse of the carpet laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of appropriate binder before the new mix is placed against it. 3.7.3.6 Seal Coat A seal coat conforming to clause 3.8 shall be applied to the surface		

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immediately after laying the carpet. No traffic shall be allowed on the road till the seal coat has been placed. 3.8 <u>SEAL COAT</u> 3.8.1 Description This work shall consist of application of a seal coat for sealing the voids in a bituminous surface laid to the specified levels, grade and camber. Seal coat shall be of either of the two types below, as specified: Type A : Liquid seal coat comprising of an application of a layer of bituminous binder followed by a cover of stonee chippings. Type B : Premixed seal coat comprising of a thin application of fine aggregate premixed with bituminous binder. 3.8.2 Materials 3.8.2.1 Binder The binder shall be bitumen of a suitable grade as directed by the Engineer and conforming to the requirements of IS:73, 217 or 454 as applicable or any other approved cutback The quantity of binder to be utilised, in terms of straight run bitumen shall be 9.8 kg and 6.8 kg per 10 square metre area for Type A and Type B seal coat respectively. 3.8.2.2 Stone Chippings for Type A Seal Coat The stone chippings shall consist of angular fragments of clean, hard, tough and durable rock of uniform quality throughout. They shall be free of elongated or flaky pieces, soft or disintegrated stone, vegetable or other deleterious matter. Stone chippings shall be of 6 mm size defined as 100 percent passing through 10 mm sieve and retained on 2.36 mm sieve. The quantity used for spreading shall be 0.09 cubic metre per 10 square metre		

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area. The chippings shall satisfy the quality requirements spelled out in Table VI except that the upper limit for flakiness Index shall be 30. 3.8.2.3 Fine Aggregate for Type B Seal Coat The fine aggregate shall be sand or fine grit and shall consist of clean, hard, durable, uncoated dry particles and shall be free from dust, soft or flaky material, organic matter or other deleterious substances. The aggregate shall pass 1.7 mm sieve and be retained on 180 micron sieve. The quantity used for premixing shall be 0.06 cubic metre per 10 square metre area. 3.8.3 Construction Operations 3.8.3.1 Preparation of Base The seal cost shall be applied immediately after the laying of bituminous course which is required to be sealed. Before application of seal coat materials the surface shall be cleaned free of any dust or other extraneous matter. 3.8.3.2 Construction of Type A Seal Coat The binder shall be heated in boilers of suitable design, to the temperature appropriate to the grade of bitumen approved by the Engineer and sprayed on the dry surface in a uniform manner preferably with the help of mechanical sprayers. Excessive deposits of binder caused by stopping or starting of the sprayer or through leakage or any other reason shall be suitably corrected before the stone chippings are spread. Immediately after the application of binder, stone chippings in a dry and clean state, shall be spread uniformly on the surface, preferably by means of a mechanical gritter, otherwise manually so as to cover the surface completely. If necessary, the surface shall be broomed to ensure uniform spread of chippings. Immediately after the application of the cover material, the entire surface shall be rolled with a 8-10 tonne smooth wheeled roller. Rolling shall commence at the edges and progress towards the centre except in super elevated portions where it shall proceed from the inner edge to		

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the outer. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. While rolling is in progress additional chippings shall be spread by hand in whatever quantities required to make up irregularities. Rolling shall continue until all aggregate particles are firmly bedded in the binder and present a uniform closed surface. 3.8.3.3 Construction of Type B Seal Coat Mixers of approved type shall be employed for mixing the aggregates with the bituminous binder. The binder shall be heated in boilers of suitable design, to the temperature appropriate to the grade of bitumen approved by the Engineer. Also the aggregates shall be dry and suitably heated to a temperature directed by the Engineer before the same are placed in the mixer. Mixing of binder with aggregates to the specified proportions shall be continued till the latter are thoroughly coated with the former. The mix shall be immediately transported from the mixing plant to the point of use and spread uniformly on the bituminous surface to be sealed. As soon as sufficient length has been covered with the premixed material, the surface shall be rolled with 6-8 tonne smooth wheeled power rollers. Rolling shall be continued till the pre-mixed material completely seals the voids in the bituminous course and a smooth uniform surface is obtained. 3.8.4 Opening to Traffic In the case of Type B Seal coat, traffic may be allowed soon after final rolling when the premixed material has cooled down to the surrounding temperature. However, as regards Type a seal coat, traffic shall not be permitted until the following day. 3.9 <u>REPAIR OF EXISTING WATER BOUND MACADAM SURFACE</u> Pot holes or patches and ruts in water bound macadam base or surface course, which is to be surface treated, shall be repaired by removal of all		

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loose material by cutting in rectangular patches and replacing with suitable materials. The repair shall be done as under : Pot holes, patches and ruts shall be drained of water and cut to regular shape with vertical sides, and then be filled either with i) coarse aggregate and screenings conforming to the specification for water bound macadam and compacted with rollers or other approved rammer or ii) premixed material conforming to the specification for open graded premix carpet and compacted with rollers or other approved means after painting the sides and bottom of the holes with a thin application of bitumen or a combination of both as directed by the Engineer. The above is only applicable in case of damage to the existing water bound macadam surfaces. In case, however, it is found that there has been damage to the granular sub-base as well, the area of the damaged surface shall be repaired by removal of all loose materials, cut to regular shape with vertical sides and re-laid with graded material as per specification of granular sub-base and then surfaced with water bound macadam as per specification for the same. 3.10 <u>BITUMINOUS CONCRETE</u> 3.10.1 Scope This clause specifies the construction of bituminous concrete, for use in wearing and profile corrective courses. This work shall consist of construction in a single or multiple layers of bituminous concrete on a previously prepared bituminous bound surface. A single layer shall be 25 mm to 100 mm in thickness. 3.10.2 Materials (a) Bitumen The bitumen shall be paving bitumen of penetration grade complying with Indian Standard Specification for Paving Bitumen. IS:73 and of the penetration indicated in Table 500-18 of MORT&H, for bituminous concrete or this bitumen as modified by one of the methods specified in clause 521 of MORT&H, or as otherwise		

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specified in the contract. Guidance on the selection of an appropriate grade of bitumen is given in The Manual for Construction and Supervision of Bituminous Works. (b) Coarse Aggregates The coarse aggregates shall be generally as specified in clause 507.2.2 of MORT&H, except that the aggregates shall satisfy the physical requirements of Table 500-17 of MORT&H. (c) Fine Aggregates The fine aggregates shall be all as specified in clause 507.2.3 of MORT&H. (d) Filler Filler shall be generally as specified in clause 507.2.4 of MORT&H. Where the aggregates fail to meet the requirements of the water sensitivity test in Table 500-17 of MORT&H then 2 percent by total weight of aggregate, of hydrated lime shall be added without additional cost. (e) Aggregate grading and binder content When tested in accordance with IS:2386 Part 1 (Wet grading method), the combined grading of the coarse and fine aggregates and added filler shall fall Within the limits shown in Table 500-18 of MORT&H for gradings 1 or 2 as specified in the Contract. 3.10.3 Mixture Design (a) Requirements for the mixture Apart from conformity with the grading and quality requirements for individual ingredients, the mixture shall meet the requirements set out in Table 500-19 of MORT&H.		

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The requirements for minimum percent voids in mineral aggregate (VMA) are set out in Table 500-12 of MORT&H. (b) Binder content The binder content shall be optimised to achieve the requirements of the mixture Set out in Table 500-19 of MORT&H and the traffic volume as specified in the Contract. The Marshall method for determining the optimum binder content shall be adopted as described in the Asphalt Institute Manual MS-2, replacing the aggregates retained on the 26.5 mm sieve and retained on the 22.4 mm sieve, where approved by the Engineer. (c) Job mix formula The procedure for formulating the job mix formula shall be generally as specified in clause 507.3.3 of MORT&H and the results of tests enumerated in Table 500-19 of MORT&H as obtained by the Contractors. (d) Plant trials-permissible variation in job mix formula The requirements for plant trials shall be all as specified in clause 507.3.3 of MORT&H and the results of tests enumerated in Table 500-19 as obtained by the contractors. (e) Laying trials The requirements for plant trials shall be all as specified in clause 507.3.5 of MORT&H. 3.10.4 Construction Operations (a) Weather and seasonal limitations The provisions of clause 501.5.1 of MORT&H shall apply.		

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(b) Preparation of base The surface on which the bituminous concrete is to be laid shall be prepared in accordance with clauses 501 and 902 of MORT&H as appropriate, or as directed by the engineer. The surface shall be thoroughly swept clean by mechanical broom and dust removed by compressed air. In locations where a mechanical broom cannot access, other approved methods shall be used as directed by the engineer. (c) Tack coat Where specified in the Contract, or otherwise required by the Engineer, a tack coat shall be applied in accordance with the requirements of clause 503 of MORT&H. (d) Mixing and transportation of the mixture The provisions as specified in clauses 501.3 and 501.5.4 of MORT&H shall apply. (e) Spreading The general provisions of clauses 501.5.3 and 501.5.4 of MORT&H shall apply. (f) Rolling The general provisions of clauses 501.6 and 501.7 of MORT&H shall apply, as modified by the approved laying trials. 3.10.5 Opening to traffic The newly laid surface shall not be open to traffic for at least 24 hours after laying and the completion of compaction, without the express approval of the engineer in writing.		

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3.10.6 Surface finish and Quality control The surface finish of the completed construction shall conform to the requirements of clause 902 of MORT&H. All materials and workmanship shall comply with the provisions set out in section 900 of this specification. 3.10.7 Arrangements for traffic During the period of construction, arrangements for traffic shall be made in accordance with the provisions of clause 112 of MORT&H. 3.11 <u>ROAD SIDE DRAINS</u> 3.11.1 Formation of Drains The road side drains shall be made in sizes and slopes as shown on drawings and/or as instructed by the Engineer. The minimum side slope shall be as instructed by the Engineer. The sides and bottom shall be neatly dressed after excavation. Proper connections shall be made to the culverts, outside plant area, as per instructions of the Engineer. The excavated spoils shall be transported and filled in low areas within the plant area or in embankments as instructed by the Engineer. The lining for the drains shall be as per Dwg. and as mentioned in the Schedule of items. Lining of drains may be of bricks or cement concrete blocks of M15 grade concrete as shown on drawing or as directed by the Engineer. If instructed by the Engineer or shown on drawing, drains may be of R.C.C. construction with necessary slopes. 3.12 <u>CULVERTS</u> Excavation in trenches for foundation of culverts and wing walls shall be done with side slopes as per the instructions of Engineer after clearing the site, etc. as per specifications of earthwork. Backfilling with ramming and watering shall be done after construction of the foundations. The construction of culverts shall be done true to lines and levels and as shown on the drawing. The specification for Masonry and/or Plain and Reinforced Cement concrete shall be followed, as applicable.		

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3.13 <u>PIPE CULVERTS AND DRAINAGE PIPES</u> 3.13.1 Materials The drainage pipes unless otherwise shown on drawings or instructed by the Engineer shall be made of R.C.C. and shall be either Class NP2 or NP3. Pipe culverts shall be made of reinforced concrete pipe and shall be of class NP3 or of RDSO class for railway as decided by the Engineer or shown in the drawing. All pipes shall meet the requirements of IS: 458- Latest edition and shall be procured from approved manufacturers with collars as per manufacturer's standard specifications. The tendered shall specifically mention the particular manufacturer's product he proposes to use. Cement shall be ordinary Portland Cement as per IS:269,8112 - Latest edition. Aggregates shall be as per IS:383 - Latest edition - Maximum size shall not exceed one third the thickness of the pipe or 20 mm whichever is smaller. Fine aggregates for concrete shall be as per IS: 383 - Latest edition. 3.13.2 Laying of Pipes Laying of concrete pipes shall correspond to IS:783 - Latest edition – and to specification given below: (a) The foundation bed for pipe shall be excavated true to lines and grades shown on the drawings or as directed by the Engineer. When trenching is involved its width on either side of the pipe shall not be less than 150 mm nor more than one-third the diameter of pipe unless otherwise instructed/permitted by the Engineer. The sides of the trench shall be as nearly vertical as possible. Side slope, shoring, bailing out water, etc. as required shall be done by the Contractor without the Owner. Side slips, if there be any, shall be removed by the Contractor. After laying of the pipes are completed, backfilling of the trenches shall be done in 250 mm layers, measured loose, clods and lumps broken, watered and compacted with iron rammers to the satisfaction of the Engineer. The surplus		

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spoils shall be transported and filled in low areas within the plant area, as instructed by the Engineer. When bed-rock or boulder strata are encountered, excavation shall be taken down to at least 200 mm below the bottom level of the pipe with prior permission of the Engineer and all rock/boulders in the area shall be removed and space filled with approved earth free from stone or fragmented material, shaped to the requirements and thoroughly compacted to provide adequate support for the pipe. Filling of trench shall be carried out simultaneously on both sides of the pipe in such a manner that unequal pressures do not occur. When two or more pipes are to be laid adjacent to each other, they shall be separated by a distance equal to at least half the diameter of the pipe subject to a minimum of 450 mm. Laying of pipes shall start from the outlet and proceed towards inlet. All pipes and fittings shall be gradually lowered into the trench or placed on the supports by approved means taking due care not to damage them. Under no circumstances the pipes shall be dropped into the trench or on supports from a height. (b) Pipe bedding shall be first class projection bedding for positive projecting pipes as per IS:783 - Latest edition -having a projection ratio of not greater than 0.70, in which the pipe is carefully bedded on fine granular materials in an earth foundation carefully shaped to fit the lower part of the pipe exterior for at least ten percent of its overall height, and in which earth filling material is thoroughly rammed and tamped in layers not exceeding 15 cm in depth around the pipe for the remainder of the lower 30 percent of its height. If the pipe is laid in trench, pipe bedding shall be first class bedding as per IS:783. When indicated on the drawings or directed by the Engineer, the pipe shall be bedded on a cradle constructed of concrete having a		

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mix not leaner than M15. The shape and dimension of the cradle shall be as indicated on the drawing or directed by the Engineer. The pipe shall be laid on the concrete bedding before the concrete has set. (c) The drop walls shall be made with first class brickwork in 1:4 cement mortar. (d) The pipe culverts shall be made with proper care regarding the invert of the pipe, gradient, if any, etc. as specified on drawings and/or as instructed by the Engineer. (e) Where R.C.C. pipes are encased in concrete at road crossings or at other places the pipes need be suitably supported avoiding reinforcements of concrete blocks, joints properly done before concreting is taken up. Concreting of total height of block may be done in a single operation or may be done up to some height for pipes to be properly laid in position and remaining height of block to be concreted subsequently. (f) The R.C.C. pipes shall be joined with cement mortar. Cement mortar shall consist of 1 part cement and 2 parts of clean sand with only enough water for workability. Procedure of jointing shall be as per IS: 783 - latest edition. 3.13.3 Relation with Water Supply Pipeline Unless specifically cleared by the Engineer, under no circumstances shall drainage pipes be allowed to come close to water supply pipelines. 3.14 Manholes and Inspection Chambers The maximum distance between manholes shall be 30 meter unless specifically permitted otherwise. In addition at every change of alignment, gradient or diameter there shall be a manhole or inspection chamber. The distance between manhole or inspection chamber and gully chamber shall not exceed 6 meters unless permitted otherwise. Manhole shall be constructed so as to be water-tight under test. The channel or drain at the bottom of chamber shall be plastered with 1:2 cement sand mortar and finished smooth to the grade. The channels and drains shall be shaped and		

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laid to provide smooth flow.

Connection to existing pipelines shall be through a manhole Manholes shall be provided with standard covers, usually C.I. or as directed by the Engineer. The covers shall be close fitting so as to prevent gases from coming out.

3.15 MASONRY

3.15.1 Brick Masonry

All bricks shall be of first class (Class A) quality, well burnt, of uniform size, shape and colour free from cracks, flaws or nodules of free lime. Bricks shall be soaked in water for at least two hours prior to use and shall be laid truly horizontal and vertical in headers and stretchers with cement mortar consisting of one part of cement and four parts of sand, unless otherwise mentioned in the schedule of Items or directed by the Engineer, in layers not exceeding 1.5 M in height. Each layer shall be allowed at least 24 hours to settle itself before another layer is placed on it and every layer cured with water until the starting of next layer above it.

Materials for mortar such as sand and cement shall be of approved quality. Mortar shall be well mixed, first dry mixed and then by adding water slowly to have a thick workable consistency. Mortar shall be mixed in small batches consistent with the rate of consumption so that no mortar is used after one hour of mixing.

Mortar joints shall be kept uniformly 10 mm thick and all joints should be full of mortar. Brickwork shall be carried up regularly in plumb every course being horizontal. No vertical joints shall come directly over one another.

Joints of the brickwork shall be raked minimum 10 mm deep using raking tool while mortar is still green to provide bond for plaster or pointing. Where plaster or pointing is not provided, the joints shall be struck flush and finished immediately. The brickwork shall be kept moist for 14 days.

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All bricks which absorb water more than 20% of their own dry weight after being immersed in water for 24 hours shall be rejected. Brick should be as per IS: 1077. Bricks shall have minimum crushing strength of 50 kg/Sq.cm 3.15.2 Stone Masonry All stones shall be from approved quarries, hard, tough, durable, compact grained, uniform in texture and colour and free from decay, flaws, veins, cracks and sand holes. A stone shall not absorb more than 5 percent of its weight of water after 24 hours immersion. Samples shall be submitted by the Contractor and approved samples shall be retained by the Engineer for comparison of bulk supply. Stone shall be thoroughly soaked before laying. Stones shall be laid on their natural quarry beds. Individual stones shall be fitted with mallet and properly wedged to reduce thickness of mortar joints. Thickness of joint shall not be less than 8 mm and not greater than 25 mm. At least two stones shall run the full width of the wall for every square meter of surface area. 3.15.3 Pointing to Masonry After raking out of the joints, the brickwork shall be brushed down with a stiff wire brush, so as to remove all loose dust from the joints and thoroughly washed with water, mortar consisting of 1 part cement and 3 parts clean, sharp, well graded sand by volume shall be pressed carefully into the joints and finished with suitable tools to shape as shown on the drawings. Any surplus mortar shall be scraped off the wall face leaving the surface clean. The pointed surface shall be kept wet for at least three days for curing. 3.16 <u>PLASTER TO MASONRY AND CONCRETE</u> Before application of plaster the surface shall be cleaned of all dirt, grease or loose particles by hard brush and water. The surface shall be thoroughly moist to prevent absorption of water from the base course. Any excess water shall be mopped up. Unless otherwise mentioned in the schedule of items plastering shall be done with cement sand mortar - 1 part by volume of cement to 4		

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3.16.1	parts by volume of clean, sharp, well graded sand. For sand cement plaster, sand and cement in the specified proportion shall be mixed dry on a watertight platform and minimum water added to achieve working consistency. For lime gauge plaster, lime putty or hydrated lime and sand in the required proportion shall be mixed on a watertight platform with necessary addition of water and thoroughly ground in mortar mill. This mix shall than be transferred to a mechanical mixer to which the required quantity of cement is added and mixed for at least 3 minutes. No mortar which has stood for more than half an hour shall be used. Plaster, when more than 12 mm thick, shall be applied in two coats. All plaster work shall correspond to IS: 1661- latest edition. Generally, all plastered surfaces shall have a standard finish unless otherwise shown on the drawing or directed by the Engineer. The interior plaster shall be finished to a smooth surface by steel trowelling. The exterior surfaces shall be finished with a wooden float. However, if shown on the drawing or directed by the Engineer the plastered surface shall have a neat cement finish. Immediately after achieving a true plastered surface with the help of a wooden straight edge, the entire area shall be uniformly treated with a paste of neat cement at the rate of one (1) kg per Sq.M. and rubbed smooth with a trowel 3.17 <u>CEMENT CONCRETE (PLAIN AND REINFORCED)</u> Shall be as laid down in "Technical Specification for Cement Concrete (Plain and Reinforced)" Section - III. 4.0 <u>TESTING AND ACCEPTANCE CRITERIA</u> 4.1 <u>ROADS</u> All testing, as mentioned in the body of the specification and as mentioned in Clause No. 900 of Specification for Roads and Bridge Works, 1983 published by IRC on behalf of Ministry of Shipping and Transport (Roads Wing) shall be carried out by the Contractor as per direction of the	

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Engineer. No extra payment shall be made for such tests. 4.2 <u>MASONRY AND PLASTERING</u> Masonry and finish to masonry and concrete shall fully comply with the drawings, approved samples and instructions of the Engineer with respect to lines, levels, thickness and any other special criteria as mentioned in the body of the specification or as shown on drawing. 4.3 <u>CEMENT CONCRETE</u> The strength requirements and acceptance criteria shall conform to the relevant clauses of IS:456.		

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1.0 <u>SCOPE</u> This specification covers all work required for the construction of concrete road including box-cutting, edging, sub-base, sub grade, unreinforced / reinforced concrete pavement include all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work. This specification also includes all work required for drainage including road side drain, R.C.C. culverts, pipe-culverts, drainage pipes, manholes etc. and all other incidental items. 2.0 <u>GENERAL</u> 2.1 <u>WORK TO BE PROVIDED FOR BY THE CONTRACTOR</u> The work to be provided for by the Contractor, unless specified otherwise, shall include but not be limited to the following: (a) Furnish all labour, supervision, services, materials, equipment, tools and plants, transportation etc. required for the work. (b) Submit for approval detailed schemes of all operations required for executing the work e.g. material handling, placement, services, approaches etc. (c) To carry out and submit to the Engineer results of tests whenever required by the Engineer to assess the quality of work. 2.2 <u>WORK TO BE PROVIDED FOR BY OTHERS</u> No work under this specification will be provided for by any agency other than the Contractor unless specifically mentioned elsewhere in the Contract.		

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2.3 <u>CODES AND STANDARDS</u> All work under this specification, unless specified otherwise, shall conform to the latest revision and/or replacements of the following or any other relevant I.S. Specifications and Codes of Practice. (a) Specification for road and bridge works of Ministry of shipping & Transport (Roads wing) Published by the IRC. (b) IRC: 58 Guidelines for the design of Rigid Pavements for highways (c) IRC: SP-11 Hand Book of Quality Control for Construction of Roads and Runways. (d) IS:456 Indian Standard Code of Practice for Plain and Reinforced Concrete. (e) IS: 2212 Code of Practice for Brickwork. (f) IS: 783 Code of Practice for Laying of Concrete Pipes. (g) IRC: 15 Standard Specifications and Code of Practice for Construction of Concrete Roads. In case any particular aspect of work is not covered specifically by Indian Standard Specification, any other standard practice as may be specified by the Engineer shall be followed. 2.4 <u>CONFORMITY WITH DESIGNS</u> The contractor shall carryout the work as per the drawings issued to him and/or contractor's drawings which are approved by the Engineer and/or the Engineer's instructions. 2.5 <u>MATERIALS TO BE USED</u> 2.5.1 General		

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2.5.2	All materials required for the work shall be of best commercial variety and as approved by the Engineer. Quality Control The Contractor shall establish and maintain quality control for the various aspects of the work, method, materials and equipment used. All works performed shall conform to the lines, grades, and cross sections and dimensions shown on the drawings or as directed by the Engineer. Permitted tolerances for road works are described hereinafter. (a) Horizontal Alignments Horizontal alignments shall be reckoned with respect to the centre line of the carriageway as shown on the drawings. The edges of the carriageway as constructed shall be correct within a tolerance of ± 25 mm there from. The corresponding tolerance for edges of the roadway and lower layers of pavement shall be ± 40 mm. (b) Longitudinal Profile The levels of the sub grade and different pavement courses as constructed, shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings or as directed by the Engineer, beyond tolerances mentioned below : Sub-grade ± 25 mm Sub-base ± 20 mm 3.0 <u>EXECUTION</u> 3.1 <u>SHOULDER CONSTRUCTION</u> 3.1.1 Description This work shall consist of constructing shoulders on either side of the pavement, accordance with the requirements of this specification	

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3.1.2 3.1.3 3.2 3.2.1	and in conformity with the lines, grades and cross- sections shown on the drawings or as directed by the Engineer. Materials Shoulder may be of selected earth or granular material conforming to the requirements of embankment construction or granular sub- base construction respectively. Hard Shoulders shall be 80mm thick PCC interlocking blocks(grade M-35) over PCC M-7.5 with sand bedding on an under-bed of 150mm thick WBM on either side of the roads. Precast Kerb stone, for construction of shoulder, shall be of precast concrete blocks having a concrete grade of M-25. The blocks shall be 100 mm wide and of suitable length and depth Construction Operations Except in the case of bituminous constructions, shoulders shall be constructed in advance of the laying of pavement courses. The compacted thickness of each layer of shoulder shall correspond to the compacted layer of pavement course to be laid adjacent to it. After compaction, the inside edges of shoulders shall be trimmed vertical and included area cleaned of all spilled material before proceeding with the construction of the pavement layer. Regardless of the method of lying, all shoulder construction material shall be placed directly on the shoulder. Any spilled material dragged on to the pavement surface shall be immediately removed, without damage to the pavement and the area so affected thoroughly cleaned. During all stages of shoulder construction, the required cross fall shall be maintained to drain off surface water. KERB Material Kerb, if required for construction of footpath, shall consist of precast concrete blocks with a concrete grade of M-15. The blocks shall be 100 mm	

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3.2.2	wide and of suitable length. The depth of blocks unless otherwise mentioned elsewhere, shall be 375 mm considering 225 mm height of footpath from the road level Laying The Kerb shall be laid by cutting trenches 150 mm deep. The width of the trench shall be minimum and just sufficient to insert the kerbs. The inside faces of the Kerbs shall be in plumb and the gap between the block shall not be more than 10 mm. The kerbs shall be thoroughly packed with a mixture of stone chips (50%) and moorum (50%) at the outside face. The laying and packing shall be done in a proper workmanlike manner acceptable to the Engineer. 3.3 <u>SUB-BASE (GRANULAR SUB-BASE)</u> 3.3.1 Description This work shall consist of laying and compacting well-graded material on prepared sub grade in accordance with the requirements of these specifications. The material shall be laid in one or more layers as shown on the drawings and according to lines, grades and cross sections shown on the drawings or as directed by the Engineer. 3.3.2 Materials The materials to be used for the work shall be natural sand, moorum, gravel, crushed stone, crushed slag, crushed concrete, brick metal, laterite, kanker etc. or combinations thereof depending upon the grading required. The mixed materials shall be free from organic or other deleterious constituents and conform to one of the three grading given in Table-I below	

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TABLE-I**GRADING FOR GRANULAR SUB-BASE MATERIALS**

Sr. No.	Sieve designation	Percent by weight passing the sieve		
		Grading 1	Grading 2	Grading 3
1.0	80 mm	100	100	100
2.0	63 mm	90-100	90-100	90-100
3.0	4.75 mm	35-70	40-90	50-100
4.0	75 micron	0-20	0-25	0-30
5.0	CBR Value (Minimum) for fraction of material passing 20 mm sieve	30%	25%	20%

Note: The material passing 425 micron sieve for all the three grading when tested according to IS: 2720 (Part V) shall have liquid limit and plasticity index of not more than 25 percent and 6 percent respectively.

3.3.3 Physical Requirements

The fraction of material passing 20 mm sieve shall give a CBR value as specified in Table-II when tested in accordance with IS:2720 (Part XVI) after preparing the samples at maximum dry density and optimum moisture content corresponding to IS:2720 (Part VII) and soaking the same in water for 4 days.

3.3.4 Spreading and Compacting

Immediately prior to the laying of sub-base, the sub grade already finished shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water, if necessary, and rolled with one pass of 8-10 tonne smooth wheeled roller.

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The sub-base material shall be spread on the sub grade with the help of a drag spreader, motor grader or other approved means. The thickness of loose layers shall be so regulated that the maximum thickness of the layer after consolidation does not exceed 150 mm. Moisture content of the loose material shall be checked in accordance with IS: 2720 (Part II) and suitably adjusted by sprinkling additional water from a hose line, truck mounted water tank or other approved means so that at the time of compaction it is from 1 percent above to 2 percent below the optimum moisture content corresponding to IS: 2720 (Part VIII). While adding water due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means if so directed by the Engineer until the layer is uniformly wet. Immediately thereafter, rolling shall be started with 8 to 10 tonne smooth wheeled rollers or other approved plant. Rolling shall commence at the edges and progress towards the centre longitudinally except that on super elevated portions it shall progress from the lower to the upper edge parallel to the centre line of the pavement. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. During rolling the grade and camber shall be checked and any high spots or depressions which become apparent corrected by removing or adding fresh material. Rolling shall be continued till the density achieved is at least 100% of the maximum dry density for the material determined as per IS:2720 (Part VII). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction plant and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted. 3.4 <u>CEMENT CONCRETE (PLAIN AND REINFORCED)</u> 3.4.1 General All concrete work shall be according to ISI relevant Codes unless mentioned		

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otherwise herein and the ISI Codes particularly IS:226, IS:455, IS:385, IS:1786 & IS:456 latest editions shall form a part of the present specification. 3.4.2 Materials (a) Cement : The cement used shall be ordinary Portland cement/ Blast Furnace slag cement/ Portland Pozzolana cement, sulphate resistant cement of approved manufacture and shall be fresh when delivered. Consignments shall be used in the order of delivery. Damaged or partly set cement shall not be permitted to be used and shall be removed from site at once. Admixture shall be used only if approved by the Engineer. The Contractor shall furnish to the Engineer, the manufacturer's certificate for cement for each consignment, procured by the Contractor direct. If at any time, the Engineer feels that the quality of cement is not upto the specification, he can stop the work and send samples of cement for testing to an approved laboratory. The Contractor shall have no claim for any loss arising out of such suspension of work. If the cement is procured by the Owner and issued to the Contractor, the Contractor shall satisfy himself at the time of taking delivery that quality and freshness of cement are upto the specified standard. No complaint will be entertained later on from the Contractor for poor concrete work due to the poor quality of cement supplied by the Owner. All rectification work on this account shall be done entirely by the Contractor at his own expenses (b) Aggregate : (i) General Aggregate shall consist of natural sand, crushed stone procured from a source known to produce satisfactory aggregate for concrete and shall be chemically inert strong,		

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hard, durable against weathering, of limited porosity and free from adhering coatings, clay lumps, coal and coal residues, clinkers, slag, organic and other impurities that may cause corrosion of the reinforcements or may impair the strength and/or durability of the concrete. They shall conform to IS: 383 - latest edition. (ii) Sand and Fine Aggregate : It shall be clean, sharp and coarse and free from all impurities and shall be washed and/or screened at the site if so demanded by the Engineer. Sand and fine aggregate shall correspond to IS: 383 - latest edition. The fine aggregate shall not contain more than 3 percent of clay or foreign matter. Fineness modulus of sand shall not be less than 2.5. (iii) Coarse Aggregate: This shall consist of broken trap, basalt or granite or some other suitable stone from a source to be approved by the Engineer and shall meet the requirements of IS: 383 - latest edition. The coarse aggregate shall be machine crushed, hard, strong, durable, free from clayey films or loamy admixtures, vegetable or organic matters and shall be washed with water and/or screened if so demanded by the Engineer. The aggregate shall be well graded. The pieces shall be angular in shape and shall have granular or crystalline surface. Friable, flaky and laminated pieces, mica and shell may be present only in such quantities that will not affect adversely the strength and/or durability of concrete and to the approval of the Engineer. The maximum size of coarse aggregate shall be 38 mm for lean concrete and M10 Grade concrete and 20 mm for M15 Grade concrete. Where permitted by the Engineer, the maximum size of the coarse aggregate may be large. All aggregate shall be uniformly graded. The amount of fine particles occurring in the Free State or as loose adherent shall not exceed 1% when determined by laboratory sedimentations tests. After 24 hours		

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immersion in water, a previously dried sample shall not have gained more than 10% of the weight. (c) Water : Water shall be clean, fresh and free from organic or deleterious matter in solution or in suspension in such amounts that may impair the strength or durability of the concrete. The Contractor shall, however, satisfy himself that the quality is upto the desired standard and shall also submit an analysis from an approved analyst if so desired by the Engineer, free of charge. (d) Reinforcements : The reinforcement shall be mild or to steel bars conforming to the latest edition of IS: 432 or IS: 1786. All reinforcing bars must be completely free from grease, oil, dirt, scales, scrap able rust, bituminous material, paint, pitted surface and manufacturing defects. (e) Tie bars. Tie bars in longitudinal joints shall be deformed steel bars of strength 415 Mpa complying with IS: 1786 and in accordance with the requirements given below. The bars shall be free from oil, dirt, loose rust and scale. Design of tie bar shall be as per IRC: 58. (i) Tie bars projecting across the longitudinal joint shall be projected from corrosion for 75mm on each side of the joints by a proactive coating of bituminous paint with the approval of the Engineer. The coating shall be dry when the tie bars are used. (ii) Tie bars in longitudinal joints shall be made up into rigid assemblies with adequate supports and fixings to remain firmly in position during the construction of slab. Alternatively, tie bars at longitudinal joints may be mechanically or manually inserted into the plastic concrete		

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from the above by vibration using a method which ensure correct placement of bars and reoccupation of the concrete around the tie bars. (iii) Tie bars shall be positioned to remain within the middle third of the slab depth as indicated in the drawing and approximately parallel to the surface and approximately perpendicular to the line of joints, with the centre of each bars on the intended line of the joints within a tolerance of ± 50 mm, and with a minimum cover of 30mm below the joint groove. (f) Separation Membrane. Separation membrane shall be used between the concrete slab and the sub base. Separation membrane shall be impermeable plastic sheeting 125 micron thick laid flat without creases. Before placing the separation membrane, the sub base shall be swept clean of all the extraneous materials using air compressor. Wherever overlap of plastic sheets is necessary, the same shall be at least 300mm and any damaged sheeting shall be replaced at the Contractors expense. The separation membrane may be nailed to the lower layer with concrete nail. (g) Joints The location and type of joints shall be shown in the drawing. The location of the joints should be transferred accurately at the site and mechanical saw cutting of joints done as per stipulated dimensions. It should be ensured that the full required depth of cut is made from edge to edge of the pavement. Transverse and Longitudinal joints in the pavement and sub base shall be staggered so that they are not coincident vertically and are at least 1m and 0.3m apart respectively. Sawing of joints shall be carried out with diamond studded blades soon after the concrete has hardened to take the load of the sawing machine and personal without damaging the texture of the pavement. Sawing operation could start as early as 6-8 hours depending upon the season. All joints shall be designed as per IRC: 58.		

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(h) Transverse joints. Location of construction joints/ expansion joints shall be as per drawing. Transverse joints shall be straight within the following tolerance along the intended line of joints which is the straight line transverse to the longitudinal axis of the carriageway at the position proposed by the Contractor and agreed to by the Engineer, except at the junction or roundabouts where the position shall be as described in the drawing. (i) Deviations of the filler board in the case of expansion joints from the intended line of the joint shall not greater than $\pm 10\text{mm}$. (ii) The best fit straight line through the joints grooves as constructed shall not more than 25mm from the intended line of the joint. (iii) Deviations of the joint groove from the best fit straight line of the joint shall not be greater than 10mm. (iv) Transverse joints on each side of the longitudinal joint shall be in line with each other and of the same type and width. (i) Longitudinal joints. The longitudinal joints shall be saw cut as per details of the joints shown in the drawing. The groove may be cut after the final set of the concrete. Joints should be sawn to at least $1/3$ the depth of the $\pm 5\text{mm}$ as indicated in the drawing. (i) Dowel bars Dowel bars shall be mild steel rounds in accordance with details/ dimensions as indicated in the drawing and free from oil, dirt, loose rust or scale. They shall be straight free of irregularities and burring restricting slippage in concrete. The sliding ends shall be sawn or cropped clearly with no protrusions outside the normal diameter of the bar. The dowel		

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bar shall be supported on cradles/dowels chairs in pre-fabricated joint assemblies positioned prior to the construction of the slabs or mechanically inserted with vibration into the plastic concrete by a method which ensures correct placement of the bars besides full reoccupation of the concrete around the dowel bars. Unless shown otherwise on the drawings, dowels bars shall be positioned at mid depth of the slab within a tolerance of $\pm 20\text{mm}$, and cantered equally about intended lines of the joint within a tolerance of $\pm 25\text{mm}$. Dowel bars shall be covered by a thin plastic sheath for at least two thirds of the length from one end for dowels bars in contraction joints or half the length plus 50mm for expansion joints. The sheath shall be tough, durable and of an average thickness not greater than 1.25mm. For expansion joints, a closely fitting cap 100mm long consisting of waterproofed cardboard or an approved synthetic material like PVC or GI pipes shall be placed over the sheathed end of each dowel bar. An expansion space at least equal in length to the thickness of the joint filler board shall be formed between the end of the cap and the end of the dowel bar by using compressible sponge. To block the entry of the cement slurry between dowels and cap it may be taped. Design of dowel bars shall be as per IRC: 58. (j) Joint sealing compound. The joint sealing compound shall be hot poured, electrometric type or cold polysulphide type having flexibility, resistance to age hardening and durability. If the sealant is of hot poured type it shall confirm to AASHTO M282 and cold applied sealant shall be in accordance with BS5212 (PART 2).		

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3.4.3 Storage of Materials (a) Cement : Cement shall be stored at the works in such a manner as to prevent deterioration either through moisture or intrusion of foreign matter. Sufficient storage shall be arranged by the Contractor to ensure continuity of consumption. Cement shall be stored in easily countable stacks of minm. Cap. 2000 M.T (b) Aggregates : Aggregates shall be stored on planking, steel plates or concrete. Different sizes shall be separated with wooden, steel, or concrete bulkheads. Care shall be taken to prevent any segregation of various sizes of particles. The aggregates must not be allowed to come in contact with dirt, clay and other injurious substances at any stage. The aggregate shall be stored in easily measurable stacks. Procurement must be at least two months in advance of consumption in dry season and four months in advance in rainy season. (c) Reinforcement : Reinforcing steel shall be stored as far as possible under cover. It shall be protected from oil, grease, dirt, etc. The stacks shall be easily measurable. 3.4.4 Workmanship (a) Reinforcement (i) Bending : Reinforcement bars shall be bent by machine or other approved means producing a gradual and even motion. All the bars shall be cold bent unless otherwise approved. Bars correctly bent only will be used. Bends and shapes shall comply strictly with the dimensions in the approved bar bending schedule. Bending schedule shall be prepared by the Contractor and got		

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approved by the Engineer before bending and he shall be entirely responsible for its correctness. No reinforcement shall be bent when in position in the work without approval of the Engineer, whether or not it is partially embedded in concrete. Unless described otherwise, lapping dimensions shall conform to IS:456 - latest edition and all bending shall correspond to IS:2502 - latest edition. (ii) Placing in Position : Fixing of reinforcement shall correspond to IS: 2502 - latest edition. Reinforcements shall be accurately fixed and maintained in position by such means as mild steel chairs and concrete spacer pieces, Bars intended to be in contact at passing points shall be securely bound together at all such points by No. 20G annealed soft iron wire conforming to IS:280 - latest edition. Binders and the like shall tightly embrace the bars with which they are intended to be in contact and shall be securely bound. The vertical distances between successive layers of bars shall be maintained by provision of mild steel spacer bars at such intervals that the main bars do not sag perceptibly between adjacent spacer bars. The placing of reinforcement shall be completed well in advance of concreting immediately before concreting; the reinforcement shall be examined for accuracy of placing and cleanliness by the Engineer and corrected if it is so desired by him. The cover for concrete over the reinforcements shall be as shown or as specified on the approved drawings. Unless otherwise directed, all laps shall be minimum 52 times the diameter of the bar in case of H.T. deformed bar and 40 times diameter of the bar in case of mild steel. If the bars in a lap are not of same diameter, the smaller will guide the lap length. The Where concrete blocks are used for ensuring the cover and position, they shall be made of mortar not leaner than one (1) part cement to two (2) parts sand and cured for at least seven days.		

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(b) Formwork : The formwork shall conform to the shape, line and dimensions as shown on the plans and shall be made of timber close and tight to prevent leakage of mortar with necessary props, bracings and wedges sufficiently strong and stable so that it should not yield on laying of concrete. Formwork shall conform to IS: 456 - latest edition - in respect of above and stripping time, cleaning and oiling, etc. (c) Concrete : Mix: The following concrete mixes shall be used for concrete roads. Grade M15 with minimum cement content of 325 kg/cum shall be used for DLC layer below PQC and minimum grade of M35 with minimum cement content of 360 kg/cum shall be used for PQC. (i) Water cement ratio and slump shall be determined to suit strength requirements of the concrete mix. (ii) Mixing : The aggregate and sand shall be washed free from all dust and earthy matter if required by the Engineer. The above materials will then be accurately measured in boxes. The quantity of cement shall be determined by weight. The quantity of water shall be predetermined after allowing for moisture content in the aggregate. All the ingredients as proportioned shall then be mixed in a mechanical mixer till the mass is uniform in texture and consistency, but in no case the mixing time shall be less than two minutes. Hand mixing if permitted by the Engineer as a special case shall be carried out on a water tight platform using 10% extra cement at Contractor's cost and care shall be taken to ensure that the mixing is continued till the mass is uniform in colour and consistency.		

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(iii) Placing and Compacting : Concrete shall be transported from the place of mixture to the place of final deposit within 45 minutes after water has been added and shall be compacted before initial setting commence and should not be subsequently disturbed. Method of transporting and placing shall be such as to preclude segregation. Concrete shall be thoroughly worked around the reinforcements, etc. and into all corners of formwork. For compaction of concrete, mechanical vibrators shall be used. Concrete shall not be placed in water. Mixing, transporting, placing and compacting of concrete shall conform to IS:456 - latest edition. (iv) Curing : Concrete shall be cured for at least 28 days from the date of placing of concrete. (v) Testing of Concrete : Concrete shall be tested in accordance with IS:516 - latest edition and accepted in accordance with IS:456 - latest edition. 4.0 <u>TESTING AND ACCEPTANCE CRITERIA</u> 4.1 <u>ROADS</u> All testing, as mentioned in the body of the specification and as mentioned in Clause No. 900 of Specification for Roads and Bridge Works, 1983 published by IRC on behalf of Ministry of Shipping and Transport (Roads Wing) shall be carried out by the Contractor as per direction of the Engineer. No extra payment shall be made for such tests.		

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4.2 <u>MASONRY AND PLASTERING</u> Masonry and finish to masonry and concrete shall fully comply with the drawings, specifications, approved samples and instructions of the Engineer with respect to lines, levels, thickness and any other special criteria as mentioned in the body of the specification or as shown on drawing. 4.3 <u>CEMENT CONCRETE</u> The strength requirements and acceptance criteria shall conform to the relevant clauses of IS: 456.		

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1.0 <u>SCOPE</u> This specification covers furnishing, installation, repairing, finishing, curing, protection, maintenance and handing over of masonry and allied works for use in structures and locations covered under the scope of the Contract. 2.0 <u>INSTALLATION</u> 2.1 <u>SOLING</u> 2.1.1 Brick Soling The ground shall be dressed, consolidated by ramming or by light rolling and a 12 mm thick cushion of sand laid. On the sand cushion the bricks shall be laid with fine joints and placed firmly in position by hammering with wooden mallet. The surface shall be free from undulations. The 'frog' side shall be on the underside. The joints shall be broken the in all direction and bricks cut as required. Orientation shall be as desired by the Engineer. After laying of each layer of bricks sand shall be spread over and worked into the joints to pack the bricks tight. 2.1.2 Stone Soling The stones for soling shall be selected on the basis of thickness of soling as shown as the drawings. The larger stones shall be laid and the gaps filled by smaller stones. The interstices shall then be firmly packed with sand by flooding with water. 2.2 <u>BRICK EDGING</u> Excavation shall be done close to the brick dimensions and in perfect alignment. Bricks shall be firmly placed by hammering with wooden mallets and sides and joints packed firmly with earth so that the edging is not disturbed easily. Alignment and level shall be acceptable to the Engineer.		

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2.3 <u>MASONRY</u> 2.3.1 All masonry work shall be true to lines and levels as shown on drawings. All masonry shall be tightly built against structural members and bonded with dowels, inserts etc. as shown on drawings. 2.3.2 Mortar Mix for mortar shall be specified in the Schedule of Items. When lime is used hydrated lime shall be mixed with water to form putty and stored with care to prevent evaporation for at least 24 hours before use. Quick lime shall be slaked with enough water to make a cream, passed through a No. 10 sieve and stored avoiding evaporation for seven days before use. Lime putty and sand in proper proportion shall be mixed on a water-tight platform with necessary addition of water and thoroughly ground in a mortar mill. This mix shall be transferred to a mechanical mix, required quantity of cement added and the content mixed for at least 3 minutes. Mixtures of lime putty and sand may be stored avoiding drying out. For cement sand mortar cement and sand in requisite proportions shall be mixed dry in a mechanical mixer and then water added and mixed further. Minimum quantity of water shall be added to achieve working consistency. Surplus mortar droppings from masonry, if received on surface free from dirt may be mixed with fresh mortar if permitted by the Engineer who may direct addition of additional cement. No mortar which has stood for more than half an hour shall be used. 2.3.3 Brick Masonry Bricks shall be soaked by submergence in clean water for at least two hours in approved vats before use. Bricks shall be laid in English bond unless specified otherwise. Broken bricks shall not be used. Cut bricks shall be used if necessary to complete bond or as closers. Bricks shall be laid with frogs upwards over full mortar beds. Bricks shall be pressed into mortar and tapped into final position so as to embed fully in mortar. Inside faces shall		

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be buttered with mortar before the next bricks is placed and pressed against it. Thus all joints between bricks shall be fully filled with mortar. Mortar joints shall be kept uniformly 10 mm thick. All joints on face shall be raked to minimum 10 mm depth using raking tool while the mortar is still green to provide bond for plaster or pointing. Where plaster or pointing is not provided, the joints shall be struck flush and finished immediately. Brickworks two bricks thick or more shall have both faces in true plane. Brickwork of lesser thickness shall have one selected face in true plane. 2.3.4 Exposed Brickwork Brickwork in superstructures which is not covered by plaster shall be as shown on drawing and executed by specially skilled mason. Courses shall be truly horizontal and vertical joints truly vertical. Wooden straight edges with brick course graduations and position of window sills and lintels shall be used to control uniformity of brick courses. Masons must check workmanship frequently with plumb, spirit level, rule and string. All brickwork shall be cleaned at the end of days work. If face bricks are specified in the drawings, the brickwork shall be in composite bricks, with face bricks on the exposed face and balance in routine bricks, but maintaining the bond fully. Where face bricks are not specified, bricks for the exposed face shall be specially selected from routine bricks. All exposed brickwork on completion of work shall be rubbed down, washed clean and pointed as specified. Where face bricks are used carborandum stone shall be used for rubbing down. 2.3.5 Reinforced Brickworks Reinforcements shall be as specified in the drawings. All reinforcements shall be thoroughly cleaned and fully embedded in mortar. Where M.S. bars are used as reinforcement, these shall be lapped with dowels if left in R.C. columns or welded to steel stanchions.		

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2.3.6 Stone Masonry Stones shall be thoroughly soaked before laying. Stones shall be laid on their natural quarry beds. Individual stones shall be fitted with mallet and properly wedged to reduce thickness of mortar joints. Thickness of joint shall be not less than 8 mm and not greater than 25 mm. At least two stones shall run the full width of the wall for every square meter of surface area. 2.3.7 Exposed Stonework Stonework which is to be kept exposed shall be as shown on drawing or described in the Schedule of Items. It shall be executed by specially skilled mason. Stones used for exposed face shall be specially selected. All exposed stone faces shall be kept clean and free from mortar and pointed up neatly as the work proceeds in a manner called for in the drawings or instructions. A sample wall, 10 sq.m. in area shall be built and approved by the Engineer and all works shall match with this sample. 2.3.8 Composite Masonry Where stonework facing with brick masonry backing is specified the bond between them shall be achieved by bond stones of dimensions and frequency as desired by the Engineer. 2.3.9 Expansion & Separation Joints Location of joints shall strictly be as shown on drawings or as instructed by the Engineer. Expansion joints shall be as shown on drawings. Expansion joint filler boards and sealing strips shall have minimum transverse joints. Transverse joints shall meet the approval of the Engineer. Separation joints shall be with standard water proof paper or with alkathene sheets about 1 mm in thickness. Length and sealing of laps shall be to the satisfaction of the Engineer		

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2.3.10 Mouldings, Cornices, Drip Course These shall be made as shown in drawings. Bricks or stone shall be cut and dressed as required. If no subsequent finish is envisaged, these shall be rubbed to correct profile with carborandum stone. 2.3.11 Curing Masonry shall be cured by keeping it wet for seven days from the date of laying. In dry weather at the end of days work top surface of masonry shall be kept wet by ponding. 2.3.12 Embedding of fixtures All fixtures shall generally be embedded in mortar and masonry units shall be cut as required. 2.3.13 Encasing of Structural Steel This shall be done by building masonry work round flanges, webs etc. and filling the gap between steel and masonry by minimum 12 mm thick mortar. Encased members shall be wrapped with chicken wire mesh when shown on drawings or instructed by the Engineer. The minimum lap in chicken wire mesh shall be 50 mm. 2.4 <u>DAMP PROOF COURSE</u> Unless otherwise specified Damp-proof course shall be 40 mm or as per schedule thick 'artificial stone' in proportion 1:1-1/2:3 cement sand stone- chips (10 mm down) with admixture of a waterproofing compound as approved by the Engineer. The percentage of admixture shall be as per manufacturer's specifications but not less than 2% by weight of cement. The top surface shall be double chequered and cured by pond for seven days.		

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2.5 <u>DAMP PROOF MEMBRANE</u> Damp proof treatment using fibre or hessian base bitumen felt shall be 6, 8 or 10 course treatment as specified in IS: 1609. The number of courses shall be as mentioned. Sequence or work shall be as directed by the Engineer. Extreme care shall be taken to prevent damage to felt during and after laying. The Contractor shall be obliged to rectify any leakage appearing within 5 years of installation by removing and renewing the coats at the point of leakage. Where shown on drawing, damp proof membrane with one layer bitumen paper or one layer alkathene sheet shall be laid with minimum 150 mm lap under slabs on grade. 3.0 <u>I.S. CODES</u> Some of the important relevant codes for this section are: (a) IS:1127 : Recommendations for dimensions and workmanship of natural building stones for masonry work. (b) IS:1597 : Code of Practice for Construction of stone Masonry. (c) IS:1609 : Code of Practice for laying Damp-proof treatment using bitumen felts. (d) IS:2212 : Code of Practice for Brickwork. (e) IS:2250 : Code of Practice for preparation and use of Masonry Mortar. (f) IS:5134 : Bitumen Impregnated Paper & Board.		

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1.0 <u>SCOPE</u> This Specification covers furnishing, installation, repairing, finishing, curing, testing, protection, maintenance till handing over of finishing items for masonry and concrete. This shall also include the work to be done to make the surface suitable for receiving the finishing treatment. Before commencing finishing items the Contractor shall obtain the approval of the Engineer regarding the scheduling of work to minimise damage by other trades. He shall also undertake normal precaution to prevent damage or disfiguration to work of other trades or other installation. 2.0 <u>INSTALLATION</u> 2.1 <u>PREPARATION OF SURFACE</u> All joints in masonry walls shall be raked out to a depth of at least 10 mm with a hooked tool made for the purpose while the mortar is still green. Walls shall be brushed down with stiff wire brush to remove all loose dust from joints and thoroughly washed with water. All laitance shall be removed from concrete to be plastered. For all types of flooring, skirting and dado work, the base cement concrete slab or masonry surface shall be roughened by chipping and cleaned of all dirt, grease or loose particles by hard brush and water. The surface shall be thoroughly moist to prevent absorption of water from the base course. Any excess of water shall be mopped up. At any point, the level of base shall be lower than the theoretical finished floor level by the thickness of floor finish. Any chipping or filling to be done to bring the base in the required level shall be brought to the notice of the Engineer and his approval shall be taken regarding the method and extent of rectification work required. Prior to commencement of actual finishing work, the approval or the Engineer shall be taken as to the acceptability of the base.		

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2.2 <u>PLASTERING</u> 2.2.1 Mortar Mortar for plastering shall be as specified in the drawings. For sand cement plaster, sand and cement in the specified proportion shall be mixed dry on a watertight platform and minimum water added to achieve working consistency. For lime gauged plaster, lime putty or hydrated lime and sand in the required proportion shall be mixed on a watertight platform with necessary addition of water and thoroughly ground in mortar mill. This mix shall then be transferred to a mechanical mixer to which the required quantity of cement is added and mixed for at least 3 minutes. No plaster which has stood for more than half an hour shall be used; plaster that shows tendency to become dry before this time, shall have water added to it 2.2.2 Application of Plaster Plaster, when more than 12 mm thick, shall be applied in two coats - a base coat followed by the finishing coat. Thickness of the base coat shall be sufficient to fill up all unevenness in the surface; no single coat, however, shall exceed 12 mm in thickness. The lower coat shall be thicker than the upper coat, the overall thickness of the coats shall not be less than the minimum thick-ness shown on the drawings. The undercoat shall be allowed to dry and shrink before applying the second coat of plaster. The under- coat shall be scratched or roughened before it is fully hardened to form a mechanical key. The method of application shall be 'thrown on' rather than 'applied by trowel'. To ensure even thickness and true surface, patches of plaster about 100 mm to 150 mm square or wooden screed 75 mm wide and of the thickness of the plaster, shall be fixed vertically about 2000 mm to 3000 mm apart, to act as gauges. The finished wall surface shall be true to plumb, and the Contractor shall make up any irregularity in the brickwork with		

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plaster. All vertical edges of brick pillars, doorjambs etc. shall be chamfered or rounded off as directed by the Engineer. All drips, grooves, mouldings and cornices as shown on drawing or instructed by the Engineer shall be done with special care to maintain true lines, levels and profiles. After the plastering work is completed, all debris shall be removed and the area left clean. Any plastering that is damaged shall be repaired and left in good condition at the completion of the job. 2.2.3 Finish Generally, the standard finish shall be used unless otherwise shown on drawing or directed by the Engineer. Wherever any special treatment to the plastered surface is indicated, the work shall be done exactly as shown on the drawings, to the entire satisfaction of the Engineer regarding the texture, colour and finish. (a) Standard Finish Wherever punning is indicated, the interior plaster shall be finished rough. Otherwise the interior plaster shall generally be finished to a smooth surface. The exterior surface shall generally be finished with a wooden float. (b) Neat Cement Finish Immediately after achieving a true plastered surface with the help of a wooden straight edge, the entire area shall be uniformly treated with a paste of neat cement at the rate of one (1) kg. Per Sq.M. and rubbed smooth with a trowel. (c) Coloured Plaster Finish This shall be done in the same way as specified in Clause 2.2.2 of this specification but using coloured cement in place of ordinary cement. When coloured plastering is specified in more than one coat, the top coat only shall be made with coloured cement.		

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Coloured cement shall be either ready mixed material or may be obtained by mixing pigments and cement at site, as approved by the Engineer. The pigments to be mixed with cement shall conform to Appendix-A of IS: 2114 latest edition. Samples of colouring material shall be submitted to the Engineer for approval and material procured, shall conform in all respects to the approved samples, which shall remain with the Engineer. All coloured cement and/or pigments shall be stored in an approved manner in order to prevent deteriorations. (d) Pebble-dash Finish Mortar of required thickness consisting of 1 part cement and 4 parts sand by volume shall be applied in the usual manner as described under plastering Clause 2.2.2. of this specification. While the mortar is still plastic small pebbles or crushed stone of size generally from 10 mm to 20 mm as approved by the Engineer shall be thrown on the plastered surface. The aggregate shall be lightly tapped into the mortar with a wood float or the flat end of a trowel, in order to ensure satisfactory bond between the dashing and the mortar. (e) Rough-Cast Finish A wet plastic mix of 3 parts coloured cement 6 parts sand and 4 parts aggregate by volume (gravel or crushed stone of size from 6 mm to 12 mm as approved by the Engineer) shall be thrown on to the wall by means of a plaster's trowel and left in the rough condition. (f) Scraped Finish Ordinary plaster as described under Clause 2.2.2 of this specification after being levelled and allowed to stiffen for a few hours, shall be scraped with a steel straight edge to remove the surface skin. The pattern shall be as approved by the Engineer. (g) Textured Finish Mortar consisting of 1 part cement and 3 parts sand by volume shall be applied in a manner as specified under "Plastering" Clause		

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2.2.2. of this specification Ornamental treatments in the form of horizontal or vertical rib texture fan texture etc. shall be applied by means of suitable tools to the freshly applied plastered surface, as approved by the Engineer 2.2.4 Curing All plastered surfaces after laying, shall be watered, for a minimum period of seven days, by an approved method, and shall be protected from excessive heat and sunlight by suitable approved means. Moistening shall commence, as soon as the plaster has hardened sufficiently and not susceptible to damage. Each individual coat of plaster shall be kept damp continuously, for at least two days, and then dried thoroughly, before applying the next coat. 2.3 <u>POINTING TO MASONRY</u> All joints of brickwork shall be raked out to a depth of 10 mm with a hooked tool made for the purpose while the mortar is still green. The brickwork shall then be brushed down with a stiff wire brush, so as to remove all loose dust from the joints and thoroughly washed with water. Mortar consisting of 1 part cement and 3 parts clean, sharp, well graded sand by volume shall be pressed carefully into the joints and finished with suitably tools to shape as shown on the drawings. Any surplus mortar shall be scraped off the wall face leaving the surface clean. The pointed surface shall be kept wet for at least three days for curing. 2.4 <u>PLASTER WITH METAL LATH</u> The supports, hangers, brackets, cleats etc. shall be as shown on drawings and/or as approved by the Engineer. These shall have a coat of prime paint before and another coat of approved paint after erection. The metal lath shall be expanded metal, with 12 mm x 38 mm mesh, 16 BG thick and 3 mm wide strands. Side laps shall be minimum 12 mm and end laps 25 mm minimum. The plastering shall be minimum 20 mm thick measured from the back of lath and applied in two layers.		

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The mortar for plastering shall consist of 1 part cement, 1/2 part lime and 4 parts sand by volume, or 1 part cement and 4 parts sand by volume mixed as specified in plastering, Clause 2.2.1. of this specification. The application, finish etc. shall be as specified under relevant clause above. A 2 mm Plaster of Paris punning shall be applied over plaster as a finishing coat to give perfectly smooth and even finish.		
2.5	<u>LIME PUNNING</u> For plastered surfaces, where an even smooth surface is specified, lime punning with 5 parts of shell lime properly slaked, strained and aged, mixed with 1 part clean, washed, sieved, fine sand by volume shall be done. The thickness of lime punning shall be not less than 2 mm and more than 3 mm. The plastered surface shall be saturated with water before application of the lime punning. The punning shall be applied by skilled workman and given a smooth and even finish free from undulations, cracks etc. and to the satisfaction of the Engineer.	
2.6	<u>PLASTER OF PARIS PUNNING</u> Plastered surfaces, where specified shall be finished with Plaster-of-Paris punning. The material shall be from approved manufacturers and approved by the Engineer. The thickness of the punning shall be 2 mm and shall be applied by skilled workmen. The finish shall be smooth, even and free from undulation, cracks etc. Before bulk work is taken in hand, a sample of punning shall be done on roughly 10 Sq. M. area and approval of the Engineer taken. The work shall then be taken in hand as per approved sample.	
2.7	<u>STONE FACING</u> Stone facing where specified shall be done as shown on design drawings and approved shop drawings. The stone shall be as specified on drawings. Samples of stone shall be submitted to the Engineer for approval and then bulk purchase made. The Contractor shall submit three copies of shop drawing for the Engineer's approval before commencing the work.	

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The thickness of facing stone shall be not less than 25 mm unless otherwise specified on drawings. The stone slabs shall be cut and finished to sizes as per pattern shown on drawings. They shall be fastened to wall with suitable non-corrodable anchorage as approved by the Engineer. Where mild steel clamps, stays etc. are used for anchorage, they shall be galvanised (weight of zinc coating shall not be less than 700 gms per square meter of surface) to prevent rust stains developing on the finished surface. There shall be at least 12 mm gap between the stone and masonry, which shall be filled up and packed by a mortar of 1 part cement and parts of sand by volume. After the mortar is set and cured for at least four days, the exposed surface shall be rubbed and polished as approved by the Engineer. The completed surface shall be neat, or uniform texture and acceptable to the Engineer. Where pointing is specified on drawings it shall be done by mortar as specified on drawings. 3.0 <u>ACCEPTANCE CRITERIA</u> Finish to masonry and concrete shall fully comply instructions of the Engineer with respect to lines, levels, thickness, colour, texture, pattern and any other special criteria as shown on drawings. 4.0 <u>I.S. CODES</u> Important relevant code for this Section: (a) IS 1661 : Code of practice for cement and cement-lime plaster finish on walls & ceilings (b) IS4101 : Code of practice for external facings and veneers		

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SECTION – 10

FLOOR FINISHES AND ALLIED WORKS

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<u>CONTENTS</u> <table><tr><th><u>CLAUSE. NO.</u></th><th><u>DESCRIPTION</u></th></tr><tr><td>1.0</td><td>SCOPE</td></tr><tr><td>2.0</td><td>INSTALLATION</td></tr><tr><td>3.0</td><td>ACCEPTANCE CRITERIA</td></tr><tr><td>4.0</td><td>I. S. CODES</td></tr></table>			<u>CLAUSE. NO.</u>	<u>DESCRIPTION</u>	1.0	SCOPE	2.0	INSTALLATION	3.0	ACCEPTANCE CRITERIA	4.0	I. S. CODES
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1.0 <u>SCOPE</u> This specification covers furnishing, installation, finishing, curing, testing, protection, maintenance till handing over various types of floor finishes and allied items of work as listed below: (a) In Situ Finishes (i) Integral finish to concrete base (ii) Red Oxide of Iron finish (iii) Terrazzo finish (iv) Granolithic finish (v) Patent Stone (vi) Metallic Hardener like "Ironite" finish (vii) Mastic Asphalt finish (viii) Chemical Resistant finish (b) Tiled Finishes (i) Terrazzo tile (ii) Chequered tile (iii) Glazed tile (iv) Tesserae (Mosaic etc.) (v) Chemical Resistant (vi) Rubber, Vinyl etc.		

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(vii) Stone Slab 1.1 <u>BASE</u> The base to receive the finish is covered under other relevant specifications. 1.2 <u>SEQUENCE</u> Commencement, scheduling and sequence of the finishing works shall be planned in detail and must be specifically approved by the Engineer in view the activities of other agencies working in that area. However, the Contractor for the finishing items shall remain fully responsible for all normal precautions and vigilance to prevent any damage whatsoever till handing over. 2.0 <u>INSTALLATION</u> 2.1 <u>SPECIAL MATERIALS</u> Basic materials are covered under Specification "Properties Storage and Handling of Common Building Materials". Special materials required for individual finishing items are specified under respective items. In general, all such materials shall be as per relevant I.S. Codes where available. In all cases these materials shall be of the best quality available indigenously, unless specified otherwise. The materials for finishing items must be procured from well-reputed specialised manufacturers and on the basis of approval of samples by the Engineer. The materials shall be ordered, procured and stored well in advance to avoid compulsion to use substandard items to maintain in the construction schedule. 2.2 <u>WORKMANSHIP</u> Only workers specially experienced in particular items of finishing work shall be engaged, where such workers are not readily available, with the Engineer's permission, experienced supervisor recommended by the manufacturer shall be engaged. In particular cases where the Engineer so desires the Contractor shall get the finishing items installed by the manufacturer.		

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2.3 PREPARATION OF THE BASE SURFACE

The surface to be treated shall be thoroughly examined by the Contractor. Any rectification necessary shall be brought to the notice of the Engineer and his approval shall be taken regarding method and extent of such rectification work.

For all types of flooring, skirting, dado and similar locations, the base to receive the finish shall be adequately roughened by chipping, raking out joints and cleaning thoroughly all dirt, grease etc. with water and hard brush and detergent if required, unless otherwise directed by the manufacturer of any special finishing materials or specifically indicated in this specification under individual item.

To prevent of water from the finishing treatment the base shall be thoroughly soaked with water and all excess water mopped up.

The surface shall be done dry where adhesives are used for fixing the finishes.

Prior to commencement of actual finishing work the approval of the Engineer shall be taken as per the acceptability of the surface.

2.4 IN SITU FINISHES

2.4.1 Integral Finish to Concrete Base

While the surface of the concrete laid as per specification for 'Cement Concrete' has been fully compacted and levelled but the concrete is still 'green' a thick slurry made with neat cement shall be applied evenly and worked in with iron floats. When the slurry starts to set it shall be pressed with iron floats to have a firm compact smooth surface without trowel mark or undulations.

This finish shall be as thin as possible by using 2.2 kg. of cement per Sq. M. of area.

The surface shall be kept in shade for 24 hours and then cured for at least 7 days continuously by flooding with water. The surface shall not be subjected

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to any load or abrasion till 21 days after lying. As desired by the Engineer the surface, while still 'green' shall be indented by pressing strings, the marking shall be of even depth, in straight lines and the panels shall be of uniform and symmetrical patterns. 2.4.2 Red Oxide of iron Finish It shall consist of an underbed and a topping over already laid and matured concrete base. (a) Thickness Unless otherwise specified the total thickness of the finish shall be minimum 40 mm for horizontal and 25 mm for vertical surface of which the topping shall (not less than 10 mm) while the topping shall be of uniform thickness the underbid may vary in thickness to provide necessary slopes. The vertical surface shall project out 6 mm from the adjacent plaster or other finishes. Necessary cutting into the surface receiving the finish shall be done to accommodate the specified thickness. All junctions of vertical with horizontal shall be rounded neatly to uniform radius of 25 mm. (b) Mix (i) Underbed The underbed for floors and similar horizontal surfaces shall consist of a mix of 1 part cement, 2 parts coarse sand and 4 parts 10 mm down graded stone chips by volume. For vertical and similar surfaces the mix shall consist of 1 part cement to 3 parts coarse sand by volume. (ii) Topping For the topping cement, screened through a fine mesh and red oxide of iron pigment powder similarly screened shall be dry mixed thoroughly in right proportions to produce the		

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desired colour when laid. The mix shall then be prepared with 1 part cement (mixed with pigment) and 3 parts coarse sand volume. The whole quantity required for each visible area shall be prepared in one batch to ensure uniform colour. (c) Laying The underbed shall be laid in panels of mixing area 5 Sq. M. each and no side shall be more than 2.5 along. For outdoor locations the maximum area shall be 2.0 Sq. M. The forms for the panels shall have perfectly aligned edges to the full depth of the total thickness of finish. If specified aluminium or glass dividing strips shall be used. The panels shall be laid in alternate bays or in chequered board pattern. No panel shall be cast in contact with another already laid until the contraction of the latter has taken place. The underbed shall be laid, compacted, levelled and brought to proper grade with a screed or float. The topping shall be placed after about 24 hours while the underbed is still somewhat 'green' but firm enough to receive the topping. The surface of the underbed shall be roughened for better bonding. The topping shall be rolled for horizontal areas and thrown and pressed for vertical areas to extract all superfluous cement and water to achieve a compact dense mass fully bonded with the underbed. The topping shall then be levelled up by trowelling and finished smooth with a slurry made with already prepared cement and pigment mixture. About 2.0 Kg. of the mixture shall be consumed/per Sq.M. for horizontal surface, and 1.0 Kg. for vertical surface. The surface shall be cured for seven days by keeping it moist. (d) Polishing About 36 hours after laying when the surface has hardened sufficiently it shall be polished with polishing stone till a smooth shiny surface to the satisfaction of the Engineer, is achieved. The finish shall be washed and cleaned just before handing over.		

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2.4.3 Terrazo Finish : In Situ

It shall consist of an underbed and a topping laid over an already laid and matured concrete base.

(a) Thickness

Unless otherwise specified the total thickness of the finish shall be minimum 40 mm for horizontal and 25 mm for vertical surface of which the topping shall be not less than 10 mm. While the topping shall be of uniform thickness the underbed may vary in thickness to provide necessary slopes. The vertical surface shall project cut 6 mm from the adjacent plaster or other finish. Necessary cutting into the surface receiving the finish shall be done to accommodate the specified thickness.

All junctions of vertical with horizontal shall be rounded neatly to uniform radius of 25 mm.

(b) Mix

(i) Underbed

The underbed for floors and similar horizontal surfaces shall consist of a mix of 1 part cement, 1.1/2 parts sand and 3 parts stone chips by volume. For vertical surfaces the mix shall consist of 1 part cement to 3 parts sand by volume. The sand shall be coarse. The stone chips shall be 10 mm down well graded. Only sufficient water to be added to give a workable consistency.

(ii) Topping

The mix for the topping shall be composed of cement, colour pigment, marble dust and marble chips. Proportions of the ingredients shall be such as to produce the terrazzo of colour texture and pattern approved by the Engineer. The cement shall be white or grey or a mixture of the two to which pigment shall be added to achieve the desired colour. To 3

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parts of this mixture 1 part marble powder by volume shall be added and thoroughly mixed dry. To 1 part of this mix 1 to 1.1/2 parts of marble chips by volume shall be added and thoroughly mixed dry again. The pigment must be stable and no fading. It must be very finely ground. The marble powder shall be from white marble and shall be finer than IS Sieve No. : 30. The size of marble chips may be between 1 mm to 20 mm. Sufficient quantity to cover each visible area shall be prepared in one lot to ensure uniform colour. Water to make it just workable shall be added to a quantity that can be used up immediately before it starts to set. (c) Laying The underbed shall be laid in panels. The panels shall not be more than 5 sq.m in area of which no side shall be more than 2.5 M long. For exposed locations the maximum area of a panel shall be 2.0 Sq. M. The panel shall be laid in alternate bays or chequered board pattern. No panel shall be cast in contact with another already laid until the latter has contracted to the full extent. Dividing strips made of aluminium or glass shall be used for forming the panels. The strips shall exactly match the total depth of underbed plus topping. After lying, the underbed shall be levelled compacted and brought to proper grade with a screed or float. The topping shall be laid after about 24 hours while the underbed is still somewhat "green" but firm enough to receive the topping. Slurry of the mixture of cement and pigment already made shall be spread evenly and brushed in just before laying the topping. The topping shall be rolled for horizontal areas and thrown and pressed for vertical areas to extract all superfluous cement and water and to achieve a compact dense mass fully bonded with the underbed. The surface of the topping shall be trowelled over, pressed and brought to a smooth dense surface showing a minimum 75% area covered by marble chips in a even		

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pattern of distribution. (d) Curing The surface shall be left for curing for about 12 to 18 hours and then cured by allowing water to stand on the surface or by covering with wet sack for four days. (e) Grinding and Polishing When the surface has sufficiently hardened it shall be watered and ground evenly with rapid cutting coarse grade (no.60) grit blocks, till the marble chips are exposed and the surface is smooth. Then the surface shall be thoroughly washed and cleaned. A grout with already prepared mixture of cement and pigment shall be applied to fill up all pinholes. The surface shall be cured for 7 days by keeping it moist and then ground with fine grit blocks (no.: 120). It shall again be cleaned with water, the slurry applied again to fill up any pinholes that might have appeared and allowed to be cured again for 5 days. Finally, the surface is ground a third time with very fine grit blocks (no.: 320) to get smooth surface without any pinhole. The grinding shall be done by a suitable machine. Where grinding machine can not be used hand grinding may be allowed when the first rubbing shall be with carborundum stone of coarse grade (no.60), second rubbing with medium grade (no.: 80) and final rubbing and polishing with fine grade (no.: 120). The surface shall be cleaned with water, dried and covered with soil free, clean sawdust if directed by the Engineer. The final polishing shall be positioned till before handing over if desired by the Engineer. Just before handing over the surface shall be dusted with oxalic acid at the rate of 0.33 gm. per. Sq.M, water sprinkled on to it and finished by buffing with felt or hessian bobs. The floor shall be cleaned with soft moist rag and dried. However, all excess wax polish to be wiped off and the surface to be left glossy but not slippery. 2.4.4 Granolithic Finish Granolithic finish shall either be laid monolithically over base concrete or separately over hardened base concrete.		

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(a) Thickness The finish shall be average 20 mm and minimum 12 mm thick, unless specified otherwise. (b) Mix The mix shall consist of 1 part cement: 1 part coarse sand: 2 parts coarse aggregate by volume. The coarse aggregate shall be very hard like granite and well graded between 6 mm and 12 mm. Minimum quantity of water to get workability shall be added. (c) Laying of Monolithic Topping The concrete base shall be laid as per specification "Cement Concrete" and levelled upto the required grade. The form shall remain sufficiently protruding to take the finish. Within about 3 hours of laying the base while it is still fully "green" the topping shall be laid evenly to proper thickness and grade. If considered necessary the surface of the base shall roughened by wire brushing. Unless manual operation is permitted by the Engineer, mechanical vibrators of suitable design shall be used to press the topping firmly and work vigorously and quickly to secure full bond with concrete base. The laitance brought to the surface during compression shall be removed carefully without disturbing the stone chips. The surface shall then be lightly trowelled to remove all marks. When sufficiently set, hand trowelling shall be done to secure a smooth surface without disturbing the stone chips. For large areas the laying shall be in panels of maximum 25 Sq.M area. The panels shall be laid in chequered board pattern. (d) Laying of Topping Separately on Hardened Base The base concrete shall be prepared as stated in clause 2.3 and a slurry of neat cement applied just prior to laying the granolithic		

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concrete mix (1:1:2). The method of compaction etc. shall be same as for monolithic topping. (e) Curing Immediately after laying, the finish shall be protected against rapid drying. As soon as the surface had hardened sufficiently, it shall be kept continuously moist for at least 10 days by means of wet gunny bags or ponding of water on the surface. The floor shall not be exposed to heavy traffic during this period. (f) Grinding If grinding is specified, it shall start only after the finish has fully set. Clause 2.4.3 (c) shall be followed. However, the ultimate polish required shall be decided upon by the Engineer. (g) Finishing Where specified, sodium silicate or magnesium or zinc silico fluoride treatment shall be done. The number of coats to be applied shall be as specified. The concentration and method of application of the solutions shall be as specified in IS : 5491. 2.4.5 Patent Stone It shall consist of an underbed and a topping laid on an already laid and matured concrete base. (a) Thickness The patent stone finish shall have thickness as stipulated under clause 2.4.2 (a) except that the topping shall be 6 mm thick. (b) Mix (i) Underbed The mix shall be as stipulated under clause 2.4.3 (b).		

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(ii) Topping The mix for the topping shall consist of 1 part cement and 1 part fine sand by volume. (c) Laying The Patent Stone finish, including the underbed shall be laid in alternate bays or in chequered board pattern. No panel shall be cast in contact with another already laid till the contraction of the latter has already taken place. The maximum area of each panel shall be 3 Sq.M of which no side shall be more than 2 M long. A cement grout shall be applied and worked into the surface to receive the finish, the underbed then laid, compacted and levelled to proper grade with a screed or float. The topping shall be applied evenly on the underbed while it is not fully set but firm enough and rolled and pressed to get full bond. The topping shall towelled to a dense finish to the satisfaction of the Engineer. All trowel marks shall be mopped out with a soft cloth to give a clean smooth surface. After the surface is sufficiently set, the finished floor shall be kept moist for 7 days for curing. If desired the finish shall be polished as directed by the Engineer. 2.4.6 Metallic Hardener Like "Ironite" Finish This will consist of a topping (incorporating iron particles) to bond with concrete base while the latter is "Green". (a) Thickness Unless otherwise specified the metallic hardener finish shall be of 12 mm depth.		

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(b) Material The hardening compound shall be uniformly graded iron particles free from non-ferrous metal impurities, oil, grease, sand soluble alkaline compounds or other injurious materials. When desired by the engineer, actual samples shall be tested. (c) Mix Proportion of the metallic hardener shall be as specified or as indicated by the manufacturer. However, in absence of any such direction 1 part metallic hardener shall be mixed dry with 4 parts cement, by weight. To this mixture 6 mm nominal size stone chips shall be added in proportion of 1 part cement (mixed with hardener) to 2 parts of stone chips by volume and uniformly mixed. Minimum quantity of water shall be added to make it workable. (d) Laying The concrete floor shall be laid as per specification "Cement Concrete" a levelled upto the required grade. The forms, if any shall remain sufficiently projecting to take the finish. The surface shall be roughened by wire brush as soon as possible. The finish shall be laid while the concrete underbed is still very "green" within about 3 hours of laying of the latter. The finish shall be of uniform thickness and even dense surface without trowel marks, pin holes etc. This topping layer shall be pressed firmly and worked vigorously and quickly to secure full bond with the concrete base. Just when the initial set starts the surface shall be finished \smoothened with steel trowel. The finished floor shall be cured for 7 days by keeping it wet. 2.4.7 Mastic Asphalt Finish This is a one layer treatment on concrete or brick base.		

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(a) Thickness The thickness shall be as specified in the drawing (b) Materials Bitumen shall be industrial bitumen of the grades 90/15 and 75/15 conforming to IS: 702. Mineral filler shall be dry stone dust passing through 75-micron IS Sieve. Fine aggregate shall be crushed and graded natural lime stone or other hard-work. Coarse aggregate shall be crushed siliceous stone or other approved aggregate 6 mm stone chips shall be used for finish upto 20 mm thick & 10 mm chips for thicker finish. (c) Composition Bitumen mastic shall conform to IS:1195 and shall be either brought to site in blocks weighing about 25Kg. or prepared at site. If brought in blocks, these shall be remelted in mechanically agitated mastic cookers and coarse aggregate, preferably preheated fed in successive portions until the complete change is thoroughly incorporated. At no stage during the remelting and mixing process, shall the temperature exceed 205°C. (d) Laying The hot mastic shall be laid on dry base surface cleaned thoroughly by wire brushing and sweeping. The mastic shall be levelled and when cooled to some extent shall be finished with a wooden float with addition of small quantity of fine sand if required. No load shall be allowed till the finish has cooled to normal temperature. The mastic shall be laid in suitable panels of about 15 Sq.M in area each formed by formers. Succeeding panels shall be		

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laid overlapping the finish panel so as to melt its edges and form a continuous finish without joint. 2.4.8 Chemical Resistant in Situ Finish Chemical resistant in situ finish shall be as epoxy resin with suitable filler material over a primer or called for in the Schedule of Items. The minimum thickness shall be 6 mm. About its performance the Engineer shall have to be fully satisfied by test results and examination of similar treatment already in existence. The Contractor shall get it done by a specialised manufacturer, get guarantee of performance from the organisation and pass it on to the Owner in addition to his own guarantee. 2.5 <u>TILED FINISH</u> These shall include finish tiles, stone slabs and similar manufactured or natural items over already laid and matured base of concrete or masonry by means of an underbed or an adhesive layer. 2.5.1 Terrazzo Tile Finish The finish will consist of manufacture terrazzo tile and an underbed. (a) Thickness The total thickness including the underbed shall be minimum 40 mm for floors 30 mm for walls unless otherwise specified. The skirting, dado and similar vertical surfaces shall project out 6 mm uniformly from the adjacent plaster or other wall finishes. The necessary cutting into the surface receiving the tiled finish, to accommodate the specified thickness shall be done. (b) Tiles : Terrazzo The tiles shall, unless specifically permitted in special cases be machine made under quality control in a shop. The tile shall be pressed hydraulically to a minimum of 140 Kg. per Sq.cm.		

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Each tile shall bear on its back permanent and legible trade mark of the manufacturer. All angles of the tiles shall be right angles all arises sharp and true, colour and texture of the wearing face uniform throughout. Maximum tolerance allowance length and breadth shall be + 1 mm and the thickness + 3 mm. Face of the tile shall be plane, free from pin holes and other blemishes. The tiles shall be composed of a backing and topping. The topping shall be of uniform thickness not less than 10 mm. The total thickness including the topping shall be as specified but not less than 20 mm in any case. The backing shall be composed of 1 part ordinary grey cement and 3 parts of stone chips by weight mixed with water. The topping shall be as specified under clause 2.4.3 (b). The tile shall be cured at the shop for at least 14 days before delivery to the site. First grinding shall be given to the tiles at the shop before delivery. Tiles shall be packed properly to prevent damage during transit and storage. The tiles must be carefully stored to prevent staining by damp, rust, oil, and grease or other chemicals. Tiles made in each batch shall be kept and used separately so that colour of each area of the floor may remain uniform. The manufacturer shall supply along with the tiles the grout mix containing cement and pigment in exact proportions as used in topping of the tiles. The containers for the grout mix shall be suitably marked to relate it to the particular type and batch of tiles. (c) Mix : Underbed The underbed for floor and similar horizontal surfaces shall be 1 part lime putty: 1 part surkhi : 2 parts coarse sand by weight mixed with sufficient water to form a stiff workable mass. For skirting and dado and all vertical surfaces it shall be about 12 mm thick and composed of 1 part cement and 3 parts coarse sand by weight.		

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(d) Laying The underbed mortar shall be evenly spread and brought to proper grade and consolidated to a smooth surface. The surface shall be roughened for better bond. Before the underbed had time to set and while it is still fairly moist but firm, cement shall be hand dusted over it or a cement slurry applied and the tiles shall immediately be placed upon and firmly pressed by wooden mallet on to the underbed until it achieves the desired level. The tiles shall be kept soaked for about 10 minutes just before laying. The joints between tiles shall be as close as possible and not more than 1.5 mm wide. Special care shall be taken to check the level of the surface and the lines of the joints frequently so that they are perfect. When tiles are required to be cut to match the dimensions these shall be sawn and edges rubbed smooth. The location of cut tiles shall be planned in advance and approval of the Engineer taken. At the junction of horizontal surface with vertical surface the tiles on the former shall enter at least 12 mm under the latter. After fixing, the floor shall be kept moist and allowed to mature undisturbed for 7 days. Heavy traffic shall not be allowed. If desired dividing strips as specified under Clause 2.4.3 (c) may be used for dividing the work into suitable panels. (e) Grinding and Polishing Procedure shall be same as Clause 2.4.3 (e).Grinding shall not commence earlier than 14 days after laying of tiles. 2.5.2 Chequered Tile Finish The finish shall consist of manufactured grey or coloured cement tiles or terrazzo tiles with chequered face and an underbed laid over concrete or brick surface.		

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(a) Thickness Thickness shall be same as in clause 2.5.1 (a). (b) Tiles : Chequered The tiles shall have chequers not less than 2.5 cm. c/c and not more than 5 cm c/c, Depth of grooves shall be not less than 5 mm. The grooves shall be uniform and straight. The tiles shall conform to clause 2.5.1 (b) except that these may have the topping in terrazzo or plain grey cement or colour pigment added to cement as specified. (c) Underbed As per clause 2.5.1 (c). (d) Laying As per clause 2.5.1 (d). (e) Grinding and Polishing As per clause 2.5.1 (e) except that the tiles shall be ground and polished by hand after laying taking special care in polishing the grooves properly and uniformly. 2.5.3 Glazed Tiles Finish This finish shall be composed of glazed earthenware tiles with an underbed laid over a concrete or masonry base. (a) Thickness The total thickness shall be between 20mm and 25mm including the underbed. The tile finish on vertical surface shall project out 6mm uniformly from the adjacent plaster or other wall finishes. The necessary cutting into the surface receiving the finish, to accommodate the specified thickness shall be done.		

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(b) Tiles : Glazed The tiles shall be of earthenware, covered with glaze white or coloured, plain or with designs, of 150 mm x 150 mm nominal sizes and 10 mm thick unless otherwise specified. The tolerance shall be + 1.5 mm for length and breadth and + 0.5 mm for thickness specials like internal and external angles, beads, covers, cornices, corner pieces etc. shall match. The top surface of the tiles shall be glazed with a gloss or matt unfading stable finish as desired by the Engineer. The tiles shall be flat and true to shape. The colour shall be uniform and fractured section shall be fine grained in textures, dense and homogeneous. The tiles shall be strong and free from flaws like cracks, craze, specks, crawlings, etc. and other imperfections. The edge and the underside of the tiles shall be completely free from glaze and the underside shall have ribs or indentations for better anchorage with the fixing mortar. The coloured tiles, when supplied, shall preferably come from one batch to avoid difference in colour. (c) Mix : Underbed The mix for the underbed shall consist of 1 part cement and 3 parts coarse sand by weight mixed with sufficient water or any other mix if specified. (d) Laying Same as clause 2.5.1 (d). (e) Finishing The joints shall be cleaned and flush pointed with white cement and cured for 7 days by keeping it wet. The surface shall be cleaned with soap or suitable detergent, washed fully and wiped with soft cloth to prevent scratching before handing over.		

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2.5.4 Tesserae Finish (Mosaic etc.) This finish consists of manufactured vitreous, glass, ceramic or similar hard small pieces set in an underbed over a concrete or masonry surface, already laid. (a) Thickness The total thickness including the underbed shall be between 16 mm and 25 mm. (b) Tesserae Finish These shall usually be 6 mm thick small piece of ceramic vitreous china, tinted glass or similar hard wearing, strong and durable material in desired shapes and sizes and patterns. The supply shall come in the desired pattern in full or sections conveniently for handling, stuck to pieces of strong thick paper on the surface to be exposed. The gum used for this purpose must be water soluble and non-staining. The sections shall be properly marked to avoid mistakes and master drawing shall be available at the site for guidance. (c) Mix : Underbed Same as clause 2.5.3 (c) (d) Laying The specification for laying if given by the manufacturer of the item shall be followed provided it is approved by the Engineer. Otherwise clause 2.5.3 (d) shall generally be followed. However, instead of grey cement the slurry shall be made with white cement to fix the panels. The paper mounted patterns in sections shall be carefully placed and pressed in position true to lines and levels. Earliest possible the paper shall be peeled off and surface examined and cleaned, joints flush pointed with white cement and cured for 7 days by keeping it wet.		

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2.5.5 Chemical Resistant Tiled Finish This shall include all varieties of special tiles used for specific chemical resistance function and an underbed over already laid concrete or masonry. (a) Tiles The chemical resistant tiles as detailed in the Schedule of items shall be of the best indigenous manufacture unless otherwise specified and shall be resistant to the chemical described in the Schedule of Items. The tiles shall have straight edges, uniform thickness, plain surface, uniform non-fading colour and textures. Glazed tiles if permitted to act as chemical resistant finish shall be considered under clause 2.5.3 (b). Usually the chemical resistant tiles shall not absorb water more than 2% by weight. The tiles shall have at least compression strength of 700 Kg/cm². The surface shall be abrasion resistant and durable. (b) Laying The mortar used for setting or for underbed the tiles shall be durable and strong. The grout which shall be to the full depth of tile shall have equal chemical resistant properties. Joints shall be pointed if so desired. The setting and fixing shall be according to the manufacturer's specification approved by the Engineer. 2.5.6 Rubber, Vinyl or Vinyl Asbestos Tiles Finish This shall include various types of tiles manufactured from rubber, vinyl, etc. set with a adhesive on concrete or masonry base. An underbed may be required to secure desirable surface and grade. (a) Thickness The thickness of the tiles shall be mentioned in the Schedule or in drawing.		

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(b) Tiles Unless otherwise desired the tiles shall be squares of approved dimensions. The tolerance in dimensions shall be 1.5mm. The face of the tiles shall be free from porosity, blisters, cracks, embedded foreign matters or either physical defects which affect appearance or serviceability. All edges shall be cut true and square. The colour shall be confiding and uniform in appearance, insoluble in water and resistant to alkalis, cleaning agents and usual floor polishes. Each tile shall be marked on the back legibly and indelibly with manufacturer's trade mark, the thickness, sizes, batch number and date of manufacturer. Tiles shall be delivered securely packed and stored in clean, dry well ventilated place at a temperature near about to that the tiles shall be called upon to stand ultimately. Adhesive to be used for sticking the tiles shall be approved by the tile manufacturer. The adhesive shall have a short drying time and long life in addition to toughness. (c) Mix : Underbed The underbed where required to make up the specified thickness or to give the required grade or to get the right type of surface shall be composed of 1 part like putty : 1 part cement: 4 parts coarse sand mixed with just sufficient water to make it workable. (d) Laying The tiles shall be kept in the room to be tiled for at least 24 hours to bring them to the same temperature as the room. For air conditioned space, the air-conditioning shall be completed before tiling is taken up.		

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The surface to receive this finish shall be firm even textured but not too smooth, without undulations and other deficiencies. If an underbed is laid the same shall be cured for at least 7 days by keeping it moist and then fully dried. The surface shall be thoroughly cleaned. All loose dust particles shall be removed. Oil and grease if any shall be completely cleaned by use of detergent. The adhesive shall be applied to fully dry surface in desired thickness uniformly. The adhesive shall also be applied to the backs and edges of the tiles and allowed to surface dry. The tiles shall be placed neatly on the surface exactly to the approved pattern and set with a suitable tool. If the edges tend to curl, weights are to be used to keep the edges down. Special care shall be taken to avoid formation of air pockets under the tiles. The joints shall be very fine. Any adhesive squeezed out through the joints shall be removed immediately. (e) Finishing If any adhesive mark is there on the surface a soft cloth soaked in solvent shall be used to wipe it off. The surface shall be cleaned with soft soap, dried and polished with an approved type of polish just before handing over. 2.5.7 Stone Slab Finish : Marble, Stone and Similar Fine Grained Stone (a) Thickness The underbed shall be minimum 12 mm and average 20 mm thick. The slabs may be 25 mm, 30 mm or 40 mm thick as specified. (b) Stone Slab The stone slabs shall be made from selected stock which are hard, sound, homogeneous and dense in texture and free from flaws. Angles and edges shall be true, square, and free from chipping and surface shall be plane. The slabs shall preferably be machine cut to the required dimensions.		

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Tolerance of 5 mm in dimensions and 2 mm in thickness will be allowed. Unless specified the slabs shall be minimum 300 mm x 300 mm. The stone slabs shall come from specific regions and in specified quality with top surface fine chisel dressed. All sides shall also be fine chisel dressed to the full depth to allow finest possible joints. The slabs shall be delivered to the site well protected against damages and stored in dry place under cover. (c) Mix : Underbed Same as clause 2.5.1 (c). (d) Laying The sides and top surface of the slabs shall be machine rubbed or table rubbed with coarse sand stone and washed clean before laying. The underbed mortar shall be evenly spread and brought to proper level on the area under each slab. The slab shall be laid over the underbed, pressed and tapped down with wooden mallet to the proper level. The slab shall then be lifted and the underbed corrected as necessary and allowed to stiffen a little. Next, thick cement slurry shall be spread over the surface. The edges of the slab shall be buttered with slurry of cement, grey/white/mixed with pigment matching the colour of the stone slabs. The slab shall be gently laid and tapped with wooden mallet to bed properly to a very fine joint and to the required level. All surplus cement slurry shall be removed and the surface mopped clean with wet soft cloth. The laid finish shall be cured for 7 days by keeping it wet. (e) Polishing, Finishing Fine chiselling shall be done to remove the slight undulations that usually exist at the joints. The polishing and finishing shall be		

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done as specified under clause 2.5.1 (e). However, the joints shall be so fine in the case of stone slabs that grouting shall not be called for. 2.5.8 Stone Slab Finish : Sand Stone and Similar Coarse Grained Stone Finish Generally clause 2.5.7 shall be followed except that the workmanship and finish shall not be fine as which are explained hereunder. The slabs shall be rough chiseled or fine chiseled as specified. Tolerance may be allowed upto + 6 mm for rough finish, but no sharp unevenness and shall be allowed. For fine chiseling the unevenness shall be limited to 2 mm. The sides shall be chisel dressed at least to half slab depth so that the maximum deviation from straight line shall be within 25 mm. Beyond this depth the edge may be slightly splayed. The joint thickness shall be kept limited to 5 mm in case of rough finish and 3 mm in case of fine finish unless wider joints are specified. The joints shall be grouted with white or coloured cement. 3.0 <u>ACCEPTANCE CRITERIA</u> The finish shall be checked specially for: (a) Level, Slope, Plumb as the case may be (b) Pattern and Symmetry (c) Alignment of joints, dividing strip etc. (d) Colour, texture (e) Surface finish (f) Thickness of joints (g) Details at edges, junctions etc. (h) Performance		

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4.0 (i) Precautions specified for durability <u>I.S. CODES</u> Important relevant codes for this section: (a) IS : 777 : Glazed earthenware tiles (b) IS : 1196 : Code of practice for laying bitumen mastic flooring (c) IS : 1197 : Code of practice for laying of rubber floors (d) IS : 1237 : Cement concrete flooring tiles (e) IS : 1443 : Code of practice for laying and finishing of cement concrete flooring tiles (f) IS : 2114 : Code of practice for laying in situ terrazzo floor (g) IS : 3461 : PVC asbestos floor tiles (h) IS : 4860 : Specification for acid resistant bricks (i) IS : 5518 : Code of practice for lying of flexible PVC Sheet and tile flooring. (j) IS : 5491 : Code of practice for laying in situ granolithic floor topping.		

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1.0 <u>SCOPE</u> This specification covers supplying, installation, repairing, finishing, testing, protection and maintenance till handing over of removable free access false flooring systems consisting of an assembly of panels mounted on adjustable pedestal and supporting steel grid system to provide an under floor space. 2.0 <u>FALSE FLOORING SYSTEM</u> 2.1 <u>BASE</u> The system shall be placed over a base of R.C.C. floor slab and with necessary grouting etc. to fix the supporting structure. 2.2 <u>SUPPORTING STRUCTURE</u> The supporting structure shall comprise of fabricated jacks made out of 25 mm. dia. MS rounds having 150 mm. threads at top. This jack shall be welded to 100 mm x 100 mm x 6 mm thick MS base plate pedestal. Pedestals shall be vertically true and located at 600 mm centre to centre to conform to the size of the floor panels and shall be fixed to the RCC floor slab with ARALDITE. The jack shall be equipped with locking device to prevent loss of finished elevation. Adjustment shall be provided by the threaded rod member and elevating nut. The capital shall be of aluminium alloy die cast and shall receive cold rolled MS floor supporting channels of size 40 mm x 40 mm x 3.15 mm thickness as per drawings, both for main and cross runners. The pedestal shall be equipped with conducting grounding pad. All MS members shall be treated with steel protective paint as per drawing. 2.3 <u>FLOOR PANEL</u> 2.3.1 The floor panels shall be made of phenol for maldehyde bonded particle board treated with fire resistant paint as per schedule items. Size of each panel shall be 600 mm x 600 mm with all panel edges finished to a tolerance of + 0.25 mm on the diagonals. The edges of the floor panels shall be covered by 4 mm. thick rigid PVC edging. The underside of the panel		

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shall have 0.05 mm. thick Aluminium foil which shall be fixed to the particle board with resin-based adhesive. 2.4 <u>STRENGTH</u> Each 600 mm x 600 mm floor panel must be capable of supporting an uniform minimum live load of 1220 Kg/Sq. M or a concentrated minimum load of 450 Kg. applied through a phenolic caster 75 mm in diameter and 45 mm wide, or a rolling minimum load of 450 Kg. at any point with a maximum deflection of 2 mm. The ultimate strength shall be capable of carrying a 2300 Kg. axial load without deformation of any part. 2.5 <u>SURFACE FINISH</u> All removable panels shall have the top surface finished with 2 mm thick Antistatic Vinyl Flooring bonded to the surface with adhesive as per manufacturer's specification. 2.6 <u>SKIRTING</u> Skirting shall be of the same Antistatic Vinyltiles, 150 mm. high and 2 mm. thick, completely matching with the false flooring surface and shall be fixed with the plastered wall surface as per manufacturer's specification. 2.7 <u>INSTALLATION</u> All steel surface are to be protected by pointing over a primer as per schedule of items and any damage to the paint during installation shall be made good. Finished floor surface, when specified by the Engineer-in-Charge shall be protected by the Contractor with kraft paper taped and sealed at edges to prevent tearing. Any damage to the sub floor during installation of the false flooring system shall be made good by the Contractor without to the owner.		

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3.0 <u>ACCEPTANCE CRITERIA</u> The false flooring system shall be checked specially for: (a) Level (b) Alignment of joints (c) Thickness of joints (d) Surface finish (e) Colour and texture		

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1.0 <u>SCOPE</u> This shall include supply, fitting and fixing of timber frames to doors and windows with M S holdfasts, paneled or flush doors, windows, shutters, partitions, wall paneling, pelmets, shelves, furniture, etc. as shown in drawings, including a prime coat of approved paint, varnish, or fixing of decorative plastic laminate. This shall also include the supply and fixing of all hardware and fixtures shown in drawing. 2.0 <u>INSTALLATION</u> 2.1 <u>MATERIALS</u> 2.1.1 Timber Unless otherwise specified, all timber shall be best quality well seasoned C P teakwood free from large or loose, knots cracks or other defects. Where specified, timber shall be treated with approved wood preservative before use. Before starting the carpenters work, the Tenderer shall have the rough timber approved by the Engineer. 2.1.2 Plywood Plywood shall be commercial quality with decorative surface veneer. Unless specifically permitted otherwise, the adhesive used in plywood shall be phenol-formaldehyde resin of B W R grade conforming to IS:848. 2.1.3 Decorative Laminated Plastic Sheets The colour, pattern, finish and texture shall be approved by the Engineer and the bulk supply procured in sheet sizes which will ensure the least number or joints in one surface. 2.1.4 Flush Doors Flush doors shall be hollow or solid core doors with commercial or decorative faces and hardwood edges. The core for solid core doors shall be of block board or wood particle board. Manufacturer's literature and test		

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certificates shall be submitted for the approval of the Engineer. The Contractor shall give a guarantee that the adhesive used is phenol formaldehyde of B W R grade, conforming to IS:848. The thickness shall be as specified in the drawing.		
2.1.5	Panel Doors	
Panel door shall be of teakwood shutter frame and panels of teakwood. Other considerations shall be as mentioned in item (d) above.		
2.1.6	Fixtures	
Fixtures for doors, windows, furniture, etc. shall be as shown on drawing.		
2.2	<u>WORKMANSHIP</u>	
2.2.1	General	
The work shall be done by skilled carpenters as per details shown on drawing or instructed by the Engineer.		
Framing timber and other work shall be close-fitting with proper wood joinery, accurately set to required lines or levels and rigidly secured in place. The surface of frames etc. which will come in contact with masonry after fixing, shall be given two coats of approved paint before fixing. Mastic caulking shall be done after fixing external door and window frames. Special care shall be taken to match the grain of timber or plywood which will be subsequently polished. Screwing or nailing will not be permitted to the edge of plywood and particle board. The edge of all plywood, blockboard and particle board shall be finished with teakwood lipping unless otherwise shown on drawings.		
Fixing for frames and partitions shall generally be with 40 mm x 6 mm x 300 mm long M S holdfasts bifurcated at end and grouted with 1:2:4 cement concrete.		
The gap between masonry and external door and window frame shall be caulked with polysulphide mastic. M S grills or guard bars shall be provided to windows where called for in the drawings.		

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2.2.2	Finish All carpentry work after finishing shall be sand papered smooth. A prime coat paint shall be given after inspection of the Engineer to all surfaces other than those which shall be subsequently polished or covered with laminated plastic sheet.	
2.2.3	Surface Treatment When shown on drawings decorative ply or laminated plastic sheets shall be bonded under pressure to the surface to be finished. The adhesive used shall be of approved brand and brought to site in sealed containers. The rate of application and the length of time for which the pressure is to be applied shall be as per the manufacturer's instructions. The edge of sheets shall be protected by teak lipping or beveled as shown on drawings.	
3.0	<u>ACCEPTANCE CRITERIA</u>	
3.1	<u>DOOR AND WINDOW FRAMES</u> All frames shall be square and flat at the time of delivery and shall be checked for dimensions and corner angles. After fixing they shall be on a fine vertical plane. All external door and window frames shall be caulked with mastic.	
3.2	<u>DOOR AND WINDOW SHUTTERS</u> Shall be of proper size, shape and design and free of warp. When fixed to frames, these shall operate smoothly without jamming and all latching or locking devices shall engage properly without undue pressure.	
3.3	<u>PARTITIONS, PANELING, PELMETS, FURNITURE, ETC</u>	
3.3.1	General These shall conform to drawings in all details. No unsightly nailmarks etc. shall be permitted. Plywood grains shall be matched to give a uniform and pleasing appearance.	

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3.3.2 Partition Shall be checked for rigidity of fixing, plumb and horizontal as well as vertical alignment. 3.3.3 Pelmet Shall be checked for rigidity of fixing and adequate clearance of fixture. 3.3.4 Cupboard Shutters Shall operate smoothly without jamming and locks, bolts and double ball catches shall engage securely. Single ball catches shall not be used. 3.3.5 Drawers Shall operate smoothly and have back stops to prevent them from being pushed too far. Locks shall engage securely. 3.3.6 Loose Furniture When placed on a level surface tables tops etc. shall be horizontal and the pieces stand stably on legs or supports.		
4.0 <u>I.S. CODES</u> Some of the important relevant Codes for the Section are: (a) IS:4021 : Timber door, window and ventilator frames (b) IS: 1003 : Timber paneled and glazed shutters (c) IS:2191 : Wooden flush door shutter (Cellular and hollow core type). (d) IS:2202 : Wooden flush door shutters (solid core type).		

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VOLUME VI-B SECTION – 13 SUSPENDED CEILING		

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1.0 <u>SCOPE</u> This specification covers the furnishing of all materials, labour, tools, equipment, supervision and services necessary for incidental to the supply, installation, finishing and completion of suspended ceiling work of various profiles and at all elevations as per drawing, specification and instruction of Architect/Owner. The work shall also include providing openings in the ceiling for lighting fixtures, air conditioning diffusers etc as shown in drawing and instruction of Architect/Engineer. 2.0 <u>MATERIAL</u> 2.1 <u>ALUMINIUM GRID SUSPENSION SYSTEM</u> 2.1.1 Suspender : Shall be fabricated from 10 dia M.S. rod angle, flast or as required to suit ceiling profile and suspension system with turnbuckle for adjustment of levels. All M.S. works shall have one coat of synthetic enamel paint over a coat of red lead primer. 2.1.2 Frame work/grid : shall be of aluminium sections as follows : Wall angle - 25 x 25 x 1.6 mm. thick. Main Tee - 35 x 25 x 1.6 mm. thick Cross Tee - 25 x 25 x 1.6 mm. thick Tees shall be jointed with adequate cleats etc. 2.2 <u>CEILING PANEL</u> 2.2.1 For 150C Type Un-perforated False Ceiling (a) Un-perforated Aluminium panel of size 150mm wide x 15mm deep made up of 0.5mm thick square edged, panel length up to 6m. Panel shall be clipped to an Aluminium panel carrier of 32mm wide x 39mm		

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deep made of 0.95mm thick in standard length of 5m with cutouts to hold the panels in a module of 150mm. The carrier shall be suspended by means of GI suspension rod of 4mm diameter and a galvanized steel suspension spring clip at a distance of 1.5m (max.) centre to centre in both directions. The suspension rod shall be fixed to RCC ceiling / beam with suitable GI 'J' hook and nylon inserts (galvanization to be done as per IS 1367 – minimum coating 250 g/Sq.m.). The suspension spring clip shall be made of spring steel and shall have cutout and holes to fit into the carrier from one side and hold the rod hanger from another side. Providing and laying Rockloyd Resin Bonded Mineral Wool of density 48 Kg/M3 and thickness 50mm encased in black polythene. (b) The edge profile wherever required as per architectural drawings and direction of Engineer-in-Charge shall be 'L' shaped profile manufactured out of 0.5mm thick Al-Mg Alloy of approved colour and shall be fixed to walls or panels as required. (c) Aluminium panel splice made of 0.5mm thick, 150mm wide x 15mm deep shall be provided and installed to connect / join panels at each point. (d) Aluminium carrier splice made 0.95mm thick, 32mm wide and 39mm deep shall be provided and installed to connect / join carriers at each point. (e) All panels, panel splice, edge profiles shall be made of Aluminium coil coated on a continuous paint line and roll formed from corrosion resistant Aluminium Alloy AA-3105 or equivalent (Al-Mg) for higher strength and good roll forming characteristics. All carriers and their splices shall be made of Aluminium, stove enamelled alloy AA-5050 or AA-5052 or equivalent (Al-Mg) of black colour. (f) Mode of measurement : Measurement shall be wall to wall along with the ceiling. Fascias to be measured separately without any deductions for lights, diffusers, grills etc. Nothing extra shall be paid for cutting and framing around lights, diffusers etc. as well for		

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providing punched holes for sprinklers, smoke detectors etc. as per requirement of architectural drawings. 2.2.2 Aluminium Tile Ceiling of 600mm x 600mm size Tiles (a) The tile size shall be 600mm x 600mm made of 0.7mm thick bevel edged Aluminium Alloy AA-3105 sheet. The tile will be manufactured on advanced equipment, which includes several levelling stages in the manufacturing process. Tile ends will be raised with pipes and stop to ensure positive engagement into the spring to enable for demounting of individual panel. The tile sides will be sufficiently high to ensure a minimum deflection across the length of tile. All tiles will be polyester based, powder coated in white colour. Tiles shall be clipped into clip in profile of 0.5mm thick. The clip in profile shall be at a distance of 600mm center to center. The clip in profile shall be supported from RCC ceiling / beam by means of GI suspension rod shall be fixed to RCC surface by means of suitable expansion wedge hold fastener of minimum size 8mm dia 50mm long made of galvanized steel (galvanization to be done as per IS 1367 – minimum coating 250g/Sq.m.). Providing and laying Rocklloyd Resin Bonded Mineral Wool of density 48 Kg/M3 and thickness 50mm encased in black polythene. (b) Edge profile wherever required, as per architectural drawings and direction of Engineer-In-Charge shall be 'L' shaped or equivalent Aluminium profile of 23mm x 23mm and 0.7mm thick. This profile shall be used in the corner and places where the false ceiling shall be terminated. (c) All perforated panels (if perforated tiles are being selected by the owner in place of non-perforated tiles) shall have non-woven tissue lining black coloured and glazed to the clip-in-profile side for the purpose of acoustical insulation. (d) The clip in profile splice shall be made of 0.50mm thick GI sheet and use to connect clip in profile. (e) Mode of measurement : Measurement shall be wall to wall along with the ceiling. Fascias to be measured separately without any		

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deductions for lights, diffusers, grills etc. Nothing extra shall be paid for cutting and framing around lights, diffusers etc. as well for providing punched holes for sprinklers, smoke detectors etc. as per requirement of architectural drawings. 3.0 <u>INSTALLATION</u> 3.1 The ceiling grid shall be suspended from structural walls slabs, beams truss structural steel etc. with suspender fabricated from M.S.rod/ angles/flasts etc. to the required level. The entire suspension system shall be of sufficient strength and rigidity to allow placing of planks over the grid for movement of maintenance personnel to attend various electrical and air conditioning installation over the ceiling and to carry ceiling panels in true level and plane without exceeding a deflecting of 1/360th of their span. All ceiling panels shall be secured in position using hold down clips of sufficient number. All joints in ceiling panels shall run straight. The installation of ceiling system shall be strictly as per drawing. 4.0 <u>SHOP DRAWINGS</u> 4.1 Contractor shall prepare complete working details layout based on the conceptual layout and design of suspended ceiling and illumination and air conditioning layout shown on the drawings and obtain approval from the Architect/Owner before installation. 5.0 <u>WORKMANSHIP</u> 5.1 Shall be done in the best workmanlike manner by the manufacturer authorised agency in accordance with manufacturer standards and recommendations. 6.0 <u>SAMPLES</u> 6.1 3 (three) mock-up samples of reasonable size showing standard grid with panels and suspender etc. having desired finish, colour etc. shall be submitted to the Architect/Owner for approval before materials are Delivered at site. Installed material shall match approved samples.		

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7.0 <u>ACCEPTANCE CRITERIA</u> Finished ceiling shall be at the correct plane and present a pleasing and uniform appearance, free from sags, warps, figures or damaged boards. Joints, exposed grids etc. shall be in true lines and symmetrically placed in manner shown on drawings. Cutouts for light fixtures, diffusers etc. shall be of exact dimensions and in exact locations. 8.0 <u>I.S. CODES</u> (a) IS:2441 : Code of Practice for fixing ceiling coverings.		

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VOLUME VI-B SECTION – 14 METAL DOORS, WINDOWS, VENTILATORS, LOUVRES, ETC.		

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1.0 <u>SCOPE</u> The work in general shall consist of supplying and/or erecting and installing of all metal doors, windows, ventilators, louvres, glazed partitions, etc. as shown on drawings with all materials complete excluding supply of glass and glazing. The scope of work shall also include the assembly and the Owner from the store at site shall supply erection of all doors, windows, louvres, glazed partitions, etc. for which fabricated materials. Supplying and/or fixing of all door and window accessories and hardware are also included in the scope. 2.0 <u>INSTALLATION</u> 2.1 <u>MATERIALS</u> Steel sections used for fabrication of doors, windows etc. shall be standard rolled steel sections specified in IS: 1038 and IS: 1361 or as specified in drawing and schedules. Steel sheets for frames, shutters, louver blades etc. shall be of gauge mentioned in drawings and schedules. Aluminium sections for fabricating doors, windows, partitions, etc. shall be extruded sections conforming to IS: 1948 and 1949 or as manufactured by Indian Aluminium Company Limited or approved equivalent. The alloy used shall conform to IS Designation HE 9-WP of IS: 733. Hardware and fixtures shall be as specified in "Schedule of Fixtures" and the best quality from approved manufacturers shall only be used. The Tenderer shall specifically state the particular manufacturer's materials he proposes to use. "Schedule of Fixtures" is for the purpose of stating the minimum requirement and improper alignment or faulty operation due to inadequate strength of hardware or fixture shall entirely be the Contractor's responsibility All hardware and fixtures shall be able to withstand repeated use. Door closers shall conform to IS: 3564 and shall be suitable for doors		

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weighing 61- 80 Kg. unless otherwise stated in schedule. Each closer shall be guaranteed against manufacturing defect for one year and any defect found within this period shall be rectified or the closer replaced free of charge. Concealed door closers shall be either floor mounted or transom mounted, suitable for installation with metal doors. It shall conform to the performance requirements & endurance test stated in IS: 3564 Appendix-A. The Contractor shall submit samples of each type of hardware to the Engineer. The approved samples shall be retained by the Engineer for comparison of bulk supply. The samples shall be returned to the Contractor towards the end for incorporation in the job. The mastic for caulking shall be of best quality from a manufacturer approved by the Engineer. In general, the mastic for fixing of metal frames shall be as per IS: 1081 and/or as approved by the Engineer. 2.2 FABRICATION 2.2.1 Steel Doors, Windows, Ventilators, Louvers, etc. (a) Door Frames Frames shall be fabricated from 16 G sheets. They shall be mortised, reinforced, drilled and tapped for hinges and lock and bolt strikes. Where necessary, frames shall be reinforced for door closers. Welded construction with mitered corners shall be used. Rubber door silencers shall be furnished for the striking jamb. Loose "T" masonry anchors shall be provided. Frames shall finish flush with floor and adjustable floor anchors shall be supplied. Frames shall be brought to site with floor ties/weather bars installed in place. (b) Double Plate Flush Door Shutters Door shutters shall be 45 mm thick, completely flush design and shall comprised of two outer sheets or 18 G steel sheets, rigidly connected and reinforced inside with continuous vertical 20 G stiffeners, spot welded in position at not more than 150 mm on centers.		

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Both edges of doors shall be joined and reinforced full height by steel channels placed immediately inside and welded to the door faces. Top and bottom of doors shall be reinforced horizontally as shown on drawing by steel channels running full width of door. Doors shall not have more than 2.5 mm clearance at jambs and heads, shall have proper level on lock stiles and rails to operate without binding, and shall be reinforced at corners to prevent sagging or twisting. Pairs or double doors shall have meeting stile edges bevelled or rebated. Where shown on drawing or called for in the schedule of items the doors shall be sound deadened by filling the inside voids with mineral wool or other suitable approved materials. Doors shall be mortised, reinforced, drilled and tapped in shop for hinges, locks and bolts. They shall also be reinforced for closers, push-plates and other surface hardware where necessary. Any drilling and tapping required for surface hardware shall be done at site. Where shown in drawing, provision shall be made for fixing glazing, vision panels, louvers etc. glazing mouldings shall be of 18 G steel or extruded aluminium sections with profiles shown in drawing and suitable for fixing 6 mm glass. Louvers blades shall be V or Z shaped and made out of 16 G sheets. (c) Single Sheet Door Shutters Single sheet doors shall be made from best quality 18 G mild steel sheets and shall present a flush surface on the outside. The inside shall be stiffened with semi-tubular edge and central stiffening rail, which shall convey the lock and other furniture. The frames shall be made from best quality 16 G mild steel sheets. Wherever required as shown on drawings, provisions for fixing glass panes, louvers, etc. shall be made. The manufacturing shall be done as specified in clause No .2.2.1.b "Double Plate Flush Door Shutters". (d) Sliding Doors Sliding doors shall be either double plate or single plate construction		

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as called for in drawings and schedules made out of 18 gauge steel sheets with adequate stiffeners. The Contractor shall specify the weight of the door in his shop and submit the manufacturer's catalogue of the sliding gear he proposes to use. Where shown on drawings or call for in the Schedule of Items, the Contractor shall make provision for openings to the door for monorail beams. Doors shall close positively to exclude rainwater from seeping in. When called for in schedule, sliding doors shall withstand specified wind loads without buckling or jamming. The door shall slide freely under all ambient conditions. (e) Door Threshold Door threshold shall be provided as shown on drawing. Doors without threshold shall have bottom tie of approved type. (f) Steel Windows, Sashes, and Ventilators etc. These shall conform in all respects to IS: 1038 and IS: 1361 latest editions and as shown on drawings. The details as called for in the above codes shall be applicable for coupling mullions, transoms, weather bars, pivot arrangements for ventilators, etc. or as shown on drawings or called for in the Schedule of Items. All welds shall be dressed flush on all exposed and contact surfaces. Where composite unit openings are shown on drawings, the individual window units shall be joined together with requisite transoms and mullions as shown on drawings. All windows shall be outside glazed fixed with putty or metal glazing beads as shown on the drawings and/or specified under Schedule of Items. Where aluminium glazing beads are specified they shall be extruded aluminium channel 9.5 mm x 9.5 mm x 1.6 mm (Indal Section No. 2209) unless otherwise shown on drawings. Aluminium beads shall be given one coat of zinc chromate primer before fixing to windows. 2.2.2 Aluminium Door, Windows and Frames Extruded sections shall have a minimum 3 mm wall thickness. All sections shall be approved by the Engineer before fabrication is taken up. Doors,		

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frames, mullions, transom etc. shall be anodized in a bath of sulphuric acid to provide a clear coating of minimum 0.6 mm thickness. The anodized materials shall then be sealed by immersing in boiling water for 15 minutes. A protective transparent coating shall be applied to the sections before shipment from the factory. All work shall be fitted and shop assembled to a first class job and ready for erection. Shop joints shall be made to hairlines and then welded or braced by such method as will produce a uniform colour throughout the work. Work on the above, other than described, shall be carefully fitted and assembled with neat joints with concealed fasteners. Wherever possible, joints shall be made in concealed locations and on edges of doors. Field connections of all work may be made with concealed screws or other approved type of fasteners. Glazing beads shall be snap fit type without visible screws and shall be of sizes to accommodate 6 mm thick glazing. All work shall be adequately braced and reinforced as necessary for strength and rigidity. 2.2.3 Aluminium Structural Glazing Providing and fixing of barriered semi unitised structural glazing system at all levels through designing and selection of mullion and transoms profiles anodised (15 to 20 micron) or powder coated (50 to 70 micron), selected for their fixing on the structure depending on the structural conditions, functional, statistical requirement and should withstand the wind load criteria as per IS-875 (part-III) – 1987. System should provide proper rebate areas for air pressure compensation /water drainage at required stages. Double insulated hard coated toughened glass consist of 6mm outer single safety glass, 12mm inter space and 6mm inner clear glass panel glued onto the glass glazing frame profile selected according to the vision / spandrel panel (Aluminium Composite Panels) requirement with DC 995 structural sealant. Proper supporting element should be provided for taking care of the respective infill load and reliving in case of the glass bonding failure. (The profile sections shall be Hindalco Alupuram unit, HYDRO product or equivalent). Floor to floor height would be 4.2m approx and width of glazing supporting frame would be 1.0m approx.		

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2.3 <u>SHOP COAT OR PAINT</u> The shop paint for steel doors, windows, etc. shall be best lead or zinc chromate primer paint from approved manufacturer. All surfaces shall be thoroughly cleaned of rust, grease, loose mill scales etc. and given one coat of shop paint. Portions like mullions, transoms etc. that will be inaccessible after assembly of units shall be given an extra coat of paint before assembly. Where called for in the Schedule of Items all steel doors, windows, etc. shall be hot dip galvanised to give a coating weight of 1-1/2 - 2 Oz per sq. ft. One coat zinc chromate primer coat shall then be applied as shop paint. Portions of aluminium frame which come in contact with masonry construction shall before shipment from workshop be protected with a heavy coat of alkali paint. Aluminium coming in contact with other incompatible metals shall be coated with zinc chromate primer. 2.4 <u>HANDLING & STORAGE OF FABRICATED MATERIAL</u> All metal doors, windows, etc. shall be packed and crated properly before dispatch to ensure that there will be no damage to the fabricated materials. Loading into wagons and trucks shall be done with all care to ensure safe arrival of materials at site in undamaged condition. When taking delivery of items supplied by Owner, the Contractor shall satisfy himself that the items supplied are upto the specified standard. Any defect detected shall promptly be brought to the notice of the Engineer. All metal doors, windows, etc. shall be stored under cover in a way to prevent damage or distortion. Special care shall be taken to prevent staining of aluminum products by rust, mortar, etc. 2.5 <u>ASSEMBLY & ERECTION AT SITE</u> In general, the fixing of steel doors, windows, ventilators, louvers, etc. shall conform to IS: 1081 and as shown on drawings. The Contractor shall assemble and install all steel doors, windows, sashes, fixed metal louvers, etc. including transoms and mullions for composite units in		

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respective places as shown on drawing keeping proper lines and levels, and in approved workman like manner to give trouble free and leak-proof installations. The installation shall be done according to the instructions of the manufacturer, and/or as approved by the Engineer. If required by the Engineer, the installation shall have to be carried out under the supervision of the manufacturer's staff. The Contractor shall take every precaution against damage of the components during installation. Necessary holes, chases, etc. required for fixing shall be made by the Contractor and made good again as per original, after installation without any extra charge. After installation of steel doors, windows, etc. all abrasions to shop-coat of paint shall be retouched and made good with the same quality of paint used in shop coat. All coupling mullions, transoms, frames, etc. in contact with adjacent steel and other members, shall be well bedded in mastic. The Contractor shall bring to the site the mastic cement in original sealed containers of manufacturer and shall apply it as per the instructions. For all frames supplied by either the Owner or the Contractor mastic shall be supplied by the Contractor and caulking done properly as per drawings, specifications and as per instructions of the Engineer. Door shutters, partitions hardware fixtures etc. shall be fixed only after major equipments have been installed in rooms Wherever required nylon cords of approved quality shall be supplied along with pivoted sashes and shall be of adequate length to terminate one metre from the floor. Loose ends of cords shall end in metal or plastic pull as approved by the Engineer. 3.0 <u>ACCEPTANCE CRITERIA</u> 3.1 <u>FOR FABRICATED ITEMS</u> 3.1.1 Overall dimensions shall be within ± 1.5 mm of the size shown on drawings. 3.1.2 Mullions, transoms etc. shall be in one length and permissible deviations from straightness shall be limited to ± 1.5 mm from the axis of the member.		

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3.1.3 Door and window shutters shall operate without jamming. The clearance at head and jamb for door shutters shall not exceed 1.5 mm. For double leaf doors, the gap at the meeting stiles shall not be more than 1.5 mm. 3.1.4 Door leaves shall be undercut where shown on drawings. 3.1.5 Doors, windows, frames, etc. shall be on a true planes, free from warp or buckle. 3.1.6 All welds shall be dressed flush on exposed and contact surfaces. 3.1.7 Correctness of location and smoothness of operations of all shop installed hardware and fixtures. 3.1.8 Provisions for hardware and fixtures to be installed at site. 3.1.9 Glazing beads shall be cut with mitered corners. 3.1.10 Glazing clips, fixing devices etc. shall be supplied in adequate numbers. 3.1.11 Shop coats shall be properly applied. 3.1.12 Exposed aluminium surfaces shall be free from scratches, stains and discolouration. Anodised surfaces shall present a uniform and pleasing look. 3.2 <u>FOR INSTALLED ITEMS</u> 3.2.1 Installations shall be at correct location, elevation and in general on a true vertical plane. 3.2.2 Fixing details shall be strictly as shown on drawings. 3.2.3 Assembly of composite units shall be strictly as per drawings with mastic caulking of transoms and mullions, gaskets, weather strips etc. complete		

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3.2.4	All frames on external walls shall be mastic caulked to prevent leakage through joint between frames and masonry.	
3.2.5	All openable section shall operate smoothly without jamming.	
3.2.6	Locks, fasteners, etc. shall engage positively. Keys shall be non interchangeable.	
3.2.7	Cutting to concrete or masonry shall be made good and all abrasions to shop paint shall be touched up with paint of same quality as shop paint.	
3.2.8	Aluminium doors, windows, etc. shall be free from scratches stain or discolouration.	
4.0	<u>INFORMATION TO BE SUBMITTED</u>	
4.1	<u>WITH TENDER</u>	
4.1.1	Names of manufacturers for doors, windows, etc.	
4.1.2	Manufacturer's catalogue for all hardware and fixtures proposed to be used.	
4.2	<u>AFTER AWARD</u>	
4.2.1	Before starting fabrication of all metal doors, windows, etc. the Contractor shall submit detailed fabrication drawings to the Engineer for approval. The fabrication shall be started only after approval of drawings.	
4.2.2	He shall submit a programme of work to be done for the approval of the Engineer.	
4.2.3	Before bulk supply, he shall submit for the approval of the Engineer samples of all bought out items and samples of each type of fabricated items. The samples shall be retained by the Engineer for comparison of bulk supply and returned to the Contractor towards the end for final incorporation in the job.	

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5.0 <u>I.S. CODES</u> Following are some of the important I.S. Codes as relevant to this section: (a) IS: 1038 : Steel doors, windows and ventilators (b) IS: 1361 : Steel windows for industrial buildings (c) IS: 1948 : Aluminium doors windows and ventilators (d) IS: 1949 : Aluminium windows for industrial buildings (e) IS: 4351 : Steel doorframes (f) IS: 1081 : Code of practice for fixing and glazing of (steel and aluminium) doors, windows, And ventilators. Metal		

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1.0 <u>SCOPE</u> The work in general shall consist of supplying and fixing all glass and glazing including all clips, putty, mastic cement etc. wherever required as shown on drawings and specifications, supply of metal glazing beads and neoprene gaskets shall not be included in this scope. This shall also include the fixing of all glass and glazing supplied by the Owner at his site stores. 2.0 <u>INSTALLATION</u> 2.1 <u>GENERAL</u> The Contractor shall supply and install all glass and glazing as required for various doors, windows, sashes, ventilators and fixed louvres, miscellaneous glazing and partitions, unless otherwise stated from approved manufacturer having uniform refractive index and free from flaws, specks and bubbles. The glass shall be brought to site in the original packing from the manufacturer and cut to size at site. 2.2 <u>MATERIALS</u> 2.2.1 Glare reducing or heat absorbing glass shall be of approved manufacturer and special care shall be taken to grind smooth and round off the edges before fixing. 2.2.2 Glass shall be float glass of required thickness and shall be clear or tinted as indicated. 2.2.3 Wired glass shall be thick rolled glass with centrally embedded 42g. Wire mesh of Georgian type. This may be of clear or coloured glass, as shown on drawings. 2.2.4 Obscure glass shall have a cast surface in one side. 2.2.5 Coloured and figured glass shall be as per approved sample.		

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2.2.6 In general, the putty shall conform to IS : 400 and be of best quality from approved manufacturer. It shall be brought to site in the manufacturer's original packing. Quick setting putty glass is used where it shall be non-setting type. 2.2.7 EPDM gaskets with snap-fit glazing beads shall be fixed as per manufacturer's instructions and shall sit snugly against glass to give a leak proof installation. 2.2.8 Float glass 2.2.9 Double glazing 2.3 <u>GLAZING, SETTING AND FINISH</u> All glazing clips, bolts, nuts, putty, mastic cement etc. as required shall be supplied by the Contractor. All glass shall be thoroughly cleaned before putting in position. Each glass pane shall be held in place by special glazing clips of approved type. As specified in relevant I.S. Codes, four glazing chips shall be provided per glass pane, except for large panes where six or more clips shall be used as per Engineer's instructions. All holes that may be necessary for holding the clips glazing heads and all other attachments shall be drilled by the Contractor. Glass panes shall be set without springing, and shall be bedded in putty and back puttied, except where moulding or gasket are specified, putty, mastic cement etc. shall be smoothly finished to the even line and figured glass shall be set with smooth side out. After completion of glazing work, the Contractor shall remove all dirt stains, excess putty etc. clean the glass panes and leave the work in perfectly acceptable condition. All broken cracked or damaged glass shall be replaced by new ones.		

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3.0 <u>ACCEPTANCE CRITERIA</u> 3.1 All installation shall be free from cracked, broken or damaged glass. Edges of large panes of thicker glass and heat absorbing glass shall be inspected carefully for chipped, cracked or underground edges. 3.2 Glazing shall be carefully done to avoid direct contact with metal frames. 3.3 All glass shall be embedded in mastic or fixed by neoprene gaskets to give a leak proof installation. 3.4 At completion, the panes shall be free from dirt, stains, excess putty etc. to the complete satisfaction of the Engineer. 4.0 <u>I.S. CODES</u> Following are some of the important I.S. Codes relevant to this Section: (a) IS : 3548 : Code of practice for glazing in building. (b) IS:1083 : Code of practice for fixing and glazing metal doors, windows & ventilators.		

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1.0 <u>SCOPE</u> This specification covers the design, supply of materials, fabrication, delivery and erection of Rolling Shutters/Grills with motor drive and/or manual operation including all accessories as hereinafter specified. 2.0 <u>INSTALLATION</u> 2.1 <u>COMPONENTS</u> 2.1.1 Slats for rolling shutters shall be made from tested bright cold rolled, annealed M.S. strips, not less than 0.9 mm thick for shutters upto 4.5 M wide and not less than 2.25 mm thick for shutters 5.5 M wide and above, machine rolled at 75 mm rolling centres, interlocking with each other. The profile will be such as to prevent excessive deflection under specified wind load. 2.1.2 Rolling grills shall be constructed out of 6 mm dia. rods at 35 mm on centres running horizontally flexible connected with vertical links spaced not more than 200 mm centres. Alternatively, rolling grills shall be made from perforated slats of approved design reinforced with 6 mm dia rods. 2.1.3 End locks shall be heavy type M.C.I./C.I. and shall be provided at each end of alternate slats unless specified otherwise in the Schedule. 2.1.4 Bottom bars shall be finished with two angles not less than 6 mm thick for external shutters. When shown on drawings, a flexible weather strip shall be applied to make tight contact with the floor. 2.1.5 Guides shall be of such depth as to retain the shutter under a wind pressure of 100 Kg/Sq.M or as specified in Schedule. 2.1.6 Shafts shall be of steel pipe of sufficient size to carry the torsion load with a maximum deflection of 1/360th of span. 2.1.7 Grease packed ball bearings or bushings shall be provided for smooth trouble free operation.		

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2.1.8 2.1.9 2.1.10 2.1.11 2.1.12 2.2	Hoods shall be formed of not less than 20 gauge steel, suitable reinforced to prevent sag. Locks shall be slide bolt and hasp, or cylinder lock operable from one or both sides. Provision securing hand chain with pad-lock, provision for removable handle for hand cranks etc. shall be made as described in Schedule or as described by the Engineer. Power unit shall be suitable for 3 phase, 50 cycle, 400 volt A.C. power supply and shall be either floor or wall mounted unit. The motor shall be of sufficient capacity to move the shutter in either direction at a speed of 0.3 metres per second. In addition to the gear motor each standard power unit shall include a magnetic brake, a reversing starter with built-in overload protection, a geared limit switch and one push button station located inside the building unless otherwise stated drawing. It is desirable that the bottom bar of motor operated doors shall be provided with a sensitive edge, electrically connected to stop the travel of the door on meeting an obstruction. Operating chains shall be of tested quality, heavily galvanised and with all ends rounded to assure smooth operation and hand protection. Reduction gears shall be high strength gray cast iron, machine moulded from machine out patterns. <u>MANUALLY OPERATED SHUTTERS/GRILLS</u> Manually operated shutters shall be easily operable by one person. The speed of operation shall be about 1.3 metres per second. In general, manually operated shutters shall be push pull type for openings upto 9 Sq. metre in area. Larger shutters shall be either chain and gear operated or crank and gear operated. The crank handle shall be removable. All shutters shall be lockable from one or both sides as described as desired by the Engineer.	

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2.3	<u>POWER OPERATED SHUTTERS/GRILLS</u> These shall be operable from a push button station conveniently located beside the door or as shown on drawings. One emergency hand chain/crank operation shall also be provided for use in case of failure of the electric system. Where called for in Schedule, externally mounted shutters shall be operated by control mechanism located inside the building.	
2.4	<u>SHOP COAT</u> Shutters shall be painted with one coat of red lead or zinc chromate primer. Where specified, doors shall be galvanized and subsequently painted one coat of zinc chromate for adhesion of field coat.	
2.5	<u>ERECTION</u> Door shall be installed by the manufacturer or his authorised representative and all work shall be as per manufacturer's instructions. Any drilling or cutting to concrete, masonry etc. shall be made good after erection of shutters and all abrasion to shop coat shall be touched up. All electrical work shall be in strict accordance with the latest Indian Electricity Rules.	
3.0	<u>ACCEPTANCE CRITERIA</u>	
3.1	<u>SHOP INSPECTION</u> After completing the manufacture of the different components of the rolling shutter, an arrangement for shop inspection by the Engineer shall be made to check the conformity with approved shop drawings.	
3.2	<u>FIELD INSPECTION</u> After installing the shutters, the Contractor shall test the performance of the shutter in the presence of the Engineer. The doors shall be smoothly operable under all ambient conditions. All control and locking devices shall give fault-free performance.	

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3.3 <u>GUARANTEE</u> The Contractor shall give one year's guarantee for the successful operation of the shutters. This shall be supported by a separate and unilateral guarantee from the manufacturer of the shutters. 4.0 <u>I.S. CODE</u> (a) IS: 6248 - Metal rolling shutters and rolling grills		

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1.0 <u>SCOPE</u> This specification shall generally be read in conjunction with section IV and V This shall include supply, fabrication and erection of miscellaneous metal items of light nature in gates, grills, balcony and stair handrails particulars, structural mullions and transoms, ladders hangers masonry anchors, shelf angles, anchor bolts, fasteners, etc. as shown on drawing or as instructed by the Engineer. The above items shall be of fabricated or cast M.S/Aluminium/Brass, cast iron, M.S. and galvanised M.S. Sheets, aluminium sheets, expanded metal, wire mesh etc. as shown on drawings and/or described. 2.0 <u>INSTALLATION</u> 2.1 <u>FABRICATION/CASTING</u> 2.1.1 General All work shall be done according to approved shop drawings. All workmanship shall be equal to the best practice in modern structural or foundry shop. 2.1.2 Shop Connections (a) All shop connections shall be riveted or welded except when noted otherwise on drawings. (b) Welding of steel shall be done in accordance with the IS: 816. Use of metal arc welding for general construction in Mild Steel. (c) Welding of aluminium shall be done in accordance with IS: 2812, Arc welding of Aluminium and Alloys, Special care shall be taken to grind smooth all welded surface that shall remain exposed to view. Welds shall be electrically continuous if so required by the Engineer.		

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2.1.3 Shop Coat Before leaving the shop, all metal work shall be thoroughly cleaned by effective means of all loose mill/ scale, rust and foreign matter. Except where encased in concrete, all steelwork shall be given one coat of approved metal protective paint, applied by brush thoroughly and evenly, well worked into joints and other open spaces. All paint shall be applied to dry surfaces. Steel work shall be galvanised or galvanized and painted with a coat of zinc chromate primer. Aluminium surfaces which shall come in contact with masonry shall be given one coat of zinc chromate primer. 2.2 <u>ERECTION</u> 2.2.1 Bracing The Contractor shall provide all necessary temporary guys and braces to ensure alignment and stability of the members and to take care of all loads to which the structure may be subjected including erection of equipment and operation of the same. 2.2.2 Temporary Bolting-Up As erection proceeds the Contractor shall plumb up and level all members and shall securely bolt up to take care of all dead load, wind load and erection stresses. Wherever piles of materials, erection equipment or other loads are carried during erection, proper provision shall be made to take care of the stresses resulting from the same. 2.2.3 Turned Bolt For field connections where bolting is specified, holes for the turned bolts may be reamed in the field, if required. All drilling or reaming for turned bolts shall be done after the parts to be connected are assembled. 2.2.4 Welding Where specified on drawings, welding shall be done in accordance with IS:		

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816 for steel and IS: 2812 for Aluminium and Alloys. 2.2.5 Cutting and Fitting No cutting of sections, flanges, webs of angles shall be done without the approval of the Engineer. Where indicated on the drawings, holes, cuttings, etc. shall be provided as required for installation, to the work by the other Contractors. No additional holes or cuttings, than those shown on drawings, shall be made without the approval of the Engineer. 2.2.6 Drifting Correction of minor misfits and a reasonable amount of reaming and cutting of excess stock from rivets may be permitted. For this, light drifting may be allowed to draw holes together. Twist drills shall be used to enlarge as necessary to make connections. Reaming that weakens the members or makes it impossible to fill the holes properly or to adjust accurately after reaming shall not be allowed. Any error in shop work which prevents the proper assembling and fitting of parts by moderate use of drift pins or a moderate amount of reaming and slight chipping and cutting shall immediately be called to the attention of the Engineer and approval of the method of correction obtained. The use of cutting torches to enlarge or alter rivet holes shall not be permitted. 2.2.7 Grouting All bearing plates, loose lintels and beams, etc. shall be set to proper grade and level by the Contractor and the Engineer's approval obtained before proceeding with the grouting. Grouting shall be done in 1:1.5:3 or 1:1- 1/2:3 concrete with 6 mm down stone chips. 2.2.8 Anchor Bolting When shown on drawings, the miscellaneous metal items shall be fixed to concrete by case hardened and drawn carbonizing steel expander nut and bolt. The Contractor shall submit the manufacturer's literature		

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showing the average pull out and average shear values for bolts of various sizes. The bolts shall be fixed strictly as per the manufacturer's instructions. 2.2.9 Pipe Joints M.S. Pipes shall be joined by threaded sockets or by welding. Cast iron pipes shall be socket and spigot jointed and caulked with hemp and molten lead. 2.2.10 Spot Painting All field rivets and bolts and also any serious abrasion to shop paint shall be spot painted with the same materials as used for the shop paint. 2.2.11 Making Good All cutting to concrete or masonry shall be made good to the satisfaction of the Engineer. 3.0 <u>ACCEPTANCE CRITERIA</u> 3.1 All items shall be of correct shape, size, weight etc. shown on drawings. 3.2 For installed items, the tolerances shall be follows : 3.2.1 Permissible deviation from straightness - 1 in 1000. 3.2.2 Seats, stiffener connections etc. Shall be as per approved drawings and shall not interfere with architectural clearances. 3.2.3 All castings shall be free from blow holes, cracks and other blemishes. 4.0 <u>I.S. CODES</u> (a) IS : 226 : Structural Steel (Standard Quality). (b) IS:800 : Code of practice for use of structural steel in general building construction..		

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(c) IS : 816 : Use of metal arc welding for general construction in mild steel. (d) IS : 2812 : Arc welding of Aluminium and Alloys. (e) IS : 3150 : Hexagonal Wire Netting. (f) IS : 4948 : Welded steel wire fabric for general use.		

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1.0 <u>SCOPE</u> This specification covers painting, white washing, varnishing, polishing etc. of both interior and exterior surfaces of wood work, masonry, concrete plastering, plaster or Paris, Punning false ceiling, structural and other miscellaneous steel items, rain water down comer, floor and roof drains, soil, waste and service water pipes, and other ferrous and non-ferrous metal items as shown on drawings, or as directed by the Engineer. Copper, bronze, chromium plate, nickel, stainless steel, aluminium and monel metal shall generally not be painted or finished except if otherwise specified. The painting Contractor shall inspect the work of others prior to the application of paint. If surface to be finished cannot be put in suitable condition for painting by customary preparatory methods, the painting contractor shall notify the Engineer in writing or assume responsibility for and rectify unsatisfactory finishing that results. Before commencing painting, the painting Contractor shall obtain the approval of the Engineer in writing regarding the schedule of work to minimize damage, disfiguration or staining by other trades. He shall also undertake normal precautions to prevent damage, disfiguration or staining to work of other trades or other installations. 2.0 <u>INSTALLATION</u> 2.1 <u>MATERIALS</u> Materials shall be highest grade products or well-known approved manufacture and shall be delivered to the site in original sealed containers, bearing brand name, manufacturer's name and colour shade, with labels intact and seals unbroken. All materials shall be subject to inspection, analysis and approved by the Engineer. It is desired that materials of one manufacturer only shall be used as far as possible & paint or one shade is obtained the same manufacturing batch. All paint shall be subject to analysis from random samples taken at site from painter's bucket, if so desired by the Engineer.		

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All prime coats shall be compatible to the material of the surface to be finished as well as to the finishing coats to be applied. All unspecified materials such as shellac, turpentine or linseed oil shall be of the highest quality available and shall conform to the latest IS standards. All such materials shall be made by reputable recognised manufacturers and shall be approved by the Engineer. All colours shall be as per painting schedule and tinting and matching shall be done to the satisfaction of the Engineer. In such cases, where samples are required, they shall be executed in advance with the specified materials for the approval of the Engineer. 2.1.1 White Washing Shall be done from pure shell lime or fat lime, or a mixture of both as instructed by the Engineer; and shall conform to IS:712 latest edition. Samples of lime shall be submitted to the Engineer for approval, and lime as per approved sample shall be brought to site in unslaked condition. After slaking, it shall be allowed to remain in a tank of water for two days and then stirred up with a pole, until it attains the consistency of thin cream. 100 grams of gum to 6 litres of white wash water and a little quantity of indigo or synthetic ultramarine blue shall be added to the lime. 2.1.2 Dry distemper Shall be made from suitable pigments, extenders, lime proof tinters, water soluble binders etc. and shall conform to IS:427. 2.1.3 Oil Bound Washable Distemper Shall be of oil emulsion type, containing suitable preservatives and shall conform to IS: 428. 2.1.4 Waterproof Cement Paint Shall be made from best quality white cement and lime resistant colours with accelerators, waterproofing agents and fungicides. The paint shall		

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conform to IS: 5410. 2.1.5 Acrylic Emulsion Paint Shall be water-based acrylic copolymer emulsion with rutil titanium dioxide and other selected pigments and fungicide. It shall exhibit excellent adhesion to plaster and cement surface and shall resist deterioration by alkali salts. The paint film shall allow the moisture in wall to escape without peeling or blistering. The paint, after it is dried, shall be able to withstand washing with mild and water without any deterioration in colour, or without showing flaking, blistering or peeling. 2.1.6 Synthetic Enamel Paint Shall be made from synthetic resins and drying oil with rutil titanium dioxide and other selected pigments to give a smooth, hard, durable and glossy finish to all exterior and interior surfaces. White and pastel shades shall resist yellowing and darkening with aging. The paint shall conform to IS: 2932 and IS: 2933. 2.1.7 Aluminium Paint Shall be in two pack containers and shall resist weathering. The paint shall conform to IS: 2339. 2.1.8 Shall be best quality alkyd varnish suitable for brushing over the tint of paint or light natural wood and shall not darken or yellow with age. 2.1.9 French Polish Shall be made from best quality shellac, denatured spirit and other suitable alcohol soluble ingredients and made by a well known approved manufacturer. The material shall conform to IS:348. French polish shall not be used on bare wood. It shall only be used as finishing coat on wood after the wood is pre-treated with liquid wood filler conforming to IS: 345 is applied and rubbed out.		

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2.2	<u>STORAGE</u> The Contractor shall arrange for safe and proper storage of all materials and tools. The storage space if allotted within the building shall be adequately protected from damage, disfigurement & stains. Paint shall be kept covered at all times and mixing shall be done in suitable containers. All necessary precautions shall be taken by the Contractor to prevent fire.	
2.3	<u>PREPARATION OF SURFACE</u> Before starting the work the Contractor shall obtain the approval of the Engineer regarding the soundness & readiness of the surface to be painted on.	
2.3.1	Wood All surfaces shall be free from dirt and loose or peeling paints. The surface shall be rubbed down smooth. All nails & screws shall be sunk below the surface and filled with putty after applying an under coat. Small knots that do not justify cutting and sap streaks shall be covered with minimum 2 coats of pure shellac coating applied thinly & extended 25 mm beyond the area. All large, loose or resinous knots shall be removed and filled with sound wood. All work shall be done as per IS: 2338.	
2.3.2	Masonry, Concrete and Plastered Surface Surface shall be free from all oil, grease, efflorescence, mildew, loose paint or other foreign and loose materials. Masonry cracks shall be cleaned out and patch filled with mortar similar to the original surface and uniformly textured. Where this type of re-surfacing may lead to the finishing paint being different in shade from the original surfaces, the resurfaces area shall be treated with minimum one coat of cement primer, which should be continued to the surrounding area for a distance of minimum 100 mm. Surface with mildew or efflorescence shall be treated as below: (a) Mildew	

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All mildewed surfaces shall be treated with an approved fungicide such as ammonia cal wash consisting of 7g of copper carbonate dissolved in 80 ml. liquor ammonia and diluted to 1 litre with water, or 2.5 percent magnesium silicofluoride solution and allowed to dry thoroughly before paint is applied. 2.3.3 Metal All metal surfaces shall be absolutely clean, dry and free from wax, grease or dried soap films. In addition, all steel and iron surfaces shall be free from rust, surfaces shall be cleaned by mechanical power tools to remove mill scales unless otherwise approved by the Engineer for exposed chemical resistant paints, surfaces shall be blast cleaned to near white metal. All galvanised iron surfaces shall be pre-treated with a compatible primer according to the manufacturer's direction. Any abrasion in shop coat shall be touched up with the same quality of paint as the original coat. 2.4 <u>APPLICATION</u> 2.4.1 General The method of application shall be as recommended by the manufacturer. In case of selection of special shades and colour (not available in standard shades) the Contractor shall mix different shades and prepare test panels of minimum size 1 meter square as per instruction of the Engineer and obtain his approval prior of application of finishing paints. Proper tools and implements shall be used. Scaffoldings if used shall be independent of the surface to be painted to avoid shade differences of the freshly repaired anchor holes. Painting shall be done by skilled labours in a workmanlike manner. All materials shall be evenly applied so as to be free of sags, runs, crawls or other defects. All coats shall be of proper consistency. In case of application by brush, no brush marks shall be visible. The brushes shall be clean and in good condition before application of paint. All priming undercoats for painting shall be applied by brush only, and rollers spray equipments etc. shall not be used.		

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No work shall be done under conditions that are unsuitable for production of good results. No painting shall be done when plastering is in progress or is drying. Application of paint, which seals the surfaces to moisture, shall only be done after the moisture on and below the surface has dried out. All coats shall be thoroughly dry before succeeding coat is applied. Coats of painting as specified are intended to cover surfaces perfectly. In case the surface is not covered properly by applying the specified number of coats, further coats shall be applied by the Contractor when so desired by the Engineer. All primers and undercoats shall be tinted to approximate the colour of the finishing coats. Finished coats shall be of exact colour and shade as per approved samples and all finish shall be uniform in colour and texture. All parts of mouldings and ornaments shall be left clean and true to finish. Painting on ferrous metal surface shall be done as per IS: 1477 (Part 1 & 2). The total dry thickness of the film should not be less than 120 micron. 2.4.2 White Washing The surface where white washing is to be applied shall be cleared of all loose materials and dirt. All holes and irregularities of the surface shall be filled up with lime putty and shall be allowed to dry up before application of the lime solution. One coat of whitewash shall consist of one stroke from top downwards, another from bottom upwards over the first stroke and another from left to right before the previous one dries up. Second coat shall be applied and in case the Engineer feels that one or more coats are required. No brush marks shall show on the finished surface. 2.4.3 Dry Distemper New plastered surface shall be allowed to dry for at least two months. New lime or lime cement plastered surface shall be washed with a solution of 1 part Vinegar to 12 parts water or 1:50 sulphuric acid solution and for		

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	24 hours after which the wall shall be thoroughly washed with clean water. For cement plastered surface, the surface shall be washed with a solution of 100 gms. Of zinc sulphate to 1 litre of water and then allowed to dry. Dry distemping shall be done as per manufacturer's instruction. In applying the distempers the brush should first be applied horizontally and immediately crossed off perpendicularly. Brushing shall not be continued too long as otherwise brush marks may result. 2.4.4 Oil bound washable distemper The distemper shall be applied after surface is primed with an alkali resistant primer, and followed by minimum two coats of oil bound washable distemper all as per Manufacturer's instruction. 2.4.5 Waterproof Cement Paint Surface to be coated with cement paint shall be washed and brushed down. As soon as the moisture has disappeared, the surface shall be given one coat of paint. Care shall be taken so that the paint does not dry out too rapidly. After 4 to 6 hours, the water shall be sprinkled over the surface to assist curing and prevent cracking. After the first coat has dried (24 to 48 hours) the second coat shall be applied in a similar manner. The finished surface shall be kept moist by occasional sprinkling with water for seven days after painting. 2.4.6 Acrylic Emulsion Paint Lime gauged cement plastered surfaces shall not be painted for at least one month after plastering. A sample patch shall be painted to check alkali reaction if so desired by the Engineer. Painting shall be strictly as per manufacturer's specification.	

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2.4.7 Synthetic Enamel Paint Shall be applied on properly prime red surface. Sub sequential coat shall not be applied till the previous coat is dry. The previous shall be lightly sand papered for better adhesion of subsequent coats. 2.4.8 Aluminium Paint The paint, supplied in two pack containers shall be mixed and applied strictly as per manufacturer's direction. When more than one coat of paint is required or indicated, the next coat shall only be applied after the previous coat become hard dry. 2.4.9 Clear Synthetic Varnish The paint, supplied in two pack containers shall be mixed and applied strictly as per manufacturer's direction The Varnish shall be applied on wood surface after (a) filling; (b) staining & (c) sealing operations are carried out. The application of a combination of filler and stain shall not be permitted. For the finishing coats of varnish, the surface shall be allowed to dry and be rubbed down lightly, wiped off and allowed to dry. Careful attention to cleanliness is required for varnishing. All dust and dirt shall be removed from the surface as well as from the neighbourhood. Damp atmosphere and draughts shall be avoided, and exposure to extreme heat or cold & dampness shall not be allowed. The varnish shall be applied liberally with a brush and spread evenly over a portion of the surface with light strokes to avoid frothing. It shall be allowed to flow on while the next section is being laid on excess varnish shall then be scrapped off the brush and the first section be crossed, recrossed and then laid off lightly. The varnish once it has began to set, shall not be retouched. In case of any mistake in application, the varnish shall be removed and the work started afresh. The varnish shall be minimum of two coats, with the first coat being a flattening varnish. This shall be allowed to dry hard and be flattened down,		

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before applying the next coat. Sufficient time must be allowed between coats to get a hard dry surface before next coat is applied. All work shall be as per relevant IS Code. 2.4.10 French Polish All unevenness of the surface shall be rubbed down to smoothness with sand paper and the surface shall well dusted. The pores in the wood shall be filled up with a paste of whitening in water or methylated spirit with a suitable pigment like burnt sienna or umber. After application of the filler paste, the French polish shall be applied with a pad of woollen cloth covered by a fine cloth. The pad shall be moistened with polish and rubbed hard on the surface in a series of overlapping circles so that the polish is sparingly but uniformly applied over the entire area to give an even surface. A trace of linseed oil may be used on the pad for ease of application. The surface shall be allowed to dry before further coats are applied in the same manner. To finish off, the pad shall be covered with a fresh piece of clean fine cloth, slightly dampened with methylated spirit and rubbed lightly and quickly with circular motions to leave the finished surface with a uniform texture and high gloss. 2.4.11 Chemical Resistant Paint For chemical resistant paints, epoxy, chlorinated rubber or vinyl butyl paint system shall be used manufacturer's recommendation regarding the paint system exposed to moderately severe corrosive condition and subject to acid/alkali spillage and fumes, shall be followed. 2.4.12 Epoxy coating/painting On the clean surface of concrete after properly drying of the following system is to be adopted as per manufacturers' specification: One coat of primer of following proportion to be applied over clean and dried concrete surface by brush application.		

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ARALDITE GY 250 - 100 Parts by weight

HARDENER HY 840 - 50 Parts by weight

Over the primer, the uneven surface of concrete should be filled with levelling putty as mentioned above. The cost of putty is included in the item rate without fixing prior limit to consumption of putty. Two top coats of the protective treatment to be applied over the prepared smooth surface in the following proportion.

(a)	ARALDITE GY 250	:	100 Parts by weight
(b)	HARDENER HY 830	:	45 Parts by weight
(c)	HARDENER BY 850	:	15 Parts by weight
(d)	SILICA FLOUR	:	20 Parts by weight
(e)	FLOW CONTROL AGENT	:	2 Parts by weight

Pigment may be added if desired by Engineer. The first top coat is applied over the primer and is left to reach a tack free state. At this stage, the final top coat is applied.

2.5 PROTECTION

Furniture and other movable objects, equipments, fittings and accessories shall be moved, protected and replaced upon completion of work. All stationary equipments shall be well covered so that no paint can fall on them. Work finished by other agencies shall be well protected. All protections shall be done as per instructions of the Engineer.

2.6 CLEANING UP

In addition to provisions in general conditions the Contractor shall, upon completion of painting etc. remove all marks and make good surfaces, where paint has been spilled, splashed or splattered, including all equipments, fixtures, glass, furniture, fittings etc. to the satisfaction of the Engineer.

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3.0 <u>ACCEPTANCE CRITERIA</u> 3.1 All painted surfaces shall be uniform and pleasing in appearance. 3.2 All varnished surfaces shall be of uniform texture and high glossy finish. 3.3 The colour, texture etc. shall match exactly with those of approved samples. 3.4 All stains, splashes and splatters of paints and varnishes shall be removed from surrounding surfaces. 4.0 <u>I.S. CODE</u> Important relevant IS Codes for this Sections are listed below : (a) IS:348 : Specification for French Polish (b) IS:427 : Specification for Distemper, dry colour as required. (c) IS:428 : Specification for Distemper oil emulsion, colour as required. (d) IS:1477 : Code of Practice for painting of ferrous (I&II) metal in buildings. (e) IS:2338 : Code of Practice for finishing of wood (I&II) and wood based materials. (f) IS:2339 : Specification for Aluminium Paints for general purposes in dual containers. (g) IS:2395 : Code of Practice for painting concrete, masonry and plaster surface. (h) IS:2932 : Specification for enamel, synthetic, exterior, type-I. (i) IS:5410 : Specification for cement paint, colour as required.		

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SECTION – 19

ROOF WATER PROOFING, INSULATION AND

ALLIED WORKS

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1.0 <u>SCOPE</u> This specification covers furnishing, installation, repairing, finishing, curing, testing, protection, maintenance till handing over of roof water-proofing, insulation and allied work for buildings and at locations covered under the scope of the Contract. 2.0 <u>INSTALLATION</u> 2.1 <u>GRADING UNDERBED</u> The surface to receive the underbed shall be roughened and thoroughly cleaned with wire brush and water. Oil patches if any shall be removed with detergent. The surface shall be soaked with water and all excess water removed just before laying of the underbed. The underbed shall not be laid under direct hot sun and shall be kept in shade immediately after laying so as to avoid quick loss of water from the mix and separation from the roof surface. The underbed shall be cured under water for at least 7 days. The underbed shall be laid to provide an ultimate run off gradient not less than 1 in 120 and as directed by the Engineer. Upto an average thickness of 25 mm the underbed shall usually be composed of cement and sand plaster. For higher thickness the underbed shall be made with cement concrete. The underbed shall be finished to receive the waterproofing treatment direct or insulation as the case may be the grading plaster shall be average 25mm thick maximum. It shall consist of cement and coarse sand in the ratio 1:4 nominal by volume. The same and cement shall be thoroughly mixed dry and then water added. Each batch of mix shall be consumed before the initial set starts The plaster shall be fully compacted to the desired grade in continuous operation. The surface shall be even and reasonably smooth.		

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2.2 <u>CONCRETE</u> The concrete shall be used where the sub grade is more than average 25mm thick. It shall consist of cement concrete 1:2:4 nominal mix by volume with 12mm down stone chips and coarse sand. The aggregate shall be mixed dry and minimum quantity of water shall be added to make the mix workable. The mix shall be laid to proper grade, fully consolidated and surface shall be smooth and even. 2.3 <u>INSULATION</u> The Tenderer shall along with the tender send specification of insulating materials he proposes to use and the proposed method of laying. Before bulk supply, the contractor shall send samples of insulating material to the Engineer, and after approval of the samples, the Contractor shall procure and transport the bulk material to the site. Whenever asked by the Engineer, the Contractor shall furnish test certificates from testing laboratory on the insulating and other properties of the materials. After laying the insulation the surface shall be made ready as required to receive the waterproofing treatment. If any plastering is used it shall be not leaner than 1:4 cement sand by volume and not thinner than 12mm and it shall be cured for seven days. 2.3.1 Foam Concrete This shall be of light weight foam concrete of average 75 mm thickness or as specified or as shown on drawings. This may be laid in situ in suitable panels or in precast blocks. The insulating properties shall be such that the thermal conductivity shall not exceed 0.125 Kcl m/m degree C. The weight of the insulating material shall be from 0.3 to 0.5 gm/cm. Before starting the laying of foam concrete samples shall be prepared at site and got tested for approval of the Engineer. The foam concrete laid shall be sufficiently strong to make the usual work load and standard loads expected on the roof. Any damaged portion shall be removed and replaced forthwith. Approval of the Engineer shall be taken before laying the waterproofing over the insulation.		

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2.3.2	While laying the foam concrete, samples from each batch of the mix shall be kept for test if so desired by the Engineer. Expanded Polystyrene Blocks The expanded polystyrene block insulation shall be fire retardant quality and shall have a maximum thermal conductivity of 0.026 KCl m/m degree C. It must be strong enough to withstand without deformation the workload and standard loads expected on the roof. The Contractor shall lay the expanded polystyrene block as per manufacturer's approved specification. Only specifically experienced workers shall be used for this work. If the Engineer is not satisfied about the efficiency of the workers the Contractor shall have to secure manufacturer's supervision. Either of above items (cl. No. 2.3.1 or 2.3.2) can be adopted subject to approval of engineer. 2.4 <u>FILLETS</u> Fillets at junction of roofs and vertical walls shall be provided with the same insulating material as provided for the main roof insulation. The fillets shall be 150 mm x 150 mm in size unless otherwise shown on drawings or instructed by the Engineer. Where there is no insulation over roof slab, fillets shall be cast-in-situ cement concrete (1:2:4) nominal mix by volume. 2.5 <u>WATER PROOFING BY EPOXY RESIN BASED APPLICATION</u> Exposed surfaces of cement concrete, lime concrete or brickwork to be treated for waterproofing by the resin based application shall be thoroughly cleaned and the epoxy resin based material to be applied as directed by the manufacturer. The material shall not have any adverse effect on the surface on which it is applied and must stick to it uniformly to make a strong durable bond. It shall not be affected by short duration from fire, sun, light traffic. The application shall be resistant to growth of fungus and	

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proof against saltpetre action. If desired by the Engineer, a sample shall be prepared in advance and tested for water proofness for 48 hours under 300 mm depth of standing water. The Contractor shall arrange the demonstration by providing free the materials and labours for the application. 2.6 <u>FLASHING</u> Unless otherwise stated flashing shall be done in the same way as the water proofing except that the last layer, instead of being finished with pea- sized gravel, shall be finished with two coats of bituminous primer. The flashing shall be extended up the vertical surfaces as shown on drawing. The flashing shall end in grooves in vertical walls. The grooves shall be at least 65 mm deep and caulked with waterproof of mastic cement. The minimum overlap with horizontal roofing felt shall be 100 mm. Where specified on drawings or directed by the Engineer, metal flashing shall be provided. The metal flashing shall be done as shown on the drawings. The materials shall be 18g or 22g G.I. sheets, as specified on the drawings and/or as directed by the Engineer. 2.7 <u>ELASTROMERIC MEMBRANE</u> 2.7.1 <u>Primer Coat</u> It shall consist of polyurethane (P.U.) or any other equivalent material. Primer coat shall be a special blend of moisture curing urethane pre-polymers in solvent. A single coat of this primer shall be applied by brush /spray with airless pray equipment over the prepared bed as an adhesion coat with an application rate of 6-8 q.m per litre depending on the surface porosity. The primer shall be allowed to dry for a minimum period of 2 to 4 hours time before the successive finishing coats of P.U. liquid membrane are applied. In any case successive finishing coat shall be applied within 24 hours.		

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The substrate shall be properly prepared by removing all loose materials by vigorous brushings, fungal growth with proprietary fungicide as recommended. Priming coat shall not be applied to damp substrate. 2.7.2 Finishing Coats The finishing coats shall consist of two successive liquid coatings of high solid content urethane pre-polymers material to form an elastomeric membrane. Application shall be with brush or spray to form a uniform jointless elastomeric membrane. The overall dry film thickness shall be 1.5 mm subject to minimum 750 gm per sq.m per coat application rate. Each coat shall be allowed to dry for minimum 12 hours before applying the next coat. The surface should be dry and smooth before application. The coating shall be continued up the parapets/walls for minimum of 150 mm over the finished roof surface or fillet with suitable tucking into the vertical wall surface. It shall be continued into rain water pipes by at least 100 mm. The final coat of PU liquid when tacky shall be sprinkled with the sand. For edges, expansion joints and any vulnerable points a layer of polyscrim cloth/fabric are to be embedded between 2 finishing coats. The entire work shall be carried out under the supervision of approved authorized agency. 2.7.3 Surface Finish Areas of roof treatment shall be provided with wearing course consisting of minimum 25 mm thick PCC 1:11/2:3 (using 12.5 mm size aggregate) cast in panel of maximum size of 1.20 m x 1.20 m and reinforced with 0.56 mm diameter galvanized chicken wire mesh and sealing of joints using sealant or elastomeric compound.		

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When the roof surface is subjected to foot traffic or used as a working area, a cement mortar (1:4) shall be applied over the top most layer of roofing treatment. Over this, a layer of chequered cement concrete flooring tiles conforming to IS:13801 shall be provided. The tiles shall be laid as per IS1443. 2.8 <u>WATERPROOFING WITH APP MODIFIED BITUMINOUS MEMBRANE</u> The RCC roof waterproofing with pre-fabricated APP (atactic polypropylene) modified waterproofing membrane with non woven polyester reinforcement treatment of 4 mm thickness, consisting 160 gsm high Molecular high- density non-woven polyester core, coated on both sides with APP modified bitumen which shall have high penetration, high heat resistance and high softening point. It should also achieve good bonding with substrate and a strong adhesion between overlaps. This polymeric Asphaltic mix shall be protected on the bottom with thermo fusible HMHDPE film, on the top with another layer of HMHDPE. The resultant membrane shall have very good elongation to absorb all structural movements. The cement sand plastered surface on foam concrete is first cleaned to eliminate all sharp projections. Suitable bituminous primer @ 0.27L/SQ.M. (IS:3384) is then coated on the surface. APP modified water proofing roll is unrolled over coated surface is first cleaned (with overlaps of 10cm) and bonded completely to the substrata. The overlaps & complete bottom are then thermo-fused by flame. Special care is taken at singularities such as drains , expansion joints etc. 2.9 <u>SURFACE FINISH</u> 18 mm thick cement sand mortar (1:4) with chicken wire mesh interposed shall be laid over water proofing treatment. Over this, a layer of chequered cement concrete flooring tiles conforming to IS:13801 shall be provided .The tiles shall be laid as per IS :1443. 3.0 <u>ACCEPTANCE CRITERIA</u> The surface level shall be such as to allow quick draining of rains without leaving any pool anywhere. The finishing course shall be fully secured and shall have an even density. There shall not be any bubble formation or		

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crushed or squeezed insulation or underbed. The Contractor shall give a guarantee in writing for all work executed under this specification supplemented by a separate and unilateral guarantee from the specified agency for the roof water-proofing treatment work. The guarantee shall be for materials and workmanship for a period of minimum 10 years. The mode of execution of the guarantee shall be acceptable to the Owner. 4.0 <u>I.S. CODES AND STANDARDS</u> (a) IS:73 : Paving Bitumen (b) IS:702 : Industrial Bitumen (c) IS:1203 : Methods of testing tar and bitumen (d) IS:1322 : Bitumen felts for waterproofing and damp proofing (e) IS:1346 : Code of Practice for waterproofing of roofs with Paving Bitumen (f) IS:3384 : Bitumen primer for use in waterproofing and damp proofing		

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SECTION – 20

SANDWICH AND PERMANENT COLOUR COATED

METAL CLADDING

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1.0 <u>GENERAL</u> 1.1 <u>DESCRIPTION</u> 1.1.1 Work included: This section covers the furnishing and installation of sandwich/double skin/single skin metal cladding with insulation for wall/roof as shown in contract drawings including making cut outs for various openings for doors, windows, ducts, pipes etc and fixing of such components with the cladding arrangement with necessary flashing, sealant as required as per contract drawings. The contractor shall furnish all labour, materials, tools and equipment required to complete the work. 1.2 <u>APPLICABLE CODES AND STANDARDS</u> 1.2.1 The following codes and standards are intended to provide an acceptable level of quality for materials and products. The contractor may propose alternative codes and standards provided they give an equivalent degree of quality as the referred codes and standards and are submitted for consultants/owner's approval. 1.2.2 ASTM - American Society for Testing Materials. (a) A446 Zinc-coated (Galvanized) steel sheets of structural quality Coils and cut lengths (b) A611 Steel, cold rolled sheet 1.3 <u>SUBMITTALS</u> 1.3.1 The contractor shall submit to the owner the following items for review before commencing work. (a) Samples (i) Three 300 x 300 mm pieces of each type of precoated and preformed metal sheet for top skin and bottom skin.		

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(ii) Three 300 x 300 mm pieces of each type of precoated and preformed metal sheet (iii) Type of insulation proposed for use and its thickness. (iv) Fabricated sandwich metal cladding. Sample size shall be 300 x 300 mm three nos. (v) Edge sealing and flashing. (b) Manufacturer's literature indicating the nature of preformed profiled, colour coating, manufacturer's recommended installation, instructions and maintenance procedure. (c) Manufacturer's certification of compliance with each delivery. (d) Shop Drawings Showing fabrication details of sandwich/double skin/single skin metal cladding with Insulation, preformed sheet profile and total colour thickness for profiled top skin and slightly ribbed bottom skin, thickness and nature of insulation, installation and erection, anchorage, fasteners and details of accessories, metal flashing and its fixing including various openings for doors, windows, louvres, pipes etc. 1.3.2 Test Reports Two copies of Test Reports and Source of Quality Control Tests. 1.3.3 Supplier Certificates Two copies of technical data showing that the proposed finish product is suitable for the environmental conditions of the job site and that the materials meet specification requirements.		

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1.4 <u>PRODUCT HANDLING</u> 1.4.1 Delivery of Materials to job site in manufacturer's original unopened packaging. 1.4.2 Identify contents with name of manufacturer, brand name, thermal value and applicable standard. 1.4.3 Store materials in an area protected from adverse climatic conditions, moisture and open flame or spark and shall be stored off the ground with one end elevated for drainage. The sheets shall be protected from inclement weather with a waterproof covering with ventilation to avoid condensation. 2.0 <u>PRODUCTS</u> 2.1 <u>GENERAL</u> 2.1.1 All goods and products covered by these specifications shall be procured from manufacturer duly approved by the owner. 2.1.2 Cladding material shall be of "Rib and Flute" design to ensure wide spanning and quick recovery after being subjected to excessive load. Single skin materials shall be interlocking type 150mm wide strip. 2.1.3 Material shall be prefabricated panel shall be conformed to relevant ASTM or alternative codes and standard. Troughed galvanized M.S. sheets having 0.6 mm minimum base metal thickness (bare material) with minimum rate of galvanization of 275 gms./sq.m. as per IS-277 of minimum yield strength of 250MPa as per IS-513(or High tensile steel sheet coated with zinc aluminium alloy @ 150 gms./sq.m. of 0.5 mm minimum base metal thickness and having minimum yield strength of 350 MPa, as per AS-1397) shall be used for the cladding system. 2.1.4 The outer side (exposed face) shall be permanently colour coated with Silicon modified polyester paint of minimum DFT 20 microns over primer, of approved colour/shade and the inner side (internal face) shall be coated with same paint of minimum DFT 20 microns over primer of off-white shade		

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2.1.10 Panel size shall be largest available size. 2.1.11 Warranty for precoated profiled metal sandwich /double skin cladding shall be for a minimum period of 40 years. 2.1.12 Sealants Penetration and end laps in sheeting shall be sealed with a non-hardening approved sealant as recommended by the manufacturer. 2.1.13 Profile HDPE Filler (a) Profile HDPE Filler shall be die cut in profile to match the profile of the sheet. (b) Metal flashing shall be of similar material and colour of top skin. 3.0 <u>DOUBLE SKIN INSULATED METAL CLADDING</u> 3.1 <u>GENERAL</u> 3.1.1 Metal cladding may be of double skin separated by an approved insulation in between. External sheet shall be of interlocking type. 3.1.2 Double skin wall cladding shall be comprising of 150F external panels manufactured out of 0.6 mm TCT (Total coated thickness) aluminium alloy AA3105/5050 with stove enamelled coil coated finish, sufficient to withstand most aggressive climate, on both sides of approved shade. The 150mm wide panels (150F) shall be clipped on to the concealed runners and shall be interlocked with each other. The inner sheeting shall be Hi Rib 0.5mm TCT silicon modified polyester coated galvalume steel (AZ 150 gsm aluminium- Zinc alloy meta metallic coating of total 550 Mpa yield stress as per AS-1397). The external panels shall be 150mm wide 17mm deep. The inner sheet shall have 1000-1020 mm cover width 28-30 mm high crests @250-255mm c/c with side laps. The inner sheet shall be fixed to structural system by means of corrosion protected self-drilling, self-tapping fasteners. The sub girts of size 50mmx50mmx50mm manufactured out of 16 G G.I (1.6mm) 'Z' shape shall be fixed to inner sheeting on face side at purline		

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locations. The external panels shall be fixed with the help of concealed runners 34.5 wide x48mm deep out of 0.95 mm thick aluminium strip with cut outs to hold the panels in a module of 150mm at 1600mm c/c and fastened on side girts. The runners shall be concealed and no fasteners are to penetrate the panels. An insulation of 50mm thick resin bonded fiberglass roll insulation of density 16kg/m³ shall be fixed in the cavity between two sheets. Contractor shall make cut out of doors, windows, louvres, pipe, ducts or other cut outs as required as per contract drawings along with flashing, leak proof sealing etc as required for these cut outs/wall openings. 4.0 <u>EXECUTION</u> 4.1 <u>INSPECTION</u> 4.1.1 The contractor shall examine the area, which will be covered, and the masonry wall where the edge of the sandwich/double skin/single skin cladding will be fixed and the structural alignments. 4.1.2 Contractor shall correct any unsatisfactory conditions prior to start of work. 4.2 <u>INSTALLATION</u> 4.2.1 Sandwich / metal permanently coated panel shall be fixed over structural members with joints overlapped and fastened using stainless steel fasteners self-drilling type or as recommended by the manufacturer. 4.2.2 Double skin /single skin wall cladding shall be installed strictly as per manufacturer specification and details. 4.2.3 All end laps of profiled sheeting and joints of flashing shall be sealed properly with non-hardening natural cure silicon sealant or as recommended by the manufacturer. 4.2.4 Accessories like fasteners, tape, and foam fillers, flashing etc. as required shall be provided as per recommendation of manufacturer. 4.2.5 The external panels shall be fixed with the help of concealed runners aluminium strip with cut outs to hold the panels and fastened on side girts. The runners shall be concealed and no fasteners are to penetrate the panels.		

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4.2.6 Contractor shall make cut out of doors, windows, louvres, pipe, ducts or other cut outs as required as per contract drawings along with flashing, leak proof sealing etc as required for these cut outs/wall openings. 4.3 <u>CLEAN-UP</u> Remove sealant splatters and smears remove steel particles generated by drilling to avoid damage.		

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1.0 <u>SCOPE</u> This section includes supply of all materials, labour and incidentals for water supply for residential, business and industrial and other types of buildings. The water supply system of a building or premises covers service pipes and the necessary connecting pipes, fittings, control valves and all appurtenances in or adjacent to the building or premises. 1.1 <u>MATERIALS</u> All materials, fittings, fixtures and appliances shall be of the best quality conforming to relevant Indian Standard and shall be procured from approved manufacturers. Unless specifically allowed by the Engineer, the Contractor shall submit samples of fittings and fixtures which will be retained by him for comparison when bulk supplies are received at the site. Ultimate choice of type, model and manufacturer lies completely with the Engineer. It shall be the responsibility of the Contractor to procure the materials selected by the Engineer. Hence order is to be placed with the manufacturers in time, so that the materials are available at the site well ahead of their requirement. The materials brought to the site, shall be stored in a separate secured enclosure away from the building materials. Pipe threads, sockets and similar items shall be specially protected till final installation. Brass and other expensive items shall be kept under lock and key. Fragile items shall be checked thoroughly when received at the site and items found damaged shall not be retained at the site. 1.2 <u>PIPES AND PIPE FITTINGS</u> Under scope of this specification, pipes and pipe fittings may be any or a combination of the following types : (a) Cast Iron (b) Steel: lined, coated with bituminous composition, out coated with		

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cement concrete or mortar or galvanised. (c) Reinforced Concrete (d) Priestesses Concrete (e) Lead (Not to be used for potable water) (f) P. V. C. (g) Copper (h) Brass (i) Wrought iron 1.3 <u>WATER RESERVOIRS</u> Water reservoirs like pressed steel tanks and G.I. tanks shall come under scope of this specification. Reservoirs made of concrete masonry or fabricated steel shall be covered by respective work specifications. 1.4 <u>RELATED WORKS</u> All works, like earthwork, masonry, concrete, steelwork, cutting holes, chases, repairs and rectification associated directly with installation of water supply systems shall come under scope of the Contractor unless specifically excluded. 1.5 <u>REGULATION</u> The work which is required to be carried out under the scope of this section, shall be executed by a licensed plumber only (engaged by the Contractor) and he shall obtain all necessary sanctions, permissions, certificates etc. from Municipal and/or other Local Authorities and shall abide by all the rules of such Authorities.		

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2.0 <u>INSTALLATION</u> While basic layouts may be available in the drawings provided by the Owner, the details might have to be supplemented by the Contractor for approval of the Engineer. Special attention shall be given by the Contractor to economy. Symmetry of layout is very important. Fittings meant for operation shall be located and oriented to allow easy reach and operation. Maintenance, repairs and replacements of pipes, fittings and fixtures must be conveniently possible. 2.1 <u>PIPE LINES</u> 2.1.1 Laying In addition to fulfilling the functional requirements all pipelines shall be laid true to line, plumb and level. Any deviation shall need approval of the Engineer. Meticulous care shall be taken to avoid chances of airlock and water hammer. Pipes shall be laid on continuous unyielding surface or on reliable supports at least one near each joint and spacing as directed by the Engineer. The support must be strong, neat and shall have provisions for securing the pipes in every direction and easy maintenance. Pipes shall be encased or concealed in masonry or concrete if shown on drawing or directed by the Engineer. 2.1.2 Back Flow The layout of pipe work shall be such that there is no possibility of back flow towards the source of supply from any cistern or appliances, whether by siphonage or otherwise. All pipe works shall be so laid or fixed and maintained as to be and to remain completely water-tight, thereby avoiding waste of water, damage of property and the risk of contamination of the water conveyed.		

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2.1.3 Contamination There shall be no cross connection whatsoever between a pipe or fitting for conveying or containing wholesome water and a pipe or fitting for containing impure water or water liable to contamination or of uncertain quality of water which has been used for any purpose. No piping shall be laid or fixed so as to pass into or through any sewer, scour outlet or drain or any manhole connected therewith. 2.1.4 Underground Pipings Underground piping shall be laid at such a depth that it is not likely to be damaged by traffic and other loads and frost, where applicable. The size and depth of the trench shall be as approved by the Engineer. Back-filling shall be done with selected fine earth, unless otherwise permitted in 150 mm layers and carefully consolidated. Special care shall be taken while filling in the vicinity of the pipe to avoid damage. Before backfilling the laid pipe shall be fully tested and approved. Where the pipe rests on rock it may be bedded on a layer of fine selected material or concrete to avoid local point support. The trench shall be so treated by gradient and filling in the area that it does not act as a drainage channel. 2.1.5 Concealed Piping Where desired by the Engineer or shown on the drawings the pipes shall be concealed in masonry or concrete of the structure. The Contractor may co-ordinate with the building Contractor for leaving the chases, openings, conduits as necessary. However, the Contractor will rectify if required the chases, openings and conduits, supplement and make good after laying and testing of the concealed pipelines.		

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2.1.6 Jointing of Pipes Jointing of pipes shall be completely leakproof and durable. Instruction of them manufacturer shall be followed unless desired otherwise by the Engineer. However, usually recommended practices are stated below for guidance: (a) Cast Iron (i) Spigot and Socket Joints Lead joint : The joint is made by first caulking in clean spun yarn upto half depth and filling the reminder by running in molten lead taking care that no dross enters the joint and then thoroughly caulking the lead. The lead need not extend into the joint further than the back of the groove formed in the socket. After completing the joint it shall not be allowed to move. For rectification the joint shall be completely redone. (ii) Flanged Joints : Flanged joints shall be made by jointing rings of good quality, smooth and hard compressed fibre board of thickness not less than 1.5 mm and of such width as to fit inside the circle of bolt. Diagonally opposite bolts shall be tightened in pairs and in stages so that degree of all bolts in a joint are similar. Damaged gaskets shall be replaced. (b) Steel Plain ended steel pipes may be jointed by welding. Screwed and socketed joints shall be carefully tightened. Care shall be taken to remove any burr from the ends of the pipes. Jointing compound, if used, shall be lead free and approved by the Engineer. Once a joint has been screwed up it shall not be backed off unless threads are reclined and new compound applied.		

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(c) GI Pipes Threads shall be cut with sharp tools, and before jointing all scales shall be removed from pipes by suitable means. The screw / threads of the pipe shall be cleaned out and the joint made by screwing the fittings after treating the threads with approved pipe jointing compound. Once a joint has been screwed up it shall not be backed off unless threads are recleaned and new compound applied. (d) Lead Lead and lead alloy pipes shall be jointed with wiped solder joints. (e) Concrete Concrete pipes may be socket and spigot ended collar or band jointed. Joints shall be effected by caulking with 1:3 cement sand mortar. (f) P. V. C. Manufacturer's instruction shall be followed. For heating approved equipment with adequate control shall be used. (g) Tyton Joint The manufacturer's instruction shall be strictly followed in making such joints. Tyton joints shall be made by push-on type specification stipulated by the pipe manufacturer. The tools specified by the pipe manufacturer shall be used to secure the joint fully. 2.1.7 Painting Where mentioned in the Schedule, underground steel and cast iron pipes shall be given 2 coats of bituminous paint on the outside after laying, when painting is to be done above ground G.I. pipes shall be given a coat of zinc chromate primer, C.I. and M.S. pipes shall be given one coat of red lead		

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or zinc chromate primer. Top coats shall be minimum 2 coats of best quality paint.		
2.2	<u>STORAGE TANK - PRESSED STEEL TANK</u> Unless otherwise mentioned, water storage tanks shall be pressed steel tanks of nominal size and capacity as mentioned in the Schedule and fabricated with all flanges external, all flanges internal, or bottom flange internal and side flanges external, as shown on drawings or schedule of items. The fabricator shall supply 6 prints of fabrication drawings to the Engineer for prior approval showing thickness of plates, method of jointing the plates, all supports, stays, gussets etc. Pads, cleats etc. required for supporting the tanks shall be supplied by the manufacturer. Inlet, overflow vent pipes, manholes etc. shall be arranged and provided as shown on \ drawing or mentioned in the schedule. Unless otherwise specified, the outlet pipe shall be 50 mm above the bottom of the tank and there shall be a 150 mm free board at the top of the tank. All tanks shall be supplied with mosquito-proof covered top with manhole not less than 450 mm diameter. Tanks deeper than 1.00 Metre shall be provided with m.s. Internal access ladder adjacent to the manhole. Water level indicator shall be provided if asked for. Two coats of anti-corrosive paint over a suitable primer shall be applied to both internal and external surface of tanks. Such paint if used shall not impart any taste or odour to water and be of lead free composition. Erection of tanks shall be in accordance with detailed drawings and manufacturer's instructions. The two finishing coats of paint shall be applied to outside after erecting is complete.	
2.2.1	G. I. Water Tank G. I. water tanks shall be procured from a reputed manufacturer. The design shall be good enough to withstand the loads safely. Galvanised iron water storage tank shall be made of minimum 2 mm thick galvanised iron sheet. Plain sheets shall be fixed at the corner to angle iron frames by means 6 mm rivets at 40 mm pitch for tanks upto 1000 litres capacity and 8 mm rivets at 35 mm pitch for tanks above 1000 litres capacity. Tanks above 1000 litres shall have 20 mm dia. galvanised / iron stay rods, one fixed to	

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angle framing at top and two in the body of the tank for extra strength. Holes for riveting shall be drilled and not punched. White lead shall be applied to the joints before riveting. In case it is desired by the Engineer that corners of tank should be welded instead of riveted then the sheets shall be welded to form a tank will not have angle iron frame. Tanks shall have 400 mm dia. holes at the top with hinged covers. The covers shall be made of galvanised iron sheet with angle iron frame. The cover shall be just loose but close fitting to keep out dust and mosquito and will not be airtight. It shall be complete with lockable arrangement. Tanks shall be provided with rising main inlets of 40 mm dia. galvanised iron pipe or as shown on Drawing and 25 mm dia. G.I. overflow pipe. The rising main shall be connected to the tank with a ball valve near the top which disconnects the supply when tank is full up to the point of overflowing. The ball valve permits the entry of water when the tank is empty and disconnects the supply when the tank is full. It consists of a hollow floating ball made of copper, plastic or hand Tubers, 110 mm in diameter, attached to an arm which is so pivoted that the end near the pivot closes the orifice of the main when the ball is raised to the required height of water in the tank and opens the main as soon as the ball drops with the fall of water level as it is drawn off through the distribution pipes. The ball valve shall be fixed to the tank independent of the inlet pipe and set in such a position that the body of the ball valve cannot submerge when the tank is full upto the water line. The ball valve shall be so adjusted as to limit the level of the water line. The level of the water in the tank to 75 mm below the lip of the overflow pipe. Free surface shall be about 150 mm above the maximum water filled level. 2.3 <u>VALVE, COCKS, TAPS</u> All valves, stop cocks, taps etc. shall conform to relevant Indian Standard Specification and shall be of best quality from approved manufacturers.		

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These shall be suitable for working pressures mentioned in the Schedule. Nominal size and material shall be as per schedule.		
2.4	<u>PROTECTION</u> Open end of each pipe shall be protected during installation by suitable covers or plugs so that the ends, threads, sockets or spigot are not damaged and no foreign material can find its way into the pipe line. Fittings and fixtures liable to be misused or stolen during the construction phase shall be fitted only before testing and handing over.	
3.0	<u>TESTING AND ACCEPTANCE</u>	
3.1	<u>INSPECTION BEFORE INSTALLATION</u> All pipes, fittings and appliance shall be inspected, before delivery at the site to see whether they conform to accepted standards. The pipes and fittings shall be inspected on site before laying and shall be sounded to disclose cracks. Any defective items shall be clearly marked as rejected and forthwith removed from the site.	
3.2	<u>TESTING OF MAINS AFTER LAYING</u> After laying and jointing, the main shall be slowly and carefully charged with water, so that all air is expelled from the main by providing a 25 mm inlet with a stop cock, allowed to stand full of water for a few days if time permits, and then tested under pressure. The test pressure shall be 5 Kg/CM² or double the maximum working pressure, whichever is greater. The pressure shall be applied by means of a manually operated test pump, or in the case of long mains or mains of a large diameter, by a power driven test pump, provided that the pump is not left unattached. In either case due precaution shall be taken to ensure that the required test pressure is not exceeded. Pressure gauges shall be accurate and shall preferably have been recalibrated before the test. The pump having been stopped, the test pressure shall maintain itself without measurable less for at least five minutes. The end of the main shall be closed by fitting a water-tight expanding plug and the plug shall be secured by struts to resist the end thrust of the water pressure in the mains.	

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3.3 <u>TESTING OF SERVICE PIPES AND FITTINGS</u> The service pipes shall be slowly and carefully charged with water allowing all air to escape avoiding all shock or water hammer. The service pipe shall then be inspected under working conditions of pressure and flow. When all draw-off taps are closed, the service pipes shall be absolutely water-tight. All piping, fittings and appliances shall be checked for satisfactory support and protection from damage, corrosion and frost. 4.0 <u>I.S. CODES</u> Important relevant IS Codes for this Specification are listed below : Latest editions shall always be consulted. (a) IS:2065 : Code for Practice for water supply in buildings (b) IS:1172 : Code of basic requirements for water supply, drainage & sanitation (c) IS:1200 : Laying of water and sewer lines including appurtenant items. (Pt. XVI) (d) IS:1239 : Specification for Mild Steel Tubes and Mild Steel Tubulars and other wrought steel pipe fittings (10 mm to 15 mm nominal diameter) (Pt. I & II) (e) IS:1536 : Specification for Centrifugally cast (Spun) iron pressure pipes for water gas and sewage (f) IS:1537 : Specification for vertically cast iron pressure pipes for water, gas and sewage. (g) IS:3486 : Specification for Cast iron spigot and socket drain pipes (80 mm to 250 nominal diameter) (h) IS:3589 : Specification for Electrically welded steel pipe for water, gas and sewage (200 mm to 2000 mm nominal diameter) (i) IS:784 : Prestressed concrete pipes		

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(j) IS:458 : Concrete pipes (with or without reinforcement) (k) IS:783 : Code of Practice for laying of concrete pipes (l) IS:1592 : Asbestos cement pressure pipes (m) IS:1626 : Asbestos cement pressure pipes, gutters and fittings (Spigot and Socket types) (n) IS:404 : Lead pipes (o) IS:3076 : Low density polyethylene pipes for potable water supplies (p) IS:4984 : High density polyethylene pipes for potable water supplies (q) IS:2501 : Copper tubes for general engineering purposes (r) IS:407 : Brass tubes for general purposes (s) IS:1230 : Cast iron rain water pipes and fittings (t) IS:804 : Rectangular pressed steel tanks		

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1.0 <u>SCOPE</u> 1.1 This section covers the layout and construction of drains for roof water, surface water and sewage together with all fittings and fixtures and inclusive of ancillary works, such as connections, manholes and inspection chambers used within the building and from the building to the connection to a public sewer or to treatment work, septic tank and soak pit dispersion trenches. 2.0 <u>INSTALLATION</u> 2.1 <u>GENERAL</u> All pipe lines, locations of fittings and fixtures, etc. shall be as per drawings or as directed by the Engineer. Correctness of lines, plumb, orientation, symmetry and levels shall be strictly ensured. All items shall be fully secured against movement in any direction and so located as to allow easy maintenance. All pipe lines, fittings and fixtures shall be installed leak proof. When the works under scope of this specification linked up with works executed by others, the connections shall be such as to prevent any splashing or spilling or emission of foul odour and gases. 2.2 <u>RAINWATER DOWNCOMERS</u> Rainwater down comers shall be standard Cast Iron Pipes. In case where specifically desired, M.S. pipes may also be used. M.S. pipes shall be painted outside with two coats of anticorrosive paints under a coat of primer. Rainwater downcomers shall run along and be secured to walls, columns etc. where desired by the Engineer these may have to be installed in chases cut in the structure All pipes shall be well secured and supported by adequately strong brackets.		

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The brackets may be wrought iron clevis type, split ring type or perforated strap iron type as approved by the Engineer. For vertical runs each pipe shall hang freely on its brackets fixed just below the socket. Suitable spacer blocks shall be provided against the vertical surface to which the pipe is fixed. All bends and junctions shall be supplied with watertight cleanouts. Roof and floor drains and yard gullies shall be installed, if required, by cutting into the structure and grouted with 1:2:4 cement concrete. All gutters shall be provided with removable gratings. All horizontal pipes shall have a minimum fall of 1 in 100. 2.3 <u>GUTTERS</u> The gutters shall be made of G.I. All gutters shall be supplied by reputable specialised firms. Each section shall be sufficiently rigid, edges and corners straight and the slopes perfectly uniform. G.I. gutters shall have the edges strengthened by suitable means. Unless noted otherwise the gutters shall have a minimum fall of 1 in 120. Adequate number of string supports shall be provided so that there is no reflection even when the gutter is full. Each joint must have a support. Unless otherwise specified the supports shall be fabricated M.S. brackets. All junctions shall be thoroughly watertight. The joints may be made by rivetting, bolting or soldering. All joints between successive lengths of gutters shall have an overlap of at least 5 cm. The drop in the overlap shall always be in the direction of the fall of the gutter. Ends of gutters shall be closed watertight. Junction with rainwater down comers shall be made fully watertight and secured. 2.4 <u>SOIL AND DRAINAGE PIPES</u> 2.4.1 Gradients If not specified the minimum gradients of soil and drainage pipe line shall be as follows.		

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(a) 100 mm nominal dia : 1 in 35 (b) 150 mm nominal dia : 1 in 65 (c) 230 mm nominal dia : 1 in 120 (d) 300 mm nominal dia : 1 in 200 2.4.2 Relation with water supply pipe lines Unless specifically cleared by the Engineer, under no circumstances shall special drainage and soil pipes be allowed to come close to water supply pipelines. 2.4.3 Laying Each separate pipe shall be individually set for line and for level. Where lengths of sewer or drain pipes are laid in trench, properly painted sight rails shall be fixed across the trench at a height, equal to length of the boning rod to be used, above the required invert level of the drain or sewer at the point where the sight is fixed. More sight rails shall be required at manholes, change of gradient and intermediate positions if the distance for sighting is more than 50 ft. apart. The excavation shall be boned in at least once in every 6 ft. The foot of the boning rod shall be set on a block of wood of the exact, thickness of the wall of the pipe. Each pipe shall be separately and accurately boned between sight rails. 2.4.4 Support and Protection on Pipelines All pipes shall be laid with sockets leading uphill. Preferably the pipe shall rest on solid and even foundations for the full length of the barrel. However, the pipe manufacturer's instruction as approved by the Engineer shall be followed in the matter of support and jointing. To achieve full and continuous support, concrete for bedding and packing is the best. Where pipes are not bedded on concrete, the floor shall be left slightly high and carefully placed so that the pipe barrels rest on undisturbed ground. If anywhere the excavation has been carried too low		

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packing shall be done in concrete. Where laid on rock or very hard ground which cannot be easily excavated to a smooth surface, the pipes shall be laid on a cradle of fine concrete floor of gravel and crushed stone overlaid with concrete or on a well consolidated gravel and crushed stone bed as desired by the Engineer. PVC or similar pipes shall be laid directly on stable soil and packed with selected soil. The minimum support and protection for glazed stoneware pipes shall be as follows: - When cover is less than 2 metre below ground level and where pipes are unavoidably exposed above ground surface, the pipes shall be completely encased or surrounded with concrete. - Where pipes are laid on soft soil with the maximum water table laying at the invert of the pipe, the sewer shall be bedded on concrete. - Where the pipes have to be laid on soft soil with the maximum water table rising above the invert of the pipe, but below the top of the barrel, the pipe sewer shall be haunched. - Where maximum water table is likely to rise above the top of the barrel or wherever the pipe is laid on soft soil the pipe sewers shall be completely encased or surrounded with concrete. Cast iron pipes and concrete pipes may be supported on suitable concrete or brick support, where specified. The supports shall be unyielding and strong enough. At least one support shall be located close to ends. Spacing of intermediate supports shall be as decided by the Engineer. Pipes shall be secured to the supports by approved means. Anchoring of pipes where necessary shall be achieved by suitable concrete encasing designed for the expected thrust. 2.4.5 Entry into structures For entry of the pipe lines into any building of structure suitable conduits under the structure or sleeves shall be used. The conduits and sleeves shall		

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be such as to allow easy repairs and replacement of the pipes. When openings or chases are required to be made in the structure for entry of pipe lines, locations and sizes shall be marked and checked by the Engineer. After laying of the pipeline the openings and chases shall be mended.		
2.4.6	Ducts	
Where solid, waste and ventilating pipes are accommodated in ducts, access to cleaning areas shall be provided. Connection to drain shall be through a gully with sealed cover to guard against ingress of sewer gas, vermin or backflow.		
2.4.7	Traps and Ventilating Pipes	
Pipes are carrying off the waste from water closets and waste water and overflow water from baths, wash basins, sinks to drains shall be trapped immediately beneath such fixtures. Traps shall have minimum water seal of 50 mm and shall be ventilated whenever such ventilation is necessary to maintain water seal of the trap.		
Ventilating pipes shall be carried up vertically from the drain to a height of at least 600 mm above the outer covering of the roof of the building or as shown on drawings. All vertical ventilating, anti-syphonage and similar pipe shall be covered on top with a cowl. The cowl shall be made of C.I. unless desired otherwise by the Engineer.		
2.4.8	Manhole and Inspection Chambers	
The maximum distance between manholes shall be 30 meter unless specially permitted otherwise. In addition, at every change of alignment gradient or diameter there shall be a manhole or inspection chamber. The distance between manhole or inspection chamber and gull chamber shall not exceed 6 metre unless desired otherwise.		
Manhole shall be constructed so as to be watertight under test. The bending at the sides shall be carried out in such a manner as to provide no lodgement for any splashing in case of accidental flashing of the chamber. The channel or drain at the bottom of chamber shall be plastered with 1:2 cement, sand mortar and finished smooth to the grade. The channels and drains		

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shall be shaped and laid to provide smooth flow. Connecting to existing sewer lines shall be through a manhole. Manholes shall be provided with standard C.I. covers. The covers shall be close fittings so as to prevent gases from coming out. Suitable heavy duty covers shall be used where necessary as decided by the Engineer. 2.4.9 Cutting of Pipes Manufacturer's instructions shall be followed for cutting of pipes where necessary. Suitable and approved tools shall be used for the cutting so as to leave surface clean and square to the axis of the pipe. 2.4.10 Jointing Jointing of laid pipes shall be so planned as to avoid completely any movement or strain to the joints already made. If any joint is suspected to be damaged it shall be opened out and redone. with the floor. Rod holes made in the channel up to the ground level 150 mm apart and the chemical emulsion poured along the channel at the rate of 7.5 litres per square meter of the vertical wall or column surface. The soil should be tamped back into place after this operation. All joints between pipes, pipes and fittings and manholes shall be gas-tight when above ground and water-tight when underground. Method of jointing shall be as per instructions of the pipe and fittings manufacturer and as approved by the Engineer. However, in the absence of any instruction available from the manufacturer the methods as detailed hereunder shall be used. (a) Cast Iron Pipes Socket and spigot pipes shall be jointed by the cast lead joints. The spigot shall be centered in the socket of the next pipe by tightly caulking in sufficient turns of tarred gasket or hemp yarn to have unfilled half the depth of socket. When the gasket or hemp yarn has been caulked tightly a jointing shall be placed round the barrel and tightened against the face of the socket to prevent airlock.		

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Molten lead shall then be poured in to fill the remainder of the socket and caulked with suitable tools right round the joint to make up for shrinkage of the molten metal on cooling and shall be finished 3 mm behind the socket face. Joints in cast iron pipes with special jointing arrangements like 'Tyton' joints etc. shall follow the instructions of the manufactures. In special cases if flanged joints are accepted by the Engineer the joints shall be made leak proof by inserting approved type of rubber gaskets. The bolts shall be secured in stages to avoid uneven strain. (b) Concrete Pipes Care shall be taken to place the collar centrally over the joint. 2.5 <u>TRENCHES AND OTHER EXCAVATIONS</u> Width of the trench at the bottom shall be such as to provide 200 mm clearance on either side of the pipe for facility of laying and jointing. Excavated material shall be stacked sufficiently away from the edge of the trench and the side of the spoil bank shall not be allowed to endanger the stability of the excavation. Spoil may be carted away and used for filling the trench behind the work. Turf, top soil or other surface material shall be set aside, turf being carefully rolled and stacked for use in reinstatement. All excavation shall be properly timbered, where necessary. Efficient arrangements for dewatering during excavation and keeping it dry till backfilling shall be made to the satisfaction of the Engineer. Sumps for dewatering shall be located away from the pipe layout. Where the excavation proceeds through roads necessary permissions shall be secured by the Contractors from the appropriate authorities. Special care shall be taken not to damage underground services, cables etc. These when exposed shall be kept adequately supported till the trench is backfilled.		

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The backfilling shall be done only after the pipeline has been tested and approved by the Engineer. Special care shall be taken under and sides of the pipe during hand packing with selected material. At least 300 mm over the pipe shall also be filled with soft earth or sand. Consolidation shall be done in 150 mm layers. The surface water shall be prevented from getting into the filled up trench. Traffic shall not be inconvenienced by heaping up unduly the backfilling material to compensate future settlement. All future settlements shall be made good regularly to minimise inconvenience of traffic where applicable. 2.6 <u>FIXTURES</u> The Tenderer shall mention in his bid the type and make of the fixtures he intends to use enclosing manufacturer's current catalogues. In the absence of any such agreement, the Engineer shall be at liberty to choose any type and make. All fixtures and fittings shall be of approved quality and type manufactured by well known manufacturers. All items brought to the site must bear identification marks of the type of the manufacturer. Procurements shall be made well in advance and inspected and approved immediately by the Engineer. All fixtures shall be adequately protected, covered and plugged till handed over. All fittings, gratings, fasteners, unless specified otherwise, shall be chromium plated. The connecting lead pipes and bends shall weigh at least 3 kg. per 25 mm dia per meter length. Where PVC or similar pipes are allowed the Contractor shall produce the test reports and convince the Engineer about their durability. Unless specified in the contract the fixtures shall be as specified hereinafter 2.6.1 Water closet (a) Raised type It shall include glazed vitreous china basin with siphon, open front solid plastic seat and plastic cover, low level glazed stoneware flushing cistern with valveless fittings, supply connections and		

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necessary fittings. All fittings shall be chromium plated. Colour of basin, cistern, seat and cover shall be as desired by the Engineer. (b) Squatting type It shall include glazed vitreous china pan with foot rests and high level cast iron flushing cistern with valve less fittings, supply connections and necessary fittings. All fittings shall be chromium plated. The foot rests shall be made of white glazed vitreous china with chequered surface. The flushing cistern shall be painted as desired by the Engineer. 2.6.2 Urinals It shall consist of wall type glazed vitreous china urinals, cast iron automatic flushing cistern complete with supply connections, flush pipe, lead pipes, gratings, traps and all other necessary fittings. Automatic flushing shall be approximately once every five minutes. For a number of urinals located together may be served by one cistern of adequate capacity. All fittings shall be chrome plated. 2.6.3 Wash basin It shall be made of glazed vitreous china. The basin shall be flat back, wall hung by painted cast iron brackets and complete with pattern with hot and cold brass faucets with nylon washers, waste chain, waste washers, lead waste pipes with traps, perforated waste complete with necessary fittings. All fittings including faucets shall be chromium plated. 2.6.4 Sink It shall be made of Marble or Granite. It shall be wall hung by painted cast iron brackets and complete with one brass faucet with nylon washers, waste chain, waste washers, and lead waste pipes with traps, perforated waste with necessary fittings. All fittings including faucets shall be chromium plated.		

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2.6.5	Bathroom mirror It shall be made of the best quality 6 mm thick glass and produced by a reputed mirror manufacturer. It shall be wall mounted with adjustable revolving brackets. The brackets, screws and other fittings shall be chromium plated.	
2.6.6	Glass shelves Glass shelves shall consist of 6 mm thick clear glass with guard rails and shall be wall mounted with brackets. All brackets, guard rails and screws shall be chromium plated.	
2.6.7	Towel rail Towel rails shall be 20 mm dia chromium plated MS pipes wall mounted with steel brackets. The brackets, screws etc. shall also be chromium plated.	
2.6.8	Soap holder It shall be made of chromium plated strong members. The holders shall be wall mounted with chromium plated screws.	
2.6.9	Liquid soap dispenser It shall be round and easily revolving with removable threaded nozzle. The body, bracket for wall mounting and screws shall be chromium plated.	
2.6.10	Toilet roll holder It shall be made of glazed vitreous china with suitable cover cum cutter. Wall mounting screws shall be chromium plated.	
2.6.11	Installation All plumbing fittings and fixtures shall be installed in most workmanlike manner by skilled workers. These shall be perfect in level, plumb, plane, location and symmetry. All items shall be securely anchored to walls and	

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	floors. All cuttings in walls and floors shall be made good by the Contractor.	
2.7	<u>EFFLUENT DISPOSAL</u>	
2.7.1	Effluent Disposal The effluent from the septic tank shall be disposed by allowing it into an open channel or a body of water if the concerned authority approves or into a soak pit for absorption by soil or shall be allowed to be absorbed by soil through open jointed CI pipes laid in a trench filled with broken bricks.	
2.7.2	Joining C.I. Pipes / dispersion trenches Minimum dia of the CI pipe shall be 150 mm nominal. The trench for laying the pipes shall be minimum 600 x 600 mm pipes. The joints of the pipes shall be made with lead. The entire length of the pipe within the trench shall be buried in 250 mm layer gravel or crushed stone of uniform size. On top of gravel/crushed stone layer is a 150 mm bed of well graded coarse aggregate. Ordinary soil is used for fill in the top of trench.	
2.8	<u>SEWAGE TREATMENT PLANT</u> Please refer. Annexure-I	
3.0	<u>TESTING AND ACCEPTANCE</u>	
3.1	<u>INSPECTION BEFORE INSTALLATION</u> All pipes, fittings and fixtures shall be inspected, before delivery at the site to see whether they conform to accepted standards. The pipes shall again be inspected on site before laying by sounding to disclose cracks. All defective items shall be clearly marked and forthwith removed from the site.	
3.2	<u>TESTING OF PIPELINES</u> Comprehensive tests of all pipe lines shall be made by simulating conditions of use. The method of actual tests shall be decided by the Engineer. All test data shall be recorded and submitted to the Engineer for review	

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and instruction. The Engineer's discretion regarding tolerance shall be final. General guidance for the tests are given below: (a) Smoke test All soil pipes, waste pipes and vent pipes and all other pipes when above ground shall be approved gastight by a smoke test conducted under a pressure of 25 mm of water and maintained for 15 minutes after all trap seals have been filled with water. The smoke is produced by burning oily waste or tar paper or similar material in the combustion chamber of a smoke machine. Chemical smokes are not satisfactory. (b) Water test For pipes other than Cast Iron Glazed ware and concrete pipes shall be subjected to a test pressure of at least 1.5m head of water at the highest point of the section under tests. The tolerance figure of two litres per centimetre of diameter per kilometre may be allowed during a period of 10 (ten) minutes. The test shall be carried out by suitably plugging the low end of the drain and the ends of connections, if any, and filling the system with water. A knuckle bend shall be temporarily jointed in at the top end and a sufficient length of the vertical pipe jointed to it so as to provide the required test head or the top end may be plugged with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitably for observation. Subsidence of test water may be due to one or more of the following cases : (i) Absorption by pipes and joints (ii) Sweating of pipes or joints (iii) Leakage at joints or from defective pipes		

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(iv) Trapped air. Allowance shall be made for (a) by adding water until absorption has ceased and after which the test proper should commence. Any leakage and the defective part of the work shall be cut out and made good. For cast iron pipes Cast iron sewers and drains shall be tested as for glazed ware and concrete pipes. The drain plug shall be suitably strutted to prevent their being forced out of the pipe during the test. (c) For straightness (i) By inserting at the high end of the sewer or drain a smooth ball of a diameter 13 mm less than the pipe bore. In the absence of obstruction, such as yarn or mortar projecting through the joints, the ball will roll down the invert of the pipe and emerge at the lower end; and (ii) By means of a mirror at one end of the line and lamp at the other. If the pipe line is straight, the full circle of light may be observed. The mirror will also indicate obstruction in the barrel if the pipe line is not straight. 3.3 <u>FIXTURES ETC.</u> All fixtures and fittings shall be connected by watertight joints. No dripping shall be accepted. 4.0 <u>CODES AND STANDARDS</u> Some of the important Codes and Standards relevant to this specification shall be followed: Latest editions shall always be consulted.		

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(a) IS:1172 : Code of basic requirements for water supply drainage and sanitation (b) IS:1200 : Laying of water and sewer lines including appurtenant items. (Pt. XVI) (c) IS:1239 : Mild Steel Tubes and Mild Steel Tubular and other (Pt. I & II) wrought steel pipe fittings (d) IS:1536 : Centrifugally cast (Spun) iron pressure pipes for water gas and sewage (e) IS:1537 : Vertically cast iron pressure pipe for water, gas & sewage. - (f) IS:3486 : Cast Iron spigot & socket drain pipes (g) IS:1537 : Vertically cast iron pressure pipe for water, gas & sewage (h) IS:3486 : Cast Iron spigot & socket drain pipes (i) IS:1742 : Code of Practice for building drainage (j) IS:5329 : Code of Practice for sanitary pipe work above ground for buildings (k) IS:2470 : Code of Practice for designs and construction of septic tank for small and large installations (l) IS:3076 : Low density polythelene pipes for potable water supplies. (m) IS:4984 : High density polythelene pipes for potable water supplies.		

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(n)	IS:1537	:	Vertically cast iron pressure pipes for water, gas and sewage.
(o)	IS:1538	:	Cast Iron fittings for pressure pipes for water, gas & sewage.
(p)	IS:1230	:	Cast Iron rain water pipes and fittings.
(q)	IS:3889	:	Centrifugally cast (spun) iron spigot & socket soil waste and ventilating pipes, fittings and accessories.
(r)	IS:1729	:	Sand cast iron spigot & socket soil, water and ventilating pipes and accessories.
(s)	IS : 1626	:	Asbestos cement building pipes, gutters and fittings (spigot & socket types)
(t)	IS:458	:	Concrete pipes (with and without reinforcement)
(u)	IS:783	:	Code of Practice for laying of concrete pipes.
(v)	IS:784	:	Prestressed concrete pipes.
(w)	IS:651	:	Salt glazed stoneware pipes & fittings
(x)	IS:4127	:	Code of practice for laying of glazed stoneware pipes
(y)	IS:1726	:	Cast Iron manhole covers and frames intended for use in drainage works
(z)	IS:5961	:	Cast Iron gratings for drainage purposes
(aa)	IS:5219 (part- I)	:	'P' & 'S' traps.
(bb)	IS:771	:	Glazed earthen-ware sanitary appliance.

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(cc) IS:772 : General requirements of enamelled cast iron sanitary appliances. (dd) IS:774 : Flushing cistern for water closets & urinals (valveless siphonic type) (ee) IS:775 : Cast Iron brackets & supports for wash basins and sinks (ff) IS:2548 : Plastic water closet seats & covers. (gg) IS:2527 : Code of Practice for fixing rain water gutters and down-pipes for roof drainage.		

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ANNEXURE –I

SEWAGE TREATMENT PLANT

DESIGN BASIS

The raw sewage quantity shall be estimated based on total no. of users. The anticipated no. of users may be considered as 1500 for design purpose. The proposed raw sewage and treated water characteristics are as follows:

(a)	Parameter	Unit	Inlet	Outlet
(b)	Total Suspended Solids (TSS)	mg/l	200	<10
(c)	BOD	mg/l	300	<10
(d)	COD	g/l	-	-
(e)	Oil & Grease	mg/l it	20	-

1.0 TREATMENT FACILITIES

1.1 The treatment facilities comprise the following process units:

1.1.1 Pre Treatment

1.1.2 Inlet Chamber and Screen Chambers

1.1.3 Raw sewage transfer pumping station

1.1.4 Grit Chamber & Fine screen chamber

1.1.5 Aeration Basin

1.1.6 Membrane Bio reactor

1.1.7 Disinfection

1.1.8 Treated water Reservoir

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1.1.9	Sludge Sump	
2.0	<u>PROCESS DESCRIPTION</u>	
2.1	<u>INLET CHAMBER</u>	
	An Inlet chamber is provided to receive the raw Sewage from various building.	
2.2	<u>MEDIUM SCREEN</u>	
	Raw Sewage passes through medium bar screen with 20 mm opening wherein floating material of size greater than 20 mm will get trapped. The cleaning of the screens would be done manually.	
2.3	<u>RAW SEWAGE SUMP CUM EQUALISATION</u>	
	Raw sewage is collected in the sanitary water storage tank where besides arresting the turbulence, flow equalisation also takes place. The storage tank is designed for 1 day storage. Submersible pumps shall transfer the sewage from this sump to the grit chamber for further treatment.	
2.4	<u>GRIT CHAMBER</u>	
	The flow from the sanitary water storage tank shall be passed into the 2(1W+1S) grit chamber tanks for removal of grit/inorganic matter. It is a channel in which sewage flows continuously where grit/inorganic matter get settled down according to settling velocity of grit particles. The settled grit particles get disposed off through chute. Grit free sewage flows to Fine bar screen chamber.	
2.5	<u>FINE BAR SCREEN CHAMBER</u>	
	The grit free sewage is subjected to screening in the mechanical fine bar screens of 2mm opening. The fine material will be screened and lifted by the rake, taken out through belt conveyor and dropped on to the trolley.	

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2.6 <u>AERATION BASIN</u> The sewage from the fine bar screen is transferred into the aeration basin, where Air is supplied to provide oxygen for BOD removal and for nitrification process. 2.7 <u>MBR BASIN</u> Partially stabilized mixed liquor from aeration tank will flow into the MBR basin by gravity. Membranes are placed in the tank. Diffusers supply air for membrane cleaning and mixing requirements. Part of the mixed liquor is recycled back to the aeration basin. The excess sludge from aeration basin shall be sent to sludge holding tank. The sludge from Sludge holding tank will be disposed to ash pond by means of sludge transfer pumps. 2.8 <u>DISINFECTION</u> The treated sewage from MBR shall be chlorinated with sodium hypo chloride and the chlorinated water will be stored in treated sewage storage tank.		

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<u>SEWAGE TREATMENT PLANT</u> <u>LIST OF CIVIL UNITS</u> (a) Inlet Chamber (b) Manual Screen Chamber (c) Sanitary Water Storage tank (d) Grit Chamber (e) Fine screen chamber (f) Aeration tank (g) MBR Tank (h) Sludge Holding Tank (i) Chemical House		

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<u>SEWAGE TREATMENT PLANT</u> <u>LIST OF MECHANICAL EQUIPMENT</u>					
		TOTAL	WORKING	STANDBY	MATERIAL OF CONSTRUCTION
(a)	Manual Bar Screen	2	1	1	SS316
(b)	Sanitary Water transfer pumps	2	1	1	C :CI ,I: FRP;Shaft:SS316
(c)	Submercible Mixer	1	1	0	SS304
(d)	Grit Chamber	2	1	1	RCC
(e)	Fine bar screen Recirculation	2	1	1	SS316
(f)	Recirculation pumps	2	1	1	C :CI ,I: FRP;Shaft:SS316
(g)	Diffuser - Preaeration Basin	1	lot		EPDM/Silicone
(h)	Submerged Membrane Units	-	-	-	-
(i)	Aeration Air blower	2	1	1	CI
(j)	MBR air blower	2	1	1	CI
(k)	Permeate Pumps	1	1	0	C & I;CI
(l)	CIP cleaning Tank	1	1	0	HDPE
(m)	CIP cleaning Tank agitator	2	1	1	SS316
(n)	CIP cleaning chemical feed pump	1	1	0	PP
(o)	Hypo Dosing Tank	2	1	1	FRP

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(p)	Hypo Pumps	Dosing	1	1	0	Diaphragm :PTFE
(q)	Hoist		2	1	1	MS

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VOLUME VIII/B SECTION – 23 ANTI-TERMITE TREATMENT		

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1.0

SCOPE

The scope of work is to set up a chemical barrier against attack by subterranean termites while the building is under construction.

2.0

EXECUTION

2.1

GENERAL

All work shall in general be executed as specified in IS: 6313 Part II-1981 and as per approved specification of the agency having special know-how for the job.

All necessary work to ensure uniform distribution and proper penetration of treatment of treating solution shall be done according to the instruction of the Engineer.

Soil treatment shall not be done when it is raining or when the soil is wet with rain or subsoil water. Once formed, the treated soil barrier shall not be disturbed.

2.2

CHEMICALS AND RATE OF APPLICATION

Any of the following chemicals (conforming to relevant Indian Standards) in water emulsion shall be applied by pressure pumps, uniformly over the area treated.

.

(a)

Chlorpyrifos Emulsifiable (IS 8944 - 1978)

:

1.0

(b)

Heptachlor Emulsifiable Concentrate (IS: : 0.5 6439 - 1978) Chlordane Emulsifiable

:

(c)

Concentrate (IS: 2682 - 1984)

:

1.0

2.2.1

Treatment of Column Pits, Wall Trenches and Basement Excavations

Foundations, basements etc. may either be fully enveloped by the chemical

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barrier or the treatment may start 500 mm below ground level. The bottom surface and sides of excavation (upto a height of about 300 mm) for column pits, walls trenches and basements shall be treated with chemicals at the rate of 5 litres / M2 of surface area. Backfills around columns, walls etc. shall be treated at the rate of 7.5 litres / Sqm of the vertical surface. Chemical treatment shall be done in stages following the compaction of earth in layers. The treatment shall be carried out after the ramming operation is done by rodding the earth at 150 mm centres close to the wall surface and spraying the chemicals in the specified dose.		
2.2.2	Treatment of Top Surface of Plinth Filling Holes 50 mm to 75 mm deep at 150 mm centres both ways shall be made with crowbars on the surface of compacted plinth fill. Chemical emulsion at the rate of 5 litres / M2 of surface shall be applied prior to laying soling or sub-grade. Special care shall be taken to maintain continuity of the chemical barrier at the junction of vertical and horizontal surfaces.	
2.2.3	Treatment of Soil Surrounding Pipes, Wastes and Conduits Special care shall be taken at the points where pipes and conduits enter the building and the soil shall be treated for a distance of 150 mm and a depth of 75 mm at the point where they enter the building.	
2.2.4	Treatment of Expansion Joints These shall receive special attention and shall be treated in a manner approved by the Engineer.	
2.2.5	Treatment at Junction of the Wall and the Floor Special care shall be taken to establish continuity of the vertical chemical barrier on inner wall surfaces from ground level up to the level of the filled earth surface. A small channel 30 x 30 mm shall be made at all the junctions of wall and columns with the floor. Rod holes made in the channel up to the ground level 150 mm apart and the chemical emulsion poured along the	

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channel at the rate of 7.5 litres per square meter of the vertical wall or column surface. The soil should be tamped back into place after this operation. 3.0 <u>ACCEPTANCE CRITERIA</u> The Contractor shall give a 10-year service guarantee in writing supplemented by a separate and unilateral guarantee from the specialised agency for the job to keep the building free of termites for the specified period. 4.0 <u>METHOD OF MEASUREMENT</u> Complete work of anti-termite treatment shall be measured for plinth area treated. This includes treatment, to foundations, walls, trenches, basements, plinth, buried pipes, conduits etc. The extended portions of foundation and like beyond plinth limit shall be the part of complete work. 5.0 <u>I.S. CODE</u> Relevant code applicable for this Specification. (a) IS: 6313 (Part-II) : Code of Practice of Anti-Termite Measures in Buildings Pre-constructional chemical treatment measures.		

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SECTION – 24

SHEETING WORK IN ROOF AND SIDING

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1.0 <u>SCOPE</u> This specification covers the erection of asbestos, C.G.I., aluminium or metal sheet covering to roof and side walls at various elevations and the fabrication and/or installation of asbestos, C.G.I or aluminium or metal gutters, flashings etc., as shown on drawings. 2.0 <u>STORAGE OF MATERIALS</u> 2.1 <u>CARE & STORAGE BEFORE INSTALLATION</u> All materials shall be stored by the Contractor in proper way to prevent all damage. If the materials are issued at site by the Owner, the Contractor shall at the time of issue, satisfy himself about the condition of issued sheets, gutters, etc. and no complaints shall be entertained later. The following points should be taken care of the Storing of Sheets: 2.1.1 Do not have uncovered sheets left lying in the open, Store in a covered area. If it is stored outside, cover the sheets with waterproof covers. Leave some space between the cover & the Sheetstacks, so that air circulation is possible. 2.1.2 The sheet should be stacked neatly, above the ground and in an inclined fashion/gentle sloping. This shall allow the rain water to drain off automatically. 2.1.3 It is advisable to keep each bundle of sheet, separately. 2.1.4 Do not store sheets, where people can walk over them. 2.2 <u>HANDLING AND HUMAN TRAFFIC MOVEMENT</u> On large building, handling time can be reduced by lifting sheet bundles with Crane, onto the roof frame. Care must be taken such that the weight of sheet bundle is not too much that it affects the structure. Where mechanical handling facilities are not present, sheets can be un-loaded & passed on to the roof, one at a time.		

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Sheets should not be dragged over the ground or any rough surface. Sheets should also not be dragged over each other. Tools used for erection should be carried and not dragged over the sheets. During erection & maintenance time, worker should careful when walking on roof. General procedure of walking on roof are : 2.2.1 When walking parallel to the ribs, walk on at least two ribs. 2.2.2 When walking across the ribs, walk close to or over the roofing supports. 2.3 <u>FASTERS & SEALANT</u> The steel sheet be fastened with nominal 40 mm zinc coated or nominal 25 mm zinc-tin alloy coated, Hex head, Self-drilling screw as per As 3566-2002 class 3 fastner of approved make with EPDM washer. The fastner size shall be calculated as per the design or manufacturer's recommendations. Natural cure, Silicon sealants should be water resistant, non-corrosive, resistance to extreme temperatures, retain good flexibility and of approved make. It shall be applied at all end laps as per approval by the engineer-in-charge. 2.4 <u>WORKMANSHIP</u> The workmanship shall be according to best construction practice to give a water tight finish to the satisfaction of the Engineer fixing of gutters and down pipes shall be according to IS:2527. 2.4.1 <u>Asbestos Sheeting</u> Asbestos sheets of profiles as stated in the Schedule of Items, shall be fixed with minimum 150 mm end lap and side laps as per manufacturer's specification Hook bolts or J-bolts shall be 8 mm dia. at 305 centres 6 mm dia galvanised iron seam bolt and nut with G.I. flat washers and bitumen washers shall be used for stitching ridge capping, corner pieces, ventilators, north light curves etc.		

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2.4.2 C.G.I. Sheetting and Aluminium Sheetting Side laps shall be 2 corrugations for roof and one corrugation for side sheetting. End laps shall be minimum 150 mm for roof and 100 mm for side sheetting. In ridges and hips where plain sheets are used the end laps shall be minimum 100 mm. Holes in C.G.I sheets shall preferably be made on the ground. The sheets should be placed on trestles and holes punched in the ridge of the corrugation from the outside inward for obtaining proper seating of limpet washers. Sheets shall be secured to sheet framing by 8 mm dia. galvanised iron hooks or J-bolts and maximum 305 mm apart. The length of the hook or J- bolts shall be to suit the sections of the bearers. Sheets shall also be bolted at the ends at every third corrugation with 6 mm dia. galvanised iron seam bolts and G.I. flat washers and bituminous washers. 2.4.3 Firbre Glass Reinforced Plastic Sheetting This shall be of thickness and profile as mentioned in the drawing. Colour and light transmittance shall be as mentioned in drawings and or schedules. Where used in conjunction with C.G.I. or asbestos sheetting the end and side laps and fixing device shall be same as used for general sheetting. Where used in lieu of glass, the fixing shall be by means of timber or metal glazing beads as mentioned in drawing. In all cases, the installation shall be completely watertight and able to withstand the designed wind-pressure. 2.4.4 Metal sheetting Sheetting should be fixed, strictly as per construction drawings. The maximum length of sheets should be the maximum transportable length. The number of sheets and the length of sheets to be worked out considering the minimum number of laps/joints in the roof system. The sheets and all accessories should be factory cut & then sent to site. Cutting of sheets at site should be avoided. If cutting of sheet at site is required, metal sheets should be cut by a Power saw with a metal cutting blade which leaves less redundant burr. Manufacturer's recommendations should be strictly followed. Before installation of roofing & cladding, it should be ensured that the supporting structure should be in true plans/perfect alignment, correctly placed & securely fixed. Cladding erection for each elevation		

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should commence at the bottom & proceed towards the top in order to ensure tight fitting laps. The installed profiled sheets have a side lap of at least one corrugation. The end lap should have sufficient overlap depending upon the slope of the roof. The end laps should use sealant so as to ensure that there is no leakage of rain water from the joints.

The General guidelines :

	Roof Slope	End lap (min.) mm	End lap (max.) mm.
(a)	Less than 1 in 4 (15°)	150	250
(b)	Greater than 1 in 4 (15°)	150	250
(c)	Wall	100	200

The suggested end laps & no. of fasteners used should be as per manufacturer's recommendations.

During cutting, drilling operations, the resulting small, sharp left over metallic particles or swarf can result stains on the coated steel roof. Swarfs should be removed & the Coated steel surface properly cleaned. During fastener installation, the installer should stand 90° to the panel, facing the purlin & drive the fastener until it is tight and the washer is firmly seated. Fasteners should not be over-driven. Proper fastener driver as recommended by manufacturer should be used for self drilling screw.

3.0 ACCEPTANCE CRITERIA

The installations shall present a neat appearance and shall be checked for water tightness. The following shall be checked:

3.1 Side and end laps

3.2 Absence of cracks, holes or damages in sheet

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3.3	Spacing of bolts, screws along with washer	
3.4	Provision of double washers (G.I. and asbestos or bituminous washers)	
3.5	Proper installation of flashing	
4.0	<u>IS CODES</u>	
	The following are some of the important IS Codes relevant to this sections :	
(a)	IS : 3007	: Code of practice for laying of asbestos cement sheets.
(b)	IS : 2527	: Code of practice for fixing rain water gutters and down pipes for roof drainage.
(c)	IS : 1626	: Specification for asbestos cement building pipes gutters and fittings.
(d)	IS : 277	: Specification for galvanised steel sheets (plain and corrugated).
(e)	IS : 14246	: Continuously pre-painted galvanized steel Sheets & coils
(f)	As-3566-2002 (class 3)	: Self-drilling screws for the building and construction industries.
(g)	As-1397	: Steel Sheet & Strip – Hot dip zinc-coated or aluminium/zinc coated.
(h)	AS/NZS 2728	: Prefinished/Pre painted sheet metal products for interior/ exterior building applications– Performance requirements.
(i)	IS-277-2003	: Galvanized Steel Sheet (Plain & Corrugated).
(j)	IS-513-1994	: Cold-rolled low Carbon Steel sheets & strips.

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
1	IFB	3.0 (4)	Submission of Price Bid	We request the Owner to consider the submission of Part 2 bid i.e. Price Bid after completion of Techno-commercial discussions. Kindly consider.	Bid specification shall prevail
2	IFB	4.1(b)	On Demand Bank Guarantee Values	Please let us know the exact percentage of On Demand Bank Guarantee the executants of the consortium need to furnish.	Clause No. 4.0 is self explanatory
3	IFB	4.2.4 (iii)	On Demand Bank Guarantee Values	Please let us know the exact percentage of On Demand Bank Guarantee the executants of the consortium need to furnish.	Clause No. 4.0 is self explanatory
4	IFB 1, 2, 2A, 2B, 2C		Contract Value & Contract Price	We have observed that the word "Contract Value" is wrongly used instead of "Contract Price" and vis-a-versa in various clauses of Volume - 1. Request Owner to re-verify.	Pl refer corrigendum No. III
5	1	1.0	Introduction	We request Owner to provide update on the status of Coal Linkage, MoEF clearance and other aspects of project development.	Pl refer clause No. 11.1.1. The query is irrelevant to the clause
6	1	4	In the event of award of the contract by the Owner to the Consortium, the lead member shall submit CP security to 10% of the contract price and the other members of consortium shall submit on Demand BG amounting to 1.5% of contract price.	Since consortium members are already jointly and severally liable and as such separate BG from each partner is not necessary in addition to performance security of 10% being provided by consortium leader. It is therefore requested to kindly amend the clause based on above request.	Bid specification shall prevail

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Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
7	1	4.2.4 iii)	In case of award of the contract, in addition to the Contract Performance Security to be submitted by the successful bidder, every Indian Manufacturer (if the entity other than the successful bidder) and collaborator shall submit on demand Bank Guarantee equivalent to 0.5% of the total contract price.	We request Owner to consider the following : 1) Indian Manufacturer and Collaborator shall submit on demand Bank Gurantee equivalent to 0.25% each (Total of 0.5%) of SG Price. 2) Indian Manufacturer and Collaborator shall submit on demand Bank Gurantee equivalent to 0.25% each (Total of 0.5%) of STG Price.	Bid specification shall prevail
8	1	7.1	The Goods and services from any country of origin shall be acceptable	Please advise whether Material and Equipment for BTG and BoP produced from China would be acceptable.	Bid specification is clear & self explanatory
9	1	10.3	The bidder irrevocably agrees..... Knowledge of bidder about the site conditions / statutory provisions	Please understand that variance due to statutory provisions is beyond the responsibility of bidder and hence we request you to delete statutory provisions from the clause	Bid specification shall prevail
10	1	13.2	Some supporting documents/printed literature may be in any other language which must be accompanied by an accurate translation of the same in English duly certified by an official translator engaged by the Court in whose jurisdiction the bidder's work place resides.	Kindly allow the translation of Foreign Languages be carried out by an independent person who has knowledge of English and Foreign Language with a self declaration certificate notarised in the court of Law.	Bid specification shall prevail
11	1	15.1.1	Currency of Bid:	We request Owner to permit quoting the bid in INR + three (3) foreign currencies i.e. Total of four (4) currencies instead of total of three (3) mentioned in the tender document.	Bid specification shall prevail

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Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
12	1	15.1.1	Currency of Bid	Please allow the bidders to quote atleast 3 currencies other than Indian Rupee as the present bid is an ICB and need sourcing of various equipment from different countries of origin. This is even the standard practice followed by other well known power utilities	Bid specification shall prevail
13	1	15.1.2	Currency of Bid: Notwithstanding the provisions above, the prices for services to be performed in India such as Inland Transportation, Marine cum Erection Insurance, Civil and Architectural Works, Erection, Testing & Commissioning etc. shall be quoted in Indian Rupees (INR) only.	Since expatriates will also be involved in providing services for the Project, we therefore request Owner to allow quotation of such services in foreign currencies.	Bid specification shall prevail
14	1	15.2.1i) 15.2.1ii)	i) Price for Supply of Equipment/materials manufactured in India (shall also include the foreign currency portion towards imported raw materials, if any). ii) Price for Supply of Mandatory Spares manufactured in India (shall also include the foreign currency portion towards imported raw materials, if any).	Please clarify if the Foreign Currency Portion declared towards procurement of imported raw material in Onshore Supplies shall be paid in foreign currency by Owner. Also confirm Bidder's understanding that the Foreign Currency Portion to be declared by the Bidder under 15.2.1i) & 15.2.1ii) shall be the CFR value of Imported Raw Material in the Supply Price for Equipments manufactured in India.	Pl refer corrigendum No.III

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
15	1	15.2	Bid Price	Please clarify whether the supply of fitting & fixtures, shutters etc those required for civil works are to be included in Supply Contract or Civil Contract.	Clause No. 15.2 of Sec I is self explanatory
16	1	16.2	Except for the taxes.....liability towards the same.	In case there are additional taxes applicable other than those specified in the the price schedule, the same shall be borne by the owner with a ceiling to the extent submitted by the bidder in the proposal.	Clause No. 16.2 of Sec I is self explanatory
17	1	18.1	Zero Date	In the definition provided Zero Date is defined as the date of issuance of LOA or NTP if the LOA does not stipulate the same. Kindly clarify the exact Zero Date to be considered for various milestones	Clause No. 18.1 of Sec I is self explanatory
18	1	18.2	~. The bidder, in his bid, shall offer the completion period as may be achievable by him and also indicate the details of various inputs required by him from the owner and their due dates in number of delays from <u>the date of award of the contract</u> in the format as per Schedule-6. ~	Please modify as below; "~. The bidder, in his bid, shall offer the completion period as may be achievable by him and also indicate the details of various inputs required by him from the owner and their due dates in number of delays from <u>Zero Date</u> in the format as per Schedule-6. ~"	Pl refer corrigendum No.III
19	1	18.3	The project completion period finally offered by the bidders as above shall be considered for evaluation of bids.	The Price Loading rate for various Guarantee factors Data is given in the tender document for the purpose of bid evaluation. Further, the tender specifies submission of the Guarantee Completion period (i.e. Schedule 7) in Part-1. This will straightway open the Differential Price (on account of loading on delivery schedule) to all the bidders before opening of the price bid. Hence it is requested to confirm that that the Guaranteed Completion Schedule may be submitted in the Price Bid (i.e. Part-2).	Pl refer corrigendum No.III

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
20	1	18.4	Reduction of contract price to the extent of difference between the contractor's evaluated price and the lowest evaluated price against this bidding.	Kindly elaborate with an example.	Bid specification is clear in this regard
21	1	18.4	If the situation warrants, the owner reserves the right to accept the base bid at its offered price. However, in such a case, if the contractor (successful bidder) fails to achieve the completion of the project within the contractual completion period, the contract price payable shall be 'reduced to the extent of difference between the contractor's evaluated 'price and the lowest evaluated price against this bidding.	As Project Schedule is included in evaluation (Cl. 18.3 & 31.6, Section 1), we request Owner to award the Project to Bidder with Lowest Evaluated Price. Hence we request for deletion of this Clause.	Bid specification shall prevail
22	1	18.4	If situation warrants.....against the bidding.	We request owner to elaborate on this.	Bid specification is clear in this regard

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Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
23	1	18.4	If the situation warrants, the owner reserves the right to accept the base bid at its offered price. However, in such a case, if the contractor (successful bidder) fails to achieve the completion of the project within the contractual completion period, the contract price payable shall be reduced to the extent of difference between the contractor's evaluated price and the lowest evaluated price against this bidding.	Please clarify the reduction in price concept and whether this reduction shall be over and above the LD for delay which shall be deducted.	Bid specification is clear and self explanatory in this regard
24	1	18.6	Electronic schedule & payment withheld for non-approval of schedule	As, the scope of contract is full EPC, all activities are within the responsibility of contractor (except activities related to owners inputs). We will submit the output of primavera (latest version) in acrobat reader format instead of *.mpp format Contractor will submit the detailed schedule covering the packages/ major equipment and activities as mentioned in this clause, however, for ease of constructibility, monitoring and control, bidder requests the WBS format shall be as per bidder's standard format. We also request that the proposed withholding of payment to link with bidders 'submission' of schedule instead of its 'approval'. Also,pl. refer to clause 18.9 , 18.10	Bid specification shall prevail

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Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
25	1	18.6	Work completion schedule indicating all construction, erection & commissioning activities in Microsoft Project format	Kindly give the option to submit the work completion schedule in Primavera also	Bid specification shall prevail
26	1	18.7	Schedule shall be generally based on Owner's Standard template of WBS	Kindly share the standard template so that we may analyse the same and decide how far it is feasible to submit the same in the standard template	Bid specification shall prevail
27	1	18.8	The activities shall be detailed to the extent that except for a few exceptions where further breakdown of the activities is not logical, the duration of the activity does not exceed 30 days period	30 days period is too less. Many activities of engineering / manufacture take more than 30 days.	Bid specification shall prevail
28	1	19	condenser back pressure- 76 mm Hg	As per clause no. 19.0 of Volume-1, Section-1 of the tender specifications, for guarantee purposes condenser back pressure is mentioned as 76 mm Hg. However, in Volume-III B, Section-1, Page 77/308, Clause 1.11.1, the same is specified as 77 mm Hg. We presume that the data given in Volume-1 prevails over Volume-III B. Kindly confirm	Mahagenco confirms that stipulation of Clause No. 19.0 of Volume-I shall prevail
29	1	19.1	Loading factor of INR 1,50,00,000.00 for completion period	Please define the unit of measurement (per month, per week, per day etc)	Pl refer Corrigendum issued vide our letter No. DG/BSL U-6/2011/T-1/0162 dtd 09.01.12
30	1	19.1	Duration offered (considering the lowest as base) for Completion of the Project as envisaged under Clause No. 30.1, Section - 2 of Bid Specification	Please clarify if this loading for shortfall in duration is per month or per day or else as the same is missing.	Pl refer Corrigendum issued vide our letter No. DG/BSL U-6/2011/T-1/0162 dtd 09.01.12

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
31	1	19.1	Sr. No. 1 INR 15,000,000 loading for evaluation	Only value is mentioned. Please clarify the rate of loading (e.g. per month)	Pl refer Corrigendum issued vide our letter No. DG/BSL U-6/2011/T-1/0162 dtd 09.01.12
32	1 3	19.1 (4) 6.3 (3)	Auxiliary Power Consumption	In line with standard industry practice, we request Owner to consider Auxiliary Power calculation for Loading as well as for Guarantee purposes to be measured on "kW" basis instead of "kWh" basis specified in the Bid Specification. Also request Owner to please clarify the measurement points & other equipment/systems/areas to be covered for guaranteeing the auxiliary power consumption. All items are not getting covered in clause 6.3 of section 3, Volume I, for eg TG lube oil with purification system, gland steam exhaust systems, seal oil system, H2 system, stator water coolant system, OLTCS, CCW system, Dosing system, Mill rejects system, Misc. pumps etc. Also excitation losses have been included erroneously in the list, since the generator output of 660 MW is net off of the excitation power.	Pl refer corrigendum No.III Refer Section 3
33	1	19.1 (5)	For increase of every 5 mg/Nm3 in Suspended Particulate Matter (SPM) level (considering lowest quoted SPM Level as base). Bids with SPM level more than 50 mg/Nm3 shall be rejected outright.	As per prevailing norms SPM level of 50 mg/ Nm3 is acceptable. Therefore, SPM level should be included in "Guarantees under Correction" and not used for evaluation. Kindly consider.	Bid specification shall prevail

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
34	1	19.1 (5)	For increase of every 5 mg/nm ³ in suspended particulate Matter (SPM) level (Considering lowest quoted SPM level as base). Bids with SPM level more than 50mg/nm ³ shall be rejected.	For Performance Guarantee, SPM shall be considered at 100% TMCR with one field out . Please confirm	Mahagenco confirms that Performance Guarantee, SPM shall be considered at 100% TMCR with one field out in each path .
35	1	22.2	Deviations without cost of withdrawal and not acceptable to Owner shall be deemed to be withdrawn by the bidder	Please appreciate that there could be deviations, for which, no cost can be allocated. In such deviations, we request the client to discuss the deviations mutually and agree before price bid opening. Please confirm.	Bid specification shall prevail
36	1	22.3 & 22.4	Separate Submission of Deviations associated with price	It is requested that for Part-1 of the bid, all the commercial and technical deviations may be listed in Annexure- VIIA and VIIIA respectively. The Annexure-VIIB and VIIIB may be used only for price bid.	Bid specification shall prevail
37	1	24.2	Enclosure-4 : Submission of Guaranteed Completion period in Part-1 of the bid	The Price Loading rate for various Guarantee factors Data is given in the tender document for the purpose of bid evaluation. Further, the tender specifies submission of the Guarantee Completion period (i.e. Schedule 7) in Part-1. This will straightway open the Differential Price (on account of loading on delivery schedule) to all the bidders before opening of the price bid. Hence it is requested to confirm that that the Guaranteed Completion Schedule may be submitted in the Price Bid (i.e. Part-2).	Pl refer corrigendum No.III

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
38	1	24.2	Enclosure -3 Copy of the bid specification (Volume I to Volume - VIII) including all clarifications, corrigenda, addenda, errata, amendments thereto issued by the owner duly sealed and signed (without filling in any data)	As the Bid Document runs into few thousands of pages, it would not be practicable to submit this Enclosure-3. We suggest to Owner to instead consider one page declaration by Bidder.	Only one copy along with original
39	1	24.2	Enclosure - 4	Kindly note that Schedule - 7 (GURANTEED TECHNICAL PARAMETERS) shall be submitted along with the Part - 2 i.e. Price Bid and not along with the Part - 1 i.e. Techno-Commercial Bid Enclosure- 4 since guaranteed technical parameters impact evaluated price.	Pl refer corrigendum No.III..
40	1	24.3 Annexure-I(B)	The Part-2 i.e. Price Bid	The list of Enclosures provided in section 24.3 and in Annexure-1(B) is not matching. We request Owner to provide us the final list.	
41	1	27.3	Declaration of information during Bid opening	Since this is public tender opening, it is requested to declare the following during bid opening: 1. Correctness of BG in terms of value and validity 2. Presence of absence of DJU in the bid, alongwith the name of the parties signing the bid 3. Presence or absence of Power of Attorney 4. Declaration regarding No Deviation on critical clauses mentioned in clause 28.4 of Volume-1, Section-1 of tender specifications. 5. Confirmation about submission of Price Bid in electronic format with in stipulated time by the bidders.	Bid specification shall prevail

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Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
42	1	28.4	The bid does not conform directly or indirectly, explicitly or implicitly shall be considered as substantially non-responsive hence rejected and shall not be considered for further evaluation and thereby opening of price bid.	Please allow bidder to <u>suggest deviation with cost of withdrawal.</u>	Bid specification shall prevail
43	1	28.4	The bid which is found to be meeting stipulated qualifying requirements, however, does not conform directly or indirectly, explicitly or implicitly, to the major commercial terms & conditions contained in Volume - I of this specification namely: 1. Duration of Completion of the Project and Project Network Schedule (Clause 18.0, Section - 1) 2. Contract Performance Security (Clause 14.0, Section- 2). 3. Bank Guarantees against the Contract (Clause 15.0, Section - 2) 4. Billing Break-up and Delivery Schedule for the Goods to be Supplied (Clause 11.0, Section- 2A). 5. Billing Break-up of Contract Value (Clause 26.0, Section - 2B) 6. Terms of Payment (Clause 12.0, Section- 2A and Clause 27.0, Section - 2B).	According to this clause, the bids which do not confirm to listed clauses will be treated as non-responsive and rejected. However GCC has provision for the Bidder to take deviations and give cost of withdrawal against such deviations. Hence such deviations will be completely withdrawn by the bidder, if the Owner so desires, and the cost of withdrawal of deviations will be added to the bid price for the purpose of bid evaluation. Please clarify that in such cases, the bids will not be treated as non-responsive.	Bid specification shall prevail

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
		Continued	7. Liquidated Damages (Clause 30.0, Section- 2 read with Clause 6.0, Section - 3) 8. Insurance (Clause - 28.0, Section 2 and Clause - 6.0, Section - 2B). 9. Performance Guarantee Test (Clause 39.0, Section - 2). 10. Defect Liability (Guarantee) Period (Clause 43.0, Section - 2) 11. Final Acceptance and Handover of Unit (Clause 41.0, Section - 2) 12. Arbitration (Clause 64.0, Section - 2) 13. Phased Manufacturing Programme (Clause 8.0, Section- 3) shall be considered as substantially non-responsive hence rejected and shall not be considered for further evaluation and thereby opening of price bid.	Continued as above.	

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
44	1	28.4	The bid which is found to be meeting stipulated qualifying requirements, however, does not conform directly or indirectly, explicitly or implicitly, to the major commercial terms & conditions contained in Volume - I of this specification namely: 1. -----13. shall be considered as substantially non-responsive hence rejected and shall not be considered for further evaluation and thereby opening of price bid.	Bidder requests Owner to consider exclusion on these terms & conditions specially "Terms of Payment" because the Terms of Payment shall result in serious cash flow issues to the Bidder , who is a newly established Indian Manufacturing facility and are yet to initiate full scale commercial operations. We request Owner to instead consider these terms & conditions as a loading factor for evaluation of Bids. We also request Owner to maintain the Terms of Payment same as NTPC Tenders which are win-win for both Owner and Contractor.	Bid specification shall prevail
45	1	28.4	Bids meeting the qualifying requirements shall be considered as substantially non responsive hence rejected and not considered for further evaluation and thereby opening of price bid.	Since post bid discussions allow addressal of deviations/ clarifications, the clause may be suitable modified as follows which incidently is also adopted by NTPC in the recent Bulk tenders " Bidders are not expected to take deviations on major commercial terms and conditions in Vol I. The employers determination of a bid's responsiveness is to be based on the content of bid itself without recourse to extrinsic evidence, If a bid is not substantially responsive, it may be rejected "	Bid specification shall prevail
46	1	28.4 (9)	Performance Guarantee test (clause 39.0 section 2)	Please confirm that PG test requirement listed under no deviation clause and explained in clause 39 of section 2 includes Category I guarantees only.	Mahagenco shall revert separately

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
47	1	29.1	After opening of Part - I i.e Techno-commercial bid in both electronic as well as physical form.....	Please confirm whether Part - I is also to be submitted in electronic form...this is contrary to what is specified in Cl. 24.1.	Pl refer corrigendum No.III
48	1	29.1	After opening of Part - 1 i.e. Techno-commercial bid in both electronic as well as physical form and preliminary evaluation as stipulated under Clause 28.0 above thereof,.....	Kindly clarify whether Part 1 (techno-commercial) shall be in both electronic as well as physical form because contrary clause 24.1 states "The Part - 1 is to be submitted in Physical form"	
49	1	29.4	By obtaining clarifications/ confirmations in respect of each of the technocommercial bids, all the bids will be brought at par as far as technical requirements and commercial terms & conditions are concerned	Various bidders possess different technologies for equipment design and manufacture. As far as functional requirements are concerned, all the bidders can be brought at par, however bringing the bidders technically at par is practically not possible. It is therefore requested that all the deviations agreed by MahaGenco with the individual bidders, may be circulated to all the bidders and on the basis of that, the bidders may be given the option to optimise their bid. Since it is two part bidding process, bidders may be allowed to submit, in the form of supplementary price bid, a lump-sum reduction in their prices which may result out from the optimisation. This will help MahaGenco in the reduction of overall cost of the project	Pl refer corrigendum No.III
50	1	31.1.3	Cost of withdrawal of deviations	What will be the policy of MahaGenco if during post bid discussions, the bidder agrees to withdraws the deviations (associated with price) without price implication	Bid specification is clear in this regard

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
51	1	31.4.1	The Owner has applied for Mega Power Project Benefits under Mega Power Project Policy of Govt. of India.	Please advise whether the Owner has obtained the Mega Power Status for this project as the basis for applicable Taxes to be considered for this project i.e considering Mega Power Benefits or Non Mega. Alternatively, all bidders may be asked to quote on Mega and Non Mega basis.	Bid specification is clear & self explanatory in this regard
52	1	31.4.1	The Owner has applied for Mega Power Project Benefits	Please confirm if we can consider mega power project benefits in our bids. Please also confirm availability of required documentation to avail such benefits	Bid specification is clear & self explanatory in this regard
53	1	31.4.2	The current provisions of the Mega Power Project Policy mandates price preference to the domestic manufacturers. As per directive of this policy, the import content (bid price in foreign currency of the supply portion) shall be increased by 15% of CIF price of the import content. For the purpose of this clause, the CIF price of import content in Ex-works price shall be 90% of the foreign currency portion of the Ex-works price whereas in case of CFR price, the same shall be 100.5% of the CFR price.	Bidder understands that Insurance shall not be considered for evaluation of bids, hence we presume that price preference loading must be on CFR price of Import Content only.	Bid specification is clear in this regard

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
54	1	31.4.2	Price Basis for Imports, Insurance by Contractor	In Cl. 31.4.2 loading criteria for both CIF & CFR prices have been defined. Whereas Schedule-1 of Price Bid stipulates bidders to quote CFR prices for imported equipment & spares. On the other hand Cl. 28.0 of Section-2 stipulates Contractor's to include all risk insurance in prices. Please clarify whether the Contractor's shall quote prices on CFR or CIF basis.	Bid specification is clear in this regard
55	1	31.5	For the purpose of evaluation.....is a holiday for SBI	We request owner to accept record date as 7 days prior to last date on submission of bid.	Bid specification shall prevail
56	1	34.1(ii)	On Demand Bank Guarantee Values	Please let us know the exact percentage of On Demand Bank Guarantee the executants of the consortium need to furnish.	Clause No. 4.0 is self explanatory
57	1	35	Construction of contract	We request to award separate contracts on each consortium member including provision of each member receiving payments directly from the owner	Bid specification shall prevail
58	1	35.1	Construction of the Contracts: The contracts shall be entered into with the successful bidder as under:	Please modify as below Construction of the Contracts: The contracts shall be entered into with the successful bidder (and <u>each consortium member</u> , if any) as under:	Bid specification shall prevail
59	1	35.1	Construction of the Contracts: The contracts shall be entered into with the successful bidder as under:	Please define the construction of the Contracts in case the bidder is a consortium of Indian and Foreign entities.	Bid specification is clear in this regard

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
60	1	35.2	Signing of contract	There is no separate contract and payments for Civil Works defined although additional Conditions for Civil Works in Section-2C have been specified. As you may appreciate the tax structure of Civil Contract shall be different than other Site services viz. Erection & Commissioning. Please clarify whether there will be a separate contract for Civil Works.	Pl refer corrigendum No.III
61	1	35.2	Construction Of Contract & Annexure -XII (Proforma for Contract Agreement)	Please clarify which terms and conditions to be included for each type of Contract Agreement? Say for Supply Contract Agreement, will it include the Terms and Conditions of SECTION 2B &2C (Services and Civil)? If so, then what will be the corresponding Schedules and Annexure, Contract Price & value of subsequent bonds etc applicable for each of the three Contract Agreements.	Pl refer corrigendum No.III
62	1	35.2	First contract: includes goods of Indian origina and of foreign origin and despatched directly to site	Please confirm that for goods of foreign origin and despatched directly to site, sale on high seas shall be effected	Pl refer corrigendum No.III

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
63	1	35.2 35.3	35.2 In case the successful bidder is an Indian Entity: i) First Contract: ii) Second Contract: iii) Third Contract: 35.3 In case the successful bidder is a Foreign Entity: i) First Contract: ii) Second Contract: iii) Third Contract:	The Contracting structure prescribed in the Tender document under 35.2 and 35.3 is intermeshing the services and Supply Contract. We request Owner to consider the contracting structure on optimized tax structure basis. i.e. (i) First Contract : For CIF (Indian port of entry) supply of plant and equipment including type test charges and mandatory spares to be supplied from abroad. (ii) Second Contract : For Ex-works (India) supply of domestically manufactured plant and equipment including type test charges and mandatory spares. (iii) Third Contract : For providing all services i.e. port handling, port clearance and port charges for the imported goods, further loading, inland transportation for delivery at site, inland transit insurance, unloading, storage, handling at site, installation services including erection, civil, structural & allied works, insurance covers other than inland transit insurance, testing, commissioning and conducting Guarantee tests in respect of all the equipments supplied under the 'First Contract' & the 'Second Contract' and all other services as specified in the Contract Documents.	Bid specification shall prevail
64	1	35.3	The foreign bidder, however, has the option, to be exercised as a part of its bid proposal, to propose an Assignee in its bid to execute the Second Contract and/or the Third Contract	MAHAGENCO is requested to kindly allow an Assignee for Indian bidder as well for the 2nd and 3rd contract. This is requested to avoid sub-contracting route and better taxation formation.	Bid specification shall prevail

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
65	1	35.8	If the successful bidder fails to sign the contract....	We kindly request the client that where the contract agreement is not signed within 90 days from date of LOA for no reasons attributable to the Bidder, then the Bidder shall have the right to suspend the contract and the parties shall mutually agree on equitable adjustment to the contract price and to the completion schedule and/or other relevant conditions of the contract. In such case we request the client, not to forfeit the Performance Guarantee.	Bid specification shall prevail
66	1	37.1	Spares Owner reserves the right after evaluation and at the time of award to vary the quantity of spares and / or delete any item ...or add altogether new item of spares.....	We suggest that the changes to the requirement of mandatory spares to be agreed by the Parties. Also confirm that the mandatory spares shall be ordered alongwith the main equipment (and not upto 6 months after LOA)	Bid specification shall prevail
67	1	2.0, Annexure - I(A)	Status of the Bidder	Please incorporate necessary changes pertaining to the concept of consortium of EPC company and Qualified manufacturers.	Pl refer corrigendum No.III
68	1	Annexure - II Schedule - 8(B)	Proforma for Bank Guarantee against Bid Security Proforma for On Demand Bank Guarantee to be submitted by the parent Manufacturer/ subsidiary Company/ JV Company/ Indian Promoter/ Collaborator	We request Owner to include the " <u>Notwithstanding</u> " clause in the Bank Guarantee formats on lines of Clause no. 10 of Performance Guarantee format (Schedule 8(A), Section 1) of Bid Documents.	Pl refer corrigendum No.III

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Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
69	1	Annexure - IV	Summary of Qualification	Please incorporate necessary changes in the Format pertaining to the experience and qualification of EPC company	Pl refer corrigendum No.III
70	1	Annexure - V (B) and Schedule 8-B	Format of DJU and BG	We would like to discuss the format of DJU and BG in Detail	Bid specification shall prevail
71	1	Annexure - V(A), Cl 2.	In case of any breach of the Contract(s).....shall be in line with provision on Limitation of Liability of the said contract(s). The liability of the parent Manufacturer hereunder shall however, be limited to an amount calculated at the rate of USD 221/ 122/ 343 Million for each of the equipment set to be supplied by the bidder/contractor.....	The liability limit of the parent Manufacturer is specified as USD 221 / 122 / 343 Million. We request Owner to clarify the applicable liability limit amounts for SG & ST Parent Manufacturers.	Mahagenco shall revert separately
72	1	Annexure VA	Arbitration provision in DJU & Consortium Proforma & the three Contract Agreements	We request to stipulate uniform acceptable arbitration procedural rule, law and place in all proforma (DJU, Consortium) and also in the three Contract Agreements. We propose that the appointment of Arbitrators & Arbitration procedural rule shall be as per institutional rule of ICC, LCIA or equivalent.	Mahagenco shall revert separately

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
73	1	Annexure-V(A)	Formats of Deed of Joint Undertaking Annex-V(A)	Inline with the amendment No. DG/BSL U-6/2011/T-1/858 issued on 23/02/2012, the named formats need to be amended to suit the revised Qualification Requirement. Kindly arrange to issue the revised formats Please clarify if separate DJUs are to be provided -one related to SG package and one related to STG package. Further, the obligations mentioned in each DJU shall apply to its respective scope - that is for SG scope under the DJU related to SG and for STG scope under the DJU related to STG package. The DJU format needs to be modified	Mahagenco shall revert separately
74	1	Annexure- V(B)	Formats of Deed of Joint Undertaking Annex-V(B)	Inline with the amendment No. DG/BSL U-6/2011/T-1/858 issued on 23/02/2012, the named formats need to be amended to suit the revised Qualification Requirement. Kindly arrange to issue the revised formats	Mahagenco shall revert separately
75	1	Annexure - VI	Proforma of Consortium Agreement	Please incorporate necessary changes pertaining to the concept of consortium of EPC company and Qualified manufacturers.	Mahagenco shall revert separately
76	1	Annexure- VI	Formats of Proforma for Consortium Agreement	Inline with the amendment No. DG/BSL U-6/2011/T-1/858 issued on 23/02/2012, the named formats need to be amended to suit the revised Qualification Requirement. Kindly arrange to issue the revised formats We request the Client to accept the Consortium Proforma as per the Parties agreement, confirming that the Parties will be jointly and severably liable to the Client.	Mahagenco shall revert separately
77	1	Annexure-VI	Consortium Agreement	Kindly redraft the Consortium agreement in lieu of the revised Qualification requirement 4.1 vide letter no. DG/BSL U-6/2011/T-1/0853, dt.23/02/2012.	Mahagenco shall revert separately

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Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
78	1	Annexure-VI	Consortium Agreement Proforma	We request the Client to accept the Consortium Proforma as per the Parties agreement, confirming that the Parties will be jointly and severably liable to the Client.	Bid specification shall prevail
79	1	Annexure-VI 3.0	vii. To take all the action for entire ~. All the members further agree and irrevocably accept that the leader member shall only be authorized to accept payments from the owner and upon making the payments to the lead member, the owner shall have discharged in full from all its liabilities to the consortium.	vii. To take all the action for entire-. All the members further agree and irrevocably accept that the leader member and the consortium member(s), if any, shall be authorised to accept the payments from the owner	Bid specification shall prevail
80	1	Annexure-VI 3.0vii	Lead Member: vii. To take all the action for entire execution of the Contract and accept payments on behalf of the Consortium from the owner. All the members further agree and irrevocably accept that the leader member shall only be authorised to accept payments from the owner and upon making the payments to the lead member, the owner shall have discharged in full from all its liabilities to the consortium.	Kindly allow the Consortium partners to receive independent payments based on the Division of Work for each member(To be declared in the Contract Agreement). Common Stream of Payment through Lead Partner for the Consortium shall expose the Consortium to Association of Persons (AOP) risk. AOP risk can be mitigated where it is clear from the contract that 1. No common scope of work 2. No common stream of payment 3. No sharing of profits and losses Hence, we request Mahagenco to structure the Contract structure in such a way that no AOP risks are envisaged.	Bid specification shall prevail

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
81	1	Annexure-XII	 wherein all the member's of the consortium jointly and severally shall be perform the obligations of the contractor and lead member of the consortium is authorised to do all acts and deeds including incurring liabilities and receive payments on behalf of the consortium to give effect to this contract.	Kindly allow the Consortium partners to receive independent payments based on the Division of Work for each member(To be declared in the Contract Agreement). Common Steam of Payment through Lead Partner for the Consortium shall expose the Consortium to Association of Persons (AOP) risk. AOP risk can be mitigated where it is clear from the contract that 1. No common scope of work 2. No common stream of payment 3. No sharing of profits and losses Hence, we request Mahagenco to structure the Contract structure in such a way that no AOP risks are envisaged.	Bid specification shall prevail
82	1	Annexure-XII Schedule-3 1.0	Details of Price Adjustments 1.1.1 The Ex-Works/FOB price element of price for supply of Equipment and Mandatory Spares thereof shall be subject price adjustment limited to $\pm 20\%$ of the said price component	Kindly remove this ceiling of $\pm 20\%$ on the price adjustment as prescribed in Schedule 3 (Details of Price Adjustments) in accordance with the GOI directive in case of NTPC Vs Technopromexport and NTPC Vs Power Machines and the recent EPC tenders, where in price adjustment of NTPC EPC Tender is without Cieling.	Bid specification shall prevail
83	1	Annexure-XII	Construction Of Contract & Annexure -XII (Proforma for Contract Agreement)	Please clarify which terms and conditions to be included for each type of Contract Agreement? Say for Supply Contract Agreement, will it include the Terms and Conditions of SECTION 2B & 2C (Services and Civil)? If so, then what will be the corresponding Schedules and Annexure, Contract Price & value of subsequent bonds etc applicable for each of the three Contract Agreements.	Pl refer corrigendum No.III

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Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
84	1	4.0, Annexure - XII	Cross Fall breach clause	The said clause is incomplete.	Pl refer corrigendum No.III.
85	1	Schedule - 1	Proforma for Break-up of Prices (Notes)	Please advise whether the Deemed Export benefits are still available for Projects bid under ICB route.	Bid specification is clear in this regard
86	1	Schedule 3	New introduction	As the project involves work related to Power Station railway siding and Shunting Locomotive, we request Owner to kindly allow price adjustment for the following items also: 1. Rails 2. Sleepers 3. Signaling Cables 4. Contract & Catenary Wires 5. Fabricated & Galvanized Steel Structures Suitable formulae for the items can be proposed by Bidder at bidding stage.	Bid specification is clear & self explanatory in this regard
87	1	Schedule 3 1.1.1,	Price Adjustments - cap of +/- 20% of contract price of the particular equipment/ item	The recent tenders of NTPC do not stipulate any cap/ limit on the price adjustment amount. We request you to kindly delete these provisions in line with recent practice.	Bid specification shall prevail

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Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
88	1	scheduled 3	Price Adjustments - cap of +/- 20% of contract price of the particular equipment/ item	Same as above. Pl. see reference clauses as below 1.1.4, 1.2.3, 1.3.1, 1.3.3, 1.4.1, 1.4.3, 2.3, 3.3	Bid specification shall prevail
89	1	Schedule-3, Cl 1.4.2	Wp ₀ = Wholesale price index	Please intimate the name of commodity	Pl refer corrigendum No.III
90	1	Schedule -3, 1.4.2	Wp ₀ = 'Value of "Wholesales Price Index" as declared by Office of the Economic Advisor, GoI, New Delhi as on base date	We understand that "Wholesales Price Index for <u>All Commodities</u> " will be considered for calculating price adjustment for Supply of Aggregate. Kindly confirm.	Pl refer corrigendum No.III
91	1	Schedule -3, 3.1	Cw ₀ = Value of Consumer Price Index (New Series) for Industrial Workers applicable for working price center as on base date as Published by Labour Bureau, Shimla, government of India	As Bhusaval is not a published price centre of Labour Bureau, we request to consider Nagpur as the price centre for calculating value of Consumer Price Index for Industrial Workers.	Nasik being the Northern Headquarter of Maharashtra, Nasik shall be considered as price centre for calculating value of Consumer Price Index for Industrial Workers.
92	1	Schedule-3, Cl 1.1.4	Total price adjustment payable against this contract for particular equipment shall not exceed ± 20% of the Ex-Works/FOB price of the particular equipment/Mandatory Spare as the case may be	The limiting value of ± 20% should be applicable to the total supply contract price of main equipment / mandatory spares and not on individual equipment / item / invoice.	Mahagenco shall revert separately

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Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
93	1	Schedule-3, Clause 1.2.3	the price adjustment shall not exceed $\pm 20\%$ of the contract price of particular steel item	The limiting value of $\pm 20\%$ should be applicable to the total supply contract price of steel and not on individual item / invoice.	Mahagenco shall revert separately
94	1	Schedule-3, Clause 2.1	The contract price adjustment for Erection, Testing & Commissioning Charges shall be as per following formula	Please confirm that for the purpose of price variation, the PV shall be paid on the total value indicated by the bidder at S. No. 2.0 of Schedule-1 (excluding taxes and duties)	Pl refer corrigendum No.III
95	1	Schedule-3, Clause 3.1	The contract price adjustment for Civil, Structural & Architectural Works shall be as per following formula	Please confirm that for the purpose of price variation, the PV shall be paid on the total value indicated by the bidder at S. No. 3.0 of Schedule-1 (excluding taxes, duties and supply price of steel)	Pl refer corrigendum No.III
96	2 1	Schedule-3, all clauses	In the event of the work performed beyond scheduled date of completion of the respective activity, the price adjustment shall be worked out based on i) the scheduled date of completion of respective activity and ii) the actual date of completion of the activity and whichever is beneficial to the owner shall be payable	Please confirm that : In the event of the work performed beyond scheduled date of completion of the respective activity due to reasons attributable to the Owner , the price adjustment shall be worked out based on i) the scheduled date of completion of respective activity and ii) the actual date of completion of the activity and whichever is beneficial to the Contractor shall be payable	Pl refer corrigendum No.III
97	1	Schedule 4	Details of import content of bid	This schedule shall also include the value of goods manufactured in a factory located in a SEZ area	Noted

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
98	1	Schedule-5	Unit Price for addition / deletion	This is an EPC contract and the bidder will quote lump-sum prices for the equipment to be supplied by him under the pervue of this contract. The unit rates of the small items indicted in Schedule-5 can not be operated during execution of the contract. The same is explained at S. No. 18.1 of Section-2, Volume-1 of tender specifications. Hence, Schedule-5 may please be deleted.	Pl refer corrigendum No.III
99	1	Schedule 7	Guaranteed Technical Parameters and LD for failure to meet performance guarantees - TG Cycle Gross Heat rate and SG efficiency	This being a turnkey EPC tender, we request that the performance guarantee is requested on Unit Gross Heat rate basis which incorporates the TG Cycle HR and SG efficiency	Bid specification shall prevail
100	1	Schedule 7	Guaranteed Technical Parameters: Suspended Particulate Matter (Maximum acceptable is 50mg/Nm3)	For Performance Guarantee, SPM shall be considered at 100% TMCR with one field out . Please confirm	Mahagenco confirms that Performance Guarantee, SPM shall be considered at 100% TMCR with one field out in each path .
101	1	Schedule 7	Guaranteed Technical Parameters and LD for failure to meet performance guarantees - TG Cycle Gross Heat rate and SG efficiency	This being a turnkey EPC tender, we request that the performance guarantee is requested on Unit Gross Heat rate basis which incorporates the TG Cycle HR and SG efficiency	Bid specification shall prevail
102	2	1.1 (g)	Equipment performance guarantee of the units for a period of 12 months from the date of performance guarantee test of the Plant equipment.	Our understanding for equipment performance guarantee is "equipment warranties". Please clarify.	Mahagenco shall revert separately

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
103	2	3.0 (xxxvi)	Zero Date	In the definition provided Zero Date is defined as the date of issuance of LOA or NTP if the LOA does not stipulate the same. Kindly clarify the exact Zero Date to be considered for various milestones	Bid specification is clear in this regard
104	2	3.1.xxxvi	zero date	In case of delay in advance payment beyond the contractual period, the zero date shall be the date of receipt of advance by the bidder	Pl refer corrigendum No.III
105	2	6.2	The Contractor shall be deemed to have inspected the site ~ including the nature of ground and sub-soil, ~. Site condition shall not relinquish the contractor from any of his obligations / responsibilities to be discharged and performed under the contract as per schedule within the contract price.	It is not possible for Contractor to totally eliminate the possibility of unforeseen physical condition of sub-soil and underground, in such a case, which requires inspection method or equipment(s) beyond currently available technology. In such a case Contractor shall be given extension of time along with cost increase as per actual base for converting subsoil condition ~	Bid specification shall prevail
106	2	6.2	Ground & sub-soil condition- Bidder's risk	As this an existing site, we kindly request the owner to provide the bidder with site and soil investigation report at least three month prior to bid submission	Bid specification shall prevail
107	2	9.2	The contract agreement is signed in ONE ORIGINAL and TWO COPIES.	This clause is in contradiction to Clause 35.7 Section 1 which states "The contract agreement is signed in One Original and One Copy"	Pl refer corrigendum No.III
108	2	16	Ownership of goods. = First contract: includes goods of Indian origin and of foreign origin and despatched directly to site	Please confirm that for goods of foreign origin and despatched directly to site, sale on high seas shall be effected	Pl refer corrigendum No.III

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
109	2	16.1	Notwithstanding anything stated herein, the contract shall be a Single Source responsibility supply- cum-erection including associated Civil Works contract but split into relevant Contracts for the sake of convenience.	Kindly clarify the statement "split into relevant Contracts for the sake of convenience" because Bidder understand that the Contract Structure defined under 35.2 and 35.3 of Section 1 is defining three independent contacts with definative Title transfer of Goods and Services bounded together with Cross fall Breach concept.	Bid specification is clear in this regard
110	2	16.2	The owner and the contractor agree and acknowledge that notwithstanding anything to the contrary contained in this contract, this contract is a turnkey contract	Kindly confirm the intent of the client defining the Contract as Turnkey Contract because the Owner has specified breaking up of the overall contract as independent 3 contracts under 35.2/35.3 with cross fall breach clause.	Bid specification is clear in this regard
111	2	18.1	As this contract is a lump sum contract on turnkey basis, any change in the contract price arising out of any alteration.....	Kindly confirm the intent of the client defining the Contract as Turnkey Contract because the Owner has specified breaking up of the overall contract as independent 3 contracts under 35.2/35.3 with cross fall breach clause.	Bid specification is clear in this regard

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
112	2	21	Vendor/ Subcontractor approval prior to appointment	To avoid any delays during execution, the list of approved vendors should be discussed and finalised before LOA and should form part of the contract as an approved vendor/ subcontractor list. We request you to suitably modify provisions of this clause accordingly. Cl. 21.2 & 21.3: Bidder shall be allowed to proposed additional names in its proposal and the same shall be reviewed and finalised before LOA and shall form part of the contract as an pre-approval vendor list. In case Contractor wishes to propose any new vendor, then contractor shall provide necessary credentials/ details of such supplier for Owner's approval Cl. 21.2. In case, owner deletes any vendor from the approved vendor list, Owner may do so but not later then 60 days prior scheduled date of placement of purchase order for such item so as not to effect the performance of the contract. In case, Owner does so after the above 60 days period, the Contractor shall be compensated for any impact on cost as well as on completion schedule. Please confirm	Bid specification shall prevail
113	2	21.2	The contractor shall procure the goods/equipment/services mentioned in the list stipulated in Volume - II of the contract from the approved sources stipulated therein	A qualified bidder with proven equipment, shall be awarded the contract by MahaGenco. If bidder himself is a regular manufacturer of the items indicated in Volume-II, Section-11, please confirm that no separate approval is required by him from Mahagenco to supply his own manufactuered items.	Bid specification is clear in this regard

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
114	2	21.2	In case of removal of approved sources by the Owner, if the contractor suffers any monetary loss due to such decision of the owner, the same shall be reimbursed against documental evidence	Any time loss shall also be to the account of the Owner.	Bid specification shall prevail
115	2	21.2	The contractor shall procure.....the source selected. The owner reserves the right to add/remove the sources for any item. Incase the source selected by the contractor is deleted by the owner after 15 days of intimation by the contractor , the contractor shall procure the goods/equipments/services from other approved sources. In such cases, if the contractor suffers any monetary loss due to such decision of the owner, the same shall be reimbursed agianst documental evidence.	Client to clarify that 15 days is the time he will take to inform the contractor from the date of intimation of source of goods/equipment/services regarding deletion of source selected by the contractor.	Bid specification is clear in this regard

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Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
116	2	21.3	However, the contractor may procure goods..... such source(s) proposed by the contractor. Such source proposed by the contractor should have.....one thermal power plant of 500 MW or above capacity.....should have completed the contractual gurantee period or should have supplied to any power plant	Client to clarify and confirm our understanding that the contractor can source the equipment from any manufacturing works of the sub-vendor provided the make and model is same as supplied by some other manufacturing location of sub-vendor for 500 MW thermal power plant.. Client to also clarify the conditions of supply of equipment to the power plants viz. commercial operation, contractual gurantee etc. It is not feasible that the equipment supplied and under one year of commercial operation would have completed the contractual gurantee period.	Bid specification is clear in this regard and shall prevail
117	2	21.7	Except for the goods/equipment/services mentioned under Clause No 2, Section - 3, Volume - I and the items mentioned in the list stipulated under Volume - II, the contractor may procure other goods and services from the sources at his option.	We understand that no vendor approval is required from MahaGenco for the items other than those specified in Clause No 2, Section - 3, Volume - I and the items mentioned in the list stipulated under Section-11 of Volume - II. Kindly confirm.	Bid specification is clear in this regard

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
118	2	25.1	The contractor shall submit all the General Arrangement drawings, Mechanical, Electrical and Civil Design Basis/Criteria, Drawings, Data Sheets, Documents, Equipment and their Capacity Selection, Test Procedure etc. and other engineering documents stipulated elsewhere in the contract (hereinafter referred to and called as 'design document') for approval of the engineer along with the design calculations and general write up wherever involved.	1. Only a few documents, mutually agreed, shall be submitted for approval of the Owner and the balance documents/ drawings etc shall be submitted for intimation only. 2. Properity design calculation shall not be submitted.	Bid specification shall prevail
119	2	25.2	Delay in approval of drawings / design documents by Owner / consultant can not be considered as the reason for extension of work completion period	You would kindly appreciate that for completion of project, the duties are to be discharges by Contractor and Owner with in a particular time frame. Delays by the Owner shall also have impact on the completion period. Hence this clause may be deleted.	Bid specification is clear and shall prevail
120	2	25.4	Submission of design document in AutoCad	All the documents shall be submitted in hard copy. If Owner requires, the same can be submitted in non-editable pdf format also. Submission of documents in AutoCad is not envisaged	Bid specification shall prevail
121	2	28.0	Insurance	We understand that the Insurance price is not to be quoted in the Price Schedule. MAHAGENCO will reimburse the actual cost of Insurance as per procedures specified in this Clause. Kindly confirm.	Bid specification is clear in this regard

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
122	2	28.0	Insurance	We request MAHAGENCO to consider reimbursement of 15% towards handling charges over and above the Insurance premium.	Bid specification shall prevail
123	2	28	Price Basis for Imports, Insurance by Contractor	In Cl. 31.4.2 loading criteria for both CIF & CFR prices have been defined. Whereas Schedule-1 of Price Bid stipulates bidders to quote CFR prices for imported equipment & spares. On the other hand Cl. 28.0 of Section-2 stipulates Contractor's to include all risk insurance in prices. Please clarify whether the Contractor's shall quote prices on CFR or CIF basis.	Bid specification is clear in this regard
124	2	28.1	Taking Over	Various activities have been referred to with Taking Over as the milestone. Please include the definition of "Taking Over" in the tender. Taking over is appearing at various places like section 2 clause 28.1, 28.10, 41.4,42,43.2, section 2A clause 11.2.2, section 2B clause 6.2 and 12.1	Pl refer clause No. 41 of Section-2, Vol-I
125	2	28.5	The charges levied by the Directorate of Insurance or Lead Insurer proposed by them together with taxes and duties applicable thereon, if any, shall be reimbursed to the contractor at actuals.	We understand that Owner will make 100% payment of Insurance charges along with applicable taxes and duties immediately on submission of invoice along with copy of insurance cover by the Contractor. Kindly confirm.	Pl refer corrigendum No.III
126	2	29.1	The period of completion of the work as stipulated in this contract shall be deemed to be essence of contract.	Delay in meeting the Project Completion Period as agreed in the Contract, the Owner has the right to levy Liquidated Damages and once the LD cap is reached, Owner has the right to Terminate the Contract. Hence, please clarify the intent of this clause 29.1	Bid specification is clear & self explanatory

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
127	2	29.4	The owner.....stipulated under the contract	The contractor shall be given suitable notice and chances to justify the reasons for delay before the owner reaches any conclusion unanimously.	Bid specification shall prevail
128	2	29.4	Time is of essence-Termination for delay	We request the Client to exercise his right of termination for delay only after exhaustion of Delay LD limit and clarify the term "time is of essence"	Bid specification shall prevail
129	2	30.1	LD for Delay in Completion of Works	Please clarify the max. liability of the Contractor (cap for delay) against this clause	Bid specification is clear in this regard
130	2	30.1.1	Liquidated Damages for Delay	Kindly inform the ceiling for liquidated damages for delay	Bid specification is clear in this regard
131	2	30.1.1		Please specify the maximum liability (cap on LD) of the Contractor against this clause as the same is not specified.	Bid specification is clear in this regard
132	2	30.1.1	Completion of all the works covered under the contract pertaining to the unit under consideration.	In line with standard industry practice, we request Owner to consider date of completion of Trial Operation as date of completion of work and consider the same for calculation of Liquidated Damages for Delay in completion of Works. Therefore we request Owner to modify sub-clause 30.1.1 (a) and delete the sub-clause 30.1.1 (b)	Bid specification shall prevail
133	2	30.1.1.b	Completion of all the works covered under the contract pertaining to the unit under consideration	Please delete this clause because of subjectivity involved in it.	Bid specification shall prevail
134	2	30.1.5	New sub-clause to Cl. 30.1 Liquidated Damages for Delay in Completion of Works:	Cap for Liquidated Damages for Delay is not specified in this Clause. We request Owner to specify the cap as 10% of the Contract Price in line with the current prevailing norms in the Industry.	Bid specification is clear & self explanatory

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
135	2	30.2.2 30.4	Notwithstanding anything contained hereinabove; the total liability of the contractor against this clause No. 30.2 shall not exceed 10% of the contract value. the aggregate liability of the contractor towards payment of Liquidated Damages stipulated under clause Nos. 30.1 and 30.2 above shall not exceed 25% of the contract value.	Bidder understands that the following clause that maximum cap on Liquidated Damages for Delay in Completion of Works shall be 25% of the Contract Value. Please clarify.	Bid specification is clear in this regard
136	2	30.2.2 30.4	Ceiling of liquidated damages in terms of percentage of contract price	For the purpose of ceiling of liquidated damages, please confirm that the contract price shall be calculated on the basis of exchange rates prevailing on the record date	Bid specification is clear in this regard
137	2	30.3	The Owner may, without prejudice to any method of recovery, deduct the amount Liquidated Damages from any amount due or which may become due to the Contractor against this contract or any other contract for this project or any other project/work awarded by the owner.	We request Owner not to deduct LD applicable on this Contract from any other project/work awarded by the Owner.	Bid specification shall prevail

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
138	2	30.4	Aggregate liability of LD	25% cap for aggregate LD for delay & performance appears to be very high. The individual cap of LD for delay is not specified. As per existing clause this would amount to 25% of contract price. This is very high. It is requested that cap on LD for delay and performance be kept 10% individually and aggregate cap for delay & performance be 15%. Pl review.	Bid specification shall prevail
139	2	30.4	Notwithstanding anything contained hereinabove, the aggregate liability of the contractor towards payment of Liquidated Damages stipulated under clause Nos. 30.1 and 30.2 above shall not exceed 25% of the contract value. For the purpose of this clause No. 30.0, the contract price shall mean the total contract price as per Price Schedule (Schedule - 1) of this contract (excluding price of mandatory spares) along with applicable price variation excluding the amount of taxes & duties.	We request Owner to consider the aggregate liability of the Contractor towards payment of Liquidated Damages stipulated under clause Nos. 30.1 and 30.2 to not exceed 15% of the Contract Price. The above request is in line with the prevailing industry norms.	Bid specification shall prevail

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Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
140	2	32	Suspension	Please add below 32.3 Contractor reserves the right to suspend whole or any part of the contract if Owner fails to pay to the Contractor the amount due under any certificate of the Engineer within a reasonable period after the same shall have become due under the terms of the contract. The date of completion shall be extended by a reasonable time, if any necessary and demonstrable costs incurred by the Contractor as a result of such suspension of the works shall be paid by the Owner.	Bid specification shall prevail
141	2	32	Suspension	The present clause does not have provision of suspension of Works by the Contractor for Owner's default. Request you to provide appropriate clause in line with prevailing industry norms.	Bid specification shall prevail
142	2	32.1	Suspension of the Work	Please include below phrase at end of 32.1; In case such suspension due to Owner, any necessary and demonstrable costs incurred by the Contractor as a result of such suspension of the works shall be paid by the Owner, provided such costs are substantiated to the satisfaction of the Engineer. If Suspension last for more than 3 months, Owner shall grant diversion of Contractor's resources, price implication and revised work completion schedule, if any, shall be mutually discussed and agreed upon.	Bid specification shall prevail
143	2	32.1	The Owner reserves.....duration of the suspension	In case the suspensions occurs due to reasons not attributable to the contractor, the contractor shall be given suitable time and cost compensation.	Bid specification is clear and shall prevail

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
144	2	32.2	Suspension of work due to delay on part of contractor	The work delayed by the contractor should not be a reason for suspension of the work. Hence this clause may please be deleted.	Bid specification shall prevail
145	2	34.1	Interaction with other contractors	The contractor will be make correspondance with Owner / consultant only. Necessary inputs to other contractors shall be provided by Owner / consultant. This will facilitate in better control of the Owner.	Bid specification shall prevail
146	2	35.1	Change in quantity	In case of quantity reduction, If the contractor has already incurred any cost on design/ engineering/ ordering/ manufacturing etc, then the contractor shall be suitably compensated. In case of increase in quantity, the Owner shall suitably extend the contract completion period, on the basis of mutual agreement	Bid specification shall prevail
147	2	35.1	The Owner reserves.....original contract price	The extent of change in the total contract price due change in quantities shall be subject to mutual agreement.	Bid specification shall prevail
148	2	36.2	All travelling and Lodging & Boarding expenses for the engineering personnel to be trained during the total period of training will be borne by the Contractor. These engineering personnel while undergoing training shall be responsible to the Contractor for discipline.	We request Owner to consider all travelling and Lodging & Boarding expenses for the Owner's engineering personnel (to be trained during the total period of training) to Owner's account.	Bid specification shall prevail
149	2	36.3	In the event, the Owner for any reason does not consider it necessary to avail of the training facilities; he shall be entitled for rebate on this account.	As training is an integral part of the EPC Package therefore non-attendance of the same shall not make Owner entitled for rebate. Kindly confirm.	Bid specification shall prevail

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
150	2	36.3	In the event, the Owner for any reason does not consider it necessary to avail the training facilities; he shall be entitled for rebate on this account.	Please advise how the rebate would be calculated.	Pl refer corrigendum No.III
151	2	37.3.1	Trial Operation of 28 days with designated fuel	Please include: If the designated fuel is not available, the trial operation shall be conducted with the available fuel and the results shall be extrapolated and trial operation shall be considered as sucessfully completed.	Bid specification shall prevail
152	2	37.3.1	Trial Operation of 28 days with designated fuel	If the fuel of enough quantity is not available for conducting trial operation of 28 days, then the trial operation shall be conducted with the available quantity of fuel. In that case 28 days of trial operation shall not be done. Please confirm	Bid specification shall prevail
153	2	37.3.1	During these trials, all the standby equipment also shall be run alternatively to prove their performance	It is requested to waive off the mandatory condition of running the standby equipment during trail run.	Bid specification shall prevail
154	2	37.3.1	Trial operation (28days)	Trial operation shall be for 14days as per the normal practice.	Bid specification shall prevail

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
155	2	37.3	After satisfactory initial operation, the plant shall be put on trial operation. The period of trial operation shall be Twenty Eight (28) days of which minimum continuous seventy two (72) hours shall be at full load on designated fuel in fully automatic mode	Please modify as below; After satisfactory initial operation, the plant shall be put on trial operation. The period of trial operation shall be <u>fourteen(14)</u> days of which minimum continuous seventy two (72) hours shall be at full load on designated fuel in fully automatic mode	Bid specification shall prevail
156	2	38.1	the contractor shall be responsible for any loss or damage to the plant until the plant is taken over by the Owner in accordance with the contract	The plant shall be taken over after final acceptance. However, after trial operation, when the machine is operated by the Owner, the responsibility of loss or damage has to be ascertained on the basis of facts, and cost of making good the damage or loss shall be assigned to the <u>responsible party</u>	Bid specification shall prevail
157	2	38.1	Under the contract, the contractor shall be responsible for any loss or damage to the plant until the plant is taken over by the Owner in accordance with the contract.	The contractor shall be responsible for loss or damage only in case the loss or damage is attributable to the Contractor.	Bid specification shall prevail
158	2	39	Performance Guarantee Test	As per the specifications, life of some of the equipment/items is to be proved under PG tests. This requires normal running of the machine for a long time. Please confirm that contract completion period, warranty period and for release of payments shall be affected without waiting of completion of such tests.	Bid specification is clear in this regard

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
159	2	39.10	The completion of the successful completion of the test shall be completed within the period of 120 days maximum from the date of first operation of the unit on designated fuel.	The Project completion date shall be extended proportionately in case the Performance Guarantee Test is not conducted within 120 days for reasons attributable to the owner e.g Owner is not able to provide shutdown etc.	Bid specification shall prevail
160	2	41.4	In case of Delay in PG test due to reasons attributable to the Owner, the payment becoming due against completion of successful Performance Guarantee Test shall be released to the contractor against the Bank Guarantee of equivalent amount	Kindly inform the validity of such Bank Guarantee with a sunset clause. It is suggested that following may be inserted: If the Performance Guarantee Tests cannot be successfully completed within the a period of 6 months from the date scheduled date of PG test, for reasons attributable to the Owner, then the Contractor shall be deemed to have fulfilled its obligations with respect to the performance guarantees	Bid specification shall prevail

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Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
161	2	41.4	In case the Performance Guarantee Test cannot be carried out at specified time due to reasons attributable to the owner, the Plant shall be taken over 120 days after the intimation from the contractor provided the owner is satisfied about his readiness for conducting the Performance Guarantee Test. In such case, the Owner shall issue notification to the contractor to the effect that the plant is taken over which shall trigger the Defect Liability (Guarantee) Period and the payments becoming due against completion of successful Performance Guarantee Test shall be released to the contractor against the Bank Guarantee of equivalent amount. However, such taking over of the plant shall not absolve the contractor from its liability to prove the performance guarantees, which	We request the Owner to consider 60 days instead of 120 days specified in this clause. Further, for any delay in PG Test, correction curve shall be applicable. For delay beyond 60 days due to reasons attributable to Owner, we request Owner to reimburse the mobilization and demobilization expenses towards performing the PG Test. For delay beyond 180 days due to reasons attributable to Owner, the Contractor shall be relieved from the responsibility of performing the PG Test and the Bank Guarantee shall be returned.	Bid specification shall prevail

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
		continued	shall be proven through a Performance Guarantee Test at the earliest possible from the date of taking over of the plant but not later than 30 days from the date of issuance of notice by the owner confirming its readiness to provide inputs required for the PG test.	Continued as above.	
162	2	41.4	In such case, the Owner shall issue notification to the contractor to the effect that the plant is taken over which shall trigger the Defect Liability (Guarantee) Period and the payments becoming due against completion of successful Performance Guarantee Test shall be released to the contractor against the Bank Guarantee of equivalent amount. However, such taking over of the plant shall not absolve the contractor from its liability to prove the performance guarantees, which shall be proven through a Performance Guarantee Test at the earliest possible from the date of taking over of the plant but not later than 30 days from the date of issuance of notice by the owner confirming its readiness to provide inputs required for the PG test.	Bidder understands that the following clause that liability to conduct Performance Guarantee Test has no Sunset Date. Please clarify the Owner's intention.	Bid specification shall prevail

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
163	2	42.1	Owner reserves the right to take possession of and use for any intended purpose, any portion or all of any delivered but as yet unaccepted Plant.	Any use of portion or all of any unaccepted plant should trigger the start of warranty of that particular equipment.	Bid specification shall prevail
164	2	42.1	Operating the plant before taking over	Please confirm that in case the Owner takes possession of and make use of the plant or part thereof before taking over, the same shall be considered as deemed Taking Over and all conditions related to Taking over shall apply	Bid specification shall prevail
165	2	42.1	Operating the plant before taking over	Upon Owner takingover the possession of and make use of the plant or part thereof before taking over the Plant is in operation under Owner's control , and hence the same shall be considered as deemed Taking Over as and all conditions related to Taking over shall apply. We request you kindly modify this clause accordingly	Bid specification shall prevail
166	2	43.1.e	the plant shall comply with the provisions of any applicable Indian Law of Directive in effect on the date of "Taking -Over" of the Plant	The change in laws at the time of taking over can not be predicted. Hence this clause may please be deleted	Bid specification shall prevail
167	2	43.1© 43.2	using only materials and goods for incorporation into the plant which are new and unused and so that such materials and goods	Please define "new" and "unused".	Bid specification is clear & self explanatory

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Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
168	2	43.12	Availability Guarantee of 90%	The availability of the plant depends on lot many factors other than the equipment. Hence it is requested to delete the requirement of availability guarantee. In any case, the availability guarantee can not be proved after the end of defect liability period	Bid specification shall prevail
169	2	43.12	At the end of defect liability period, the Contractor's liability ceases except for latent defects and Contractor's obligation to prove 90% availability of the plant.	The availability of the plant is a function of various parameters which are beyond the control of the Contractor. Accordingly the Contractor's obligation to prove 90% availability is not feasible.	Bid specification shall prevail
170	2	43.12	At the end of defect liability period, the Contractor's liability ceases except for latent defects and Contractor's obligation to prove 90% availability of the plant.	Please clarify "90% availability of the plant" beyond defect liability period against	Bid specification shall prevail
171	2	43.2	guarantee of equipment for a period of 12 (twelve) calendar months commencing immediately upon completion of successful Performance Guarantee Test of the Plant OR taking over of the plant by the owner as per the provisions of Clause No. 41.4	In case the PG test is delayed due to reasons attributable to the Owner, the plant shall be taken over on 120th day of intimatin from the contractor. However, the guarantee period shall start on the scheduled date of conductance of PG test.	Bid specification shall prevail

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
172	2	43.3	latent defect	Please confirm that latent defect period commences from COD for 36 months and also confirm that the latent defects are limited to such defects which inherently lie within the such defect which prevent the safe operation and which could not have been disclosed by reasonable examination carried out by the owner in accord with their manuals.	Bid specification is clear in this regard and shall prevail
173	2	44.1.3	All spares shall be properly protected and packed for long storage at site under prevailing conditions.	Please clarify the storage period at site.	Pl refer corrigendum No.III
174	2	44.2.1	It shall be the responsibility of the contractor to maintain adequate items in sufficient number, as erection & commissioning spares to ensure that erection commissioning works and operation upto end of guarantee period do not hamper for want of spares.	Erection and commissioning spares shall be available upto PG testing and thereafter because the plant will be operated and maintained by the owner, hence essential or mandatory spares will be available and used. Please clarify.	Pl refer corrigendum No.III
175	2	45	Long term availability of spares	We request the provisions of this clause be applicable to spares manufactured by the Bidder/ its Associates for TG/ SG. This is also inline with NTPC's recent tenders	Bid specification shall prevail
176	2	45.1	The Contractor shall ensure the long term availability of spares to the owner for the full life of the equipment covered under the contract.	Please clarify "Full life of the equipment ".	Pl refer corrigendum No.III

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
177	2	45.2	in case of discontinuance of manufacture of any spares by the Contractor or his sub- contractor, the contractor shall provide the owner, one year in advance, with full manufacturing drawings, material specification and technical information required by the owner for the purpose of manufacture of such items	Please modify as : However, the contractor's proprietary information, if any, shall be out of perview of this contract	Bid specification shall prevail
178	2	46	Power to omit or vary work	Please clarify the clause in case of omit / vary of work by Client on contract price, schedule and performance	Bid specification is clear in this regard and shall prevail
179	2	46.2	a reasonable and agreed sum in respect thereof shall be paid to the contractor	please modify as: a reasonable and agreed sum in respect thereof shall be paid to the contractor, in addition to mutually agreed extension in the contract completion period	Bid specification shall prevail
180	2	46.2	Powers to Vary or Omit Work:	Any variation, especially in the work already done, will require additional time also. Therefore, please add the word "along with suitable extension in contractual schedule" at the end of the clause.	Bid specification shall prevail
181	2	51.2	The Engineer shall issue to the Contractor progressive certificate certifying completion of works up to a said date, within a reasonable period after receiving of an application, there for, made in accordance with this clause.	Please clarify "reasonable period". Request the Owner to specify a definative period.	Bid specification is clear & self explanatory

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
182	2	56	The marginal notes to any clause of the contract shall not affect or control the construction of such clause.	Please guide that the notes to any clause shall not be read in conjunction with the main clause.	Bid specification is clear & shall prevail
183	2	60.1	The aggregate liability of the contractor to the owner under the contract shall not exceed the Total Contract Price	Please limit the aggregate liability in line with clause 30.4 of Section-2	Bid specification is clear in this regard and shall prevail
184	2	60.1 (b)	The aggregate liability of the contractor to the owner under the contract shall not exceed the Total Contract Price, provided that this limitation shall not apply to any obligation of the contractor to repair or replace defective equipment or to indemnify the owner with respect to patent infringement.	We request Owner to kindly note that liability of the Contractor to repair or replace defective equipment will be limited to the Total Contract Price and therefore request to delete "to repair or replace defective equipment or" from this clause.	Bid specification shall prevail
185	2	62	Force Majeure is herein defined as any cause which is beyond the control of the contractor or the owner as the case may be, which they could not foresee or with a reasonable amount of diligence could not have foreseen and which substantially affects the performance of the contract as mentioned hereunder but not limited to:	Kindly Clarify "But not limited to" in clause 62. We request the Owner to not keep the clause open ended and delete "But not limited to".	Bid specification shall prevail

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Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
186	2	62.1	Force Majeure conditins	Please include: f) strikes, blakouts or other industrial action or blockade or embargo or any other form of civil disturbance, in each case affecting on a general basis the industry related to the affected Services and which is not attributable to any unreasonable action or inaction on the part of the any Party or any of its Subcontractors or suppliers and the settlement of which is beyond the reasonable control of all such persons g) other unforeseeable circumstances beyond the control of the Parties against which it would have been unreasonable for the affected party to take precautions and which the affected party cannot avoid even by using its best efforts	Bid specification is clear and shall prevail

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
187	2	62.1	Force majeure is herein.....government authority.	We request to owner to add following text into this clause : f) Riots, Lockouts, strikes, unavailability of labour and local disturbance around project site.	Bid specification is clear and shall prevail
188	2	62.1e)	Confiscation, nationalisation, mobilisation, commandeering or requisition by or under the order of any govt. of de jure or de facto authority or ruler or any other act or failure to act of any local or state or national government authority.	Kindly clarify the extent of the conditions covered under this clause.	Bid specification is clear and shall prevail
189	2	64	Arbitration	We request to stipulate uniform acceptable arbitration procedural rule, law and place in all proforma (DJU, Consortium) and also in the three Contract Agreements. We propose that the appointment of Arbitrators & Arbitration procedural rule shall be as per institutional rule of ICC, LCIA or equivalent.	Bid specification shall prevail
190	2	64	Arbitration - Arbitrator is ex-employee of owner and Cost of arbitration is equally shared by parties.	We request that the appointment of Arbitrators & procedural rule shall be as per institutional rule of ICC, LCIA or equivalent. Please refer to our above comment on arbitration.	Bid specification shall prevail
191	2	64.3	Arbitration	In case the Indian bidder is an Indian Public Sector Enterprise/Government Department, the dispute arising between the Purchaser and the Contractor shall be referred for resolution to a Permanent Arbitration Machinery (PAM) of the Department of Public Enterprise, Government of India. This is in line with the directives issued by Government of India to all Central PSUs.	Bid specification shall prevail

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
192	2	64.3	Constitution of Arbitration Tribunal	We request Owner to consider Constitution of Arbitration Tribunal and arbitral proceedings in accordance with the provisions of the Arbitration and Conciliation Act 1996 and the rules thereunder, as amended from time to time	Mahagenco shall revert separately
193	2	64.3.3	Selection of Arbitrators	The arbitration panel would be three arbitrators, comprising one each to be appointed by the Owner and the Contractor, and the third arbitrator (presiding arbitrator) to be appointed by such two arbitrators within thirty (30) days of the appointment of the second arbitrator.	Mahagenco shall revert separately
194	2	64.5.5	Where the arbitral award is for payment of money, no interest shall be payable on whole or any part of the money for any period till the date on which the award is made.	Please add: However, regarding any payments, including the interest on delayed payments, the decision of Arbitration Panel shall be final.	Bid specification shall prevail
195	2	New clause		The GCC does not have provision for Change in Law. The same may please be added	Bid specification shall prevail
196	2A	2.1	Quality Plans for critical equipments	The contractor will submit the quality plans for all critical equipment, alongwith the bid. You would kindly appreciate that the quality plans shall have bearing on time and cost of the contract therefore, the QPs submitted alongwith the tender shall be followed by the contractor.	Bid specification shall prevail

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
197	2A	2.1.1	The list of major equipment/materials for which the quality plan shall be submitted by the contractor shall be finalised during the kickoff meeting or a meeting specially organised for this purpose. The owner reserves the right to add/delete any item in/from such list during the period of currency of the contract but before the predespatch inspection of such equipment	Items are required to be listed/mutually agreed prior to contract which becomes the guide to execute, any change can be mutually agreed only prior to start of manufacture. Please clarify.	Bid specification shall prevail

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Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
198	2A	2.1.2	Immediately after finalisation of the source but before taking up the equipment for manufacturing, the contractor shall submit the quality plan of the equipment to be manufactured which shall indicate the special characteristics of the equipment/component/input materials to be used for manufacturing the same, quality checks proposed, nature and frequency of the same, acceptance norms, records to be maintained, customer hold points etc. However, the owner reserves the right to modify the quality plan including customer hold points before the respective manufacturing stage is completed.	The delivery schedules are based on Manufacturing Quality Plans mutually agreed/approved with identified Customer Hold Points. Any change thereafter will alter the project schedule. Please clarify.	Bid specification shall prevail

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
199	2A	3.2.2	Indigenous supplies: The contractor, at least one month prior to expected date of attaining the respective stage of manufacturing/readiness of the goods, shall submit the inspection call indicating the date of inspection to the controller of the quality appointed by the owner/IIA under intimation to the controller of quality.	Conflict in clauses: Vol IV-B Sec-1 Page 17 of 457, Clause 5.3.1 All Tests shall be performed in presence of owner/purchasers representative. If so desired by the purchaser. The contractor shall give at least seven (7) days advance notice of shop tests. Vol II, sec-7, Page 156 of 555, clause 4.2 The contractor shall give the engineer/inspector fifteen (15) days written notice of any material being ready for testing. For Domestic supplies :Inspection call may be raised 7 days prior to date of inspection as one month notice may not be realistic.	Provisions of clause No. 3.2.2, Section 2A, Volume-I shall prevail
200	2A	3.2.3	Inspection by Owner	The Owner / IIA to ensure that they visit for inspection on the date and time requested by the contractor.	Bid specification shall prevail

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Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
201	2A	3.3.1	Offshore Supplies: 3.3.1 Inspection at customer hold points shall be carried out by the Independent Inspection Agency (IIA) of international repute and having presence in the country where inspection is to be carried at the offshore works of contractor/subcontractor. Such agency shall be appointed by the contractor on prior approval of the owner. All the costs of appointing such agency shall be borne by the contractor.	Please clarify if Contractor appointed Inspection agency whom approved by Owner is changed to Owner's inspector/ Owner's representative, then all the charges including traveling, boarding and lodging charges of Owner's Inspector/Owner's representative shall be borne by the Owner.	Bid specification is clear & self explanatory

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
202	2A	3.3.4	Offshore supplies: The contractor atleast two months before the expected date of attaining such stage of manufacturing/readiness of goods,shall intimate the chief engineer(P&P).The Chief engineer(P&P) within twenty one days from the date of receipt of such intimation,shall revert confirming owners intentions of the owner to witness such tests or otherwise.In the event,the owner intents witnessing such tests,the contractor shall extend all his co-operation for arrangement of visa etc.	Conflict in clauses: Vol IV-B Sec-1 Page 17 of 457,Clause 5.3.1 <i>All Tests shall be performed in presence of owner/purchasers representative.If so desired by the purchaser.The contractor shall give at least seven (7) days advance notice of shop tests.</i> Vol II,sec-7,Page 156 of 555,clause 4.2 <i>The contractor shall give the engineer/inspector fifteen (15) days written notice of any material being ready for testing.</i> Inspection Call may be raised 15 days prior to the date of inspection as two months notice may not be realistic.	Provisions of clause No. 3.3.4 Section 2A, Volume-I shall prevail
203	2A	4	Despatch clearance	Please confirm that this clause is applicable only for those items which involve CHP during inspection. Other items shall not require Despatch clearance.	Pl refer corrigendum No.III
204	2A	8.1.1	Customs Duty	We request that customs duty as applicable on imported goods which are despatched directly to site are paid by Owner directly to the customs authorities, as Owner is the importer of such goods. This shall also apply to goods manufactured in a factory located in a SEZ area	Bid specification is clear in this regard and shall prevail

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Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
205	2A	8.1.1 8.2.1	The customs duty including all the duties payable to the customs as on the date of clearance of materials/equipment imported by the contractor/sub-contractor to be directly delivered at site and to be supplied against this contract shall be reimbursed to the contractor at the rates applicable for the Project Imports against documentary evidence admissible as per the statute in force. Excise Duty and Cess/surcharge thereon if applicable, payable on the materials manufactured and supplied by the contractor against this contract shall be paid to the contractor at the rates applicable as on date of shipment against the excise invoice submitted by the contractor.	Please clarify that the all applicable taxes on the procurement of Raw Material / components from India or abroad by the Indian Contractor / Subcontractor and to be used for manufacturing operations shall also be reimbursed by the Owner against documentary evidence, in case the exemption of advance authorisation is withdrawn by the Government under the Change in Law.	Mahagenco shall revert separately
206	2A	8.2.2.	Excise Duty and Cess thereon:	We understand that Excise Duty and Cess/ surcharge will be reimbursed for all Direct Dispatch items to Site irrespective of whether it is dispatched by Contractor from its works and/ or from its sub-vendors/sub-suppliers works.	Bid specification is clear in this regard

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Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
207	2A	8.3 8.8	CST reimbursement	There are contradicting statements on CST reimbursement for materials dispatched directly from the sub-contractor's / sub-vendor's works to Site. As per Clause no. 8.3, such CST will be reimbursed, however in this Clause 8.8 the same is not reimbursed. Request you to kindly clarify.	Pl refer corrigendum No.III
208	2A	8.3.2	Central Sales Tax (CST)	We understand that Central Sales Tax will be reimbursed for all 6(2) sales transactions.	Bid specification is clear
209	2A	8.1	Customs Duty	We request Owner to consider High Sea Sales for supply of imported equipment & materials to be directly delivered to Site.	Pl refer corrigendum No.III
210	2A	9	Statutory variation in Taxes and Duties	We request that this provisions of this clause shall also apply for any change in rates of Taxes/ duties or or any change in interpretation or application of any Tax occurs in the course of the performance of Contract, which was or will be assessed on the Contractor in connection with performance of the Contract	Clause No. 8, Section 2A is clear & self explanatory
211	2A	12	Terms of Payment	Please confirm that the payment shall be made in the currency of the contract.	Pl refer corrigendum No.III
212	2A	12.0	Payment Terms	We understand that Owner will make payments in the quoted currencies. Kindly confirm.	

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
213	2A	12	Terms of Payment	The terms of Payment proposed by the owner has very high retention component. We request owner to adopt 'terms of payment' being followed in NTPC Contracts and other reputed power utilities for similar sized projects. We request owner to amend terms of payment as follow : <u>Supply of Equipment:</u> 1. Advance Payment - 15 %. 2. Dispatch of Equipment - 60% 3. Reciept at site - 15 %. 4. Synchronization - 5% 5. Commercial Operation - 5%	Mahagenco shall revert separately
214	2A	12	Mode of payment is not mentioned	kindly enlighten us on the mode of payment. Bidder requests for LC payment for all payments except Advance Payment (through TT)	Pl refer corrigendum No.III
215	2A	12.0	Payment Terms - Imported Supplies - Main equipment & Mandatory Spares	Please check to include Letter of Credit as the mode of payment for Imported supplies (Main equipment & Spares) as being adopted by many reputed power utilities like NTPC	Bid specification shall prevail

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
216	2A	12.0	Payment terms & Interest for late payment	The stipulated payment terms will lead to negative cashflow for the bidder and request to consider the following: cl. 12.2.1 Advance payment may please be increased to 12% of supply price Further, additional advance payment of 15% of the supply price may please be paid at end of 6 months from date of LOA Cl. 12.3.1: this payment may please be paid against despatch. Accordingly, in clause 12.3.1a)v) replace with Original Bill of Lading, and in clause 12.3.1b)v) replace with LR/ Rail Receipt. We request all payments except initial advance be payable against irrevocable letter of credit established in the name of the Contractor, within 30 days from date of LOA. We also request the client to stipulate % interest on late payment. 12.3.3 The retention of 30% payment is extremely on higher side and therefore would request you to reduce it to 20% out of which we recommend	Mahagenco shall revert separately
		continued		milestone payment at clause 12.3.4 to be 15% out of which item 12.3.4 viii) should be 2.5% and final payment at PG test at clause 12.5.1 as 5%. Please confirm	continued as above
217	2A	12.10	Currency of Payment- All payment will be made in INR.	We request the Client to make any payments under all Contract Agreement in the respective currency of bidders quote.	Pl refer corrigendum No.III

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
218	2A	12.3	Due date for payment : within 30 days	Please inform how the contractor shall be compensated if the payments not received by him with in 30 days from submission of bills with desired documents.	Bid specification shall prevail
219	2A	12.4	Payment Terms - Imported Supplies - Main equipment & Mandatory Spares	Please include Letter of Credit as the mode of payment for Imported supplies (Main equipment & Spares) as being adopted by many reputed power utilities including NTPC	Bid specification shall prevail
220	2A	16	First contract: includes goods of Indian origin and of foreign origin and despatched directly to site	Please confirm that for goods of foreign origin and despatched directly to site, sale on high seas shall be effected	Pl refer corrigendum No.III
221	2B	27	Terms of Payment	The terms of Payment proposed by the owner has very high retention component. We request owner to adopt 'terms of payment' being followed in NTPC Contracts and other reputed power utilities for similar sized projects. We request owner to amend terms of payment as follow : Installation & Civil Services : 1. Advance Payment - 10 %. 2. Prorata Payments - 80% 3. Synchronization - 5% 4. Commercial Operation - 5%	Mahagenco shall revert separately
222	2A	12.0	Construction of Contracts and Payment terms of different Contracts	There is no separate contract and payments for Civil Works defined although additional Conditions for Civil Works in Section-2C have been specified. As you may appreciate the tax structure of Civil Contract shall be different than other Site services viz. Erection & Commissioning. Please clarify whether there will be a separate contract for Civil Works.	Bid specification is clear in this regard and shall prevail

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
223	2A	11.12.1	The deliveries of Mandatory Spares and Special Tools & Tackles shall commence from the date of first synchronisation of the unit and shall be completed on or before the date of taking over the unit	The spares and tools and tackles shall be supplied alongwith the main equipment. It is not possible to complete the supplies of all spares of the entire EPC project with in a period of 2-3 months.	Bid specification shall prevail
224	2A	12.1.4	The payment shall be released by the Project manager or the financing institute(s) with whom the owner has tied up the funding for this project.	We request Owner to consider payment through Letter of Credit At Sight for Supply Contract excluding advance payment.	Bid specification shall prevail

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
225	2A	12.2.1 (iii) 12.2.1 (iv) 12.2.2 (iii) 12.2.3 (iii)	A copy of the acceptance of the contract performance security issued by the owner/ the Project manager. A copy of the acceptance of the bank guarantee of equivalent amount submitted by the contractor against advance payment. A copy of the acceptance of the bank guarantee of equivalent amount submitted by the contractor against advance payment. A copy of the acceptance of the bank guarantee of equivalent amount submitted by the contractor against advance payment.	We request Owner to remove acceptance of Bank Guarantee condition and consider submission of Bank Guarantees as a pre-requisite for the release of the advance payment.	Bid specification shall prevail
226	2A	12.2.1.ii i & iv, 12.2.2.ii i, 12.2.3.ii i	Release of payment in 30 days after acceptance of CPG and ABG	The acceptance procedure is internal to MahaGenco. Hence these two clauses may please be deleted.	Bid specification shall prevail

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
227	2A	12.2.5	Interest on unadjusted advance	Please confirm that interest on unadjusted advance shall not be charged if the delays are attributable due to force majeure conditions or due to reasons not attributable to the contractor.	Bid specification is clear & self explanatory pl refer clause no.62.0
228	2A	12.3.1	Payment against Supply of Materials/Equipments	The present payment terms links the entire payment (Offshore & Onshore) on receipt of material at site. Instead we suggest the Owner to consider the following : 70% of the Ex-works / CFR supply price minus advance adjustment on prorata basis along with 100% taxes & duties to be paid on prorata basis within 30 days from the date submission of documents as list in clause 12.3.1 a) and b) respectively for Offshore & Onshore supplies expect for (v) i.e. "Copy of Stores receipt Note (SRN) issued by Owner's Site Authority". 10% of the Ex-works / CFR supply price to be paid on prorata basis within 30 days from date submission of "Copy of Stores receipt Note (SRN) issued by Owner's Site Authority". We request Owner to kindly modify the clause accordingly.	Mahagenco shall revert separately
229	2A	12.3.1	70% of the Ex-works.....Owner's site authority & 70 % of the basic contract price.....included in invoice.	In case owner delays release of payments, the contractor shall be given interest on delayed payments @ SBI Retail Prime Lending Rate.	Bid specification shall prevail

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
230	2A	12.3.1.a. v 12.3.1.b .v	Payment on issue of SRN	In case site receipt note is not issued with in 3 days of submission of request by the Owner, then the bills may please be paid without the requirement of SRN	Bid specification shall prevail
231	2A	12.3.3	30% payment shall be retained.	In line with our request above for 80% payment on completion of supplies, we request Owner to consider retention of 20% instead of 30% specified in the tender. Kindly consider.	Mahagenco shall revert separately
232	2A	12.3.4	Milestone Payments	We request Owner to consider Total Milestone payments of 15% instead of 20% specified in the tender as below : i) Commissioning of DM Plant - 1% ii) Boiler Light up - 1% iii) Commissioning of Cooling Tower and CW System - 2% iv) Commissioning of WTP and STP - 2% v) Synchronisation of the Unit - 2% vi) Commissioning of CHP and AHP - 2% vii) Coal Firing of Unit on achieving 'vi' above - 2.5% viii) Completion of successful trial operation - 2.5%	Mahagenco shall revert separately
233	2A	12.4.1	Supply of Mandatory Spares, Special Tools & Tackles	We request Owner to consider 95% payment as against 90% mentioned in this clause	Bid specification shall prevail
234	2B	12.5.1 27.4	Final Payment against Supply of Equipment/material and Mandatory Spares Final Payment against Services Rendered	In line with the Payment terms requested above, the final payment shall be 5%. Request the Owner to kindly consider.	Bid specification shall prevail

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
235	2B	12.7 27.5	Payment of Price Adjustment:	We request Owner to release payments for price adjustment in line with the payment terms of Supply/ Mandatory Spares/ Services/ Site Works, as applicable.	Bid specification shall prevail
236	2A	12.7.2	Payment of Price Variation on completion of milestones	Since the exact amount of price variation is not known till the end of the contract, billing of PV against completion of milestones may not be possible. Therefore it is requested that only 10% of the Price variation may be paid as per clause 12.5 and balance 90% may be released in clause 12.7.1, which may be modified accordingly	Bid specification shall prevail
237	2B	4.2.1	Electricity : The contractor shall be provided with supply of electricity for construction purpose at one point.....The contractor shall make his own further distribution arrangement.the supply of electricity shall be on non-chargebla basis.	Bidder requests client to supply additional 2 nos point of Electricity source nearer to staff & labour Colony at free of Cost	Bid specification shall prevail
238	2B	4.3.1	Supply of water for construction and potable use shall be made available at one point each at the location decided by the project manager. The contractor shall make further distribution arrangements thereafter at his own costs.	We understand that the location shall be inside the project site. Kindly confirm.	Bid specification is clear in this regard

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S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
239	2B	4.3.1	Water: 4.3.1-Supply of water for construction & portable use shall be available at one point Further distribution arrangement thereafter at his own cost 4.3.2 -The supply of water together with taxes and duties if any levied thereon shall be free of cost. water is one of the most precious resource	Bidder requests client to supply additional 2 nos point of portable water source nearer to staff & labour Colony at free of Cost	Bid specification shall prevail
240	2B	4.5.1	The owner will allow the contractor to use the railway siding facilities and shunting locomotive (when construction in the vicinity of the owner's existing Power Station) for unloading of material and equipment despatched against the contract as and when available without any charge.	Kindly confirm that the loco operator (subject to availability) shall also be provided to the contractor without any charge	Pl refer corrigendum No.III
241	2B	7.1	If the Works of the contractor is delayed because of any acts or omission of another contractor, the Contractor shall have no claim against the owner on that account other than an extension of time for completing his works.	For bidder, work done by the other contractor shall be as if it is done by the Owner. If the bidder's work is delayed due to other contractor, he should be compensated with time and money.	Bid specification shall prevail

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
242	2C	12.1	The owner reserves the right to make any changes in the designs and plans of the works and the contractor shall be bound to carry them out. <u>No claim or compensation would be allowed on this account.</u>	Please clarify the relevance of this clause as this is a contradiction to the Variation clause (Clause 17.1 - Power to Order Variation)	Bid specification is clear in this regard
243	2B	23.3	Except for the Service Tax, no tax shall be payable to the contractor on the services rendered against this contract.....	We request Owner to clarify regarding reimbursement of "Construction Cess" applicable as per BOCW Act.	Pl refer clause No. 27.8 in this regard
244	2B	24	Statutory variation in Taxes and Duties	We request that this provisions of this clause shall also apply for any change in rates of Taxes/ duties or or any change in interpretation or application of any Tax occurs in the course of the performance of Contract, which was or will be assessed on the Contractor in connection with performance of the Contract	Clause No. 23, is clear & self explanatory
245	2B	24	Statutory variation in Taxes and Duties	We request that this provisions of this clause shall also apply for any change in rates of Taxes/ duties or or any change in interpretation or application of any Tax occurs in the course of the performance of Contract, which was or will be assessed on the	Bid specification shall prevail
246	2B	27.0	Payment Terms	Kindly confirm that the Payment Terms specified in this clause is applicable for both the Second Contract i.e. Services Contract and the Third Contract i.e. Civil, Structural & Architectural works	Pl refer corrigendum No.III

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT					
CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
247	2B	27	Construction of Contracts and Payment terms of different Contracts	There is no separate contract and payments for Civil Works defined although additional Conditions for Civil Works in Section-2C have been specified. As you may appreciate the tax structure of Civil Contract shall be different than other Site services viz. Erection & Commissioning. Please clarify whether there will be a separate contract for Civil Works.	Pl refer corrigendum No.III
248	2B	27.3.1	Payment towards Services Rendered	As services payment is done on prorata basis on completion of milestones, hence we request Owner to only keep retention of 5% towards PG test and withdraw the retention of 20% towards various Milestones. To summarise, we are requesting Owner for 95% payment minus advance adjustment together with Service Tax on prorata basis within 30 days for Services. Kindly consider. We feel that (ii) Packing slip for each consignment is wrongly mentioned here. We request Owner to replace it with "(ii) Certificate certifying the completion of work claimed in invoice". Kindly confirm.	Bid specification shall prevail
249	2B	27.3.1	70% of the Ex-works.....Owner's site authority & 70 % of the basic contract price.....included in invoice.	In case owner delays release of payments, the contractor shall be given interest on delayed payments @ SBI Retail Prime Lending Rate.	Bid specification shall prevail

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT					
CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
250	2B	27.3.1	70% of the Basic Contract value as per the approved billing breakup minus advance adjustment on prorata basis (e.g. 60% if advance paid till then is 10%) together with service tax thereon shall be paid on prorata basis within 30 days from the date of submission of the invoice and related documents as mentioned	Please clarify the event upon fulfillment, this payment shall be due.	Bid specification is clear & self explanatory
251	2B	27.3.3	30% payment shall be retained and out of which be released on achievement of important milestones in the project 20% payment shall completion as stipulated below	We request Owner to release 5% payment on PG Test. Kindly consider.	Bid specification shall prevail
252	2B	36	The entire work.....shall be firm.	Suitable compensation shall be given to the contractor on weekly basis for any/all non fulfilment of owner's obligation. The amount of compensation shall be mutually agreed between owner and contractor.	Bid specification shall prevail
253	2B	36.2	Free over run period of 6 months	There will not be any free over run period. The contractor has to spend on each and every day in the over run also apart from delay in receipt of the deferred payments. Hence please deleted this clause.	Bid specification shall prevail

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
254	2B	36.2	The Contractor shall not be liable for any compensation if the works get prolonged for <u>6 (six)</u> months beyond the contract period due to the non-fulfillment of the obligations on the part of the Owner and this 6 (six) months period will be treated as free over run period to the Owner.	please modify as follows; The Contractor shall not be liable for any compensation if the works get prolonged for <u>1 (one)</u> months beyond the contract period due to the non-fulfillment of the obligations on the part of the Owner and this 1 (One) months period will be treated as free over run period to the Owner.	Bid specification shall prevail

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT					
CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
255	2B	36.2	The Contractor shall not be liable for any compensation if the works get prolonged for 6 (six) months beyond the contract period due to the nonfulfillment of the obligations on the part of the Owner and this 6 (six) months period will be treated as free over run period to the Owner.	We request owner to delete the sub-clause as the same is not in line with the standard contract conditions prevailing in the industry.	Bid specification shall prevail

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
256	2B	36.2 36.3	The Contractor shall not be liable for any compensation if the works get prolonged for 6 (six) months beyond the contract period due to the non-fulfilment of the obligations on the part of the Owner and this 6 (six) months period will be treated as free over run period to the Owner. The Contractor shall be liable for compensation, only if the contract period gets extended beyond 6 (six) months from the scheduled date of completion due to non-fulfillment of the obligations by the owner/or his authorised representative/other agencies under his control at the rate of INR 1,500,000/- (In words INR One Million Five Hundred Thousands only) per month and prorata for part of the month. This rate shall be firm.	Please clarify the justification behind free 6 months overrun period requested by the Owner and thereafter INR 1,500,000 / month as the compensation charges for such overruns.	Bid specification shall prevail
257	2B	36.3	Compensation of Rs. 15,00,000/- per month and pro-rata for part of the month	This amount is too less. Kindly consider a payment equivalent to the LD amount.	Bid specification shall prevail

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
258	2B	36.3	~, only if the contract period gets extended beyond <u>6 (six)</u> months ~ at the rate of <u>INR 1,500,000/- (In word INR One Million Five Hundred Thousands only)</u> per month and prorata for part of the month. This rate shall be firm.	Please modify as follows; ~, only if the contract period gets extended beyond <u>1 (one)</u> months ~ at the rate of INR 22,500,000/- (In word INR Twenty Two Millions and Five Hundred Thousands only) per month and prorata for part of the month. This rate shall be firm.	Bid specification shall prevail
259	2B	36.3	The Contractor shall be liable for compensation, only if the contract period gets extended beyond 6 (six) months from the scheduled date of completion due to non-fulfillment of the obligations by the owner/or his authorized representative / other agencies under his control at the rate of INR 1,500,000/- (In words INR One Million Five Hundred Thousands only) per month and prorata for part of the month. This rate shall be firm.	As requested above, we request for deletion of the "no compensation up to 6 months extension due to non-fulfillment of obligations by the Owner". Further, the expenses incurred by the Contractor for such extension may vary based on the project execution stage and hence cannot be fixed at Rs. 1,500,000/-. We suggest that for such extensions the compensation shall be at actuals to be established through documentation. Kindly confirm.	Bid specification shall prevail
260	2B	37.4	Unless all material are removed and clear space is handed over back to the owner, the final bill payment as well as release of contract performance security shall not be considered by the owner.	Please delete this clause as release of performance security and release of last payments are not linked with closing of site office	Pl refer corrigendum No.III

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
261	2C	3.1	Facilities for other contractors	This is applicable only for work connected with the unit-6 and not for the existing units.	Bid specification is clear in this regard
262	2C	6.1	Compensation for all damage done intentionally or unintentionally by contractor's labour whether in or beyond the limits of the owner properly shall be estimated by the Engineer-in-charge,.....	Kindly clarify the "all damage done intentionally or unintentionally by contractor's labour whether in or beyond the limits of the owner"	Bid specification shall prevail
263	2C	9.1	In the case of any work for which there is no specification as is mentioned, such a work shall be carried out in accordance with the Divisional specifications and in the event of there being no Divisional specification the work shall be carried out in all respects in accordance with the instructions and requirements of the Engineer-in-charge.	Kindly clarify the "Divisional Specification"	In case of any work for which there is no specification as is mentioned in the Bid Documents, the same shall be carried out in accordance with the specifications laid down by PWD, Irrigation and MJP Departments and as per IS guidelines.
264	2C	12.1	The owner reserves the right to make any changes in the designs and plans of the works and the contractor shall be bound to carry them out. No claim or compensation would be allowed on this account.	We request Owners to compensate the contractor on cost & time impact due to such change in the designs by owner.	Bid specification shall prevail
265	2C	17	Variations	Please clarify the clause in case of omit / vary of work by Client on contract price, schedule and performance	Bid specification is self explanatory

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
266	2C	18	Variations	Please clarify the clause in case of omit / vary of work by Client on contract price, schedule and performance	Bid specification is self explanatory
267	2C	20.6	The contractor shall submit reconciliation statement of steel/cement/ other materials used by him and incorporated in the work once in every ~~three (3) months (quarter)~~	Please explain the purpose of this quarterly reconciliation	Pl refer corrigendum No.III
268	2C	-	Taxes and Duties / Payment Terms	Kindly incorporate a suitable clause for Taxes and Duties including Work Contracts Tax (WCT) if applicable and Payment Terms related to the Civil Contract.	Bid specification is clear in this regard
269	3	1.3	Availability Guarantee	Please delete this clause as The availability of the plant depends on lot many factors other than the equipment.	Bid specification shall prevail
270	3	1.3	The Contractor shall guarantee 90% availability of the plant for one (1) year from the date of trial operation. In case this is not achieved, such period shall be further extended to one year from the date of repair of the equipment, until such availability is achieved till such time Contract Performance Security shall required to be extended. The Contractor shall maintain full fledged supervisory staff until such period.	Please delete clause 1.3; Availability of a power plant depends solely on O&M schedule of the Owner, which cannot be interfered by Contractor. Contractor's liability shall be limited to Defect Liability and Latent Defect after Taking Over.	Bid specification shall prevail

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
271	3	1.3	The contractor shall guarantee 90% availability of the plant for one (1) year from the date of trial operation. In case this is not achieved, such period shall be further extended to one year from the date of repair of the equipment, until such availability is achieved till such time Contract Performance Security shall required to be extended. The contractor shall maintain full fledged supervisory staff until such period.	We request Owner to furnish formula for calculating availability for our understanding.	Pl refer MERC regulations in this regard
272	3	2	Provenness Criteria	Mahagenco has a supercritical project under execution and hence we suggest to replicate proveness criteria of that project (for both BTG and BoP) in this Bhusawal Project. Kindly consider.	Bid specification shall prevail

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
273	3	2	Proveness criteria	Bidder requests client to add the following clause in continuation to clause 2.2 and clause 2.3: A JV company / subsidiary company formed for manufacturing and supply of equipment(s) listed at 2.2 above in India, can also manufacture such equipments provided one of its promoters/its subsidiary(ies) / holding company meets the requirements of clause 2.2 above. However, in such a cas, the JV company /subsidiary company formed for manufacturing of equipment(s) listed under 2.2 above should have a collaboration or valid licensing agreement for design, engineering, manufacturing of such equipment(s) in India with the JV promoter/its subsidiar(ies) / holding company who meets the requirments stipulated at clause 2.2 above.	Bid specification shall prevail

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT					
CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
274	3	2.3	Other critical equipment, auxiliaries, systems and bought out items in STG package	The current clause 2.3 may be renamed as 2.3 i) and add the following after this clause " 2.3 ii) A JV company / subsidiary company formed for manufacturing and supply of equipments listed at clause 2.1.2 clause 2.2.3 above in India can also manufacture such equipments provided one of its promoters / its subsidiaries / holding company meets the requirement at clause 2.1.2/ 2.2.3 above. However in such a case the JV company / subsidiary company formed for manufacturing of the equipments listed under clause 2.1.2 / 2.2.3 above should have collaboration or valid licensing agreement for design, engineering, manufacturing of such equipments in India with JV promoter /its subsidiaries / holding company who meets the requirement stipulated at clause 2.1.2 / clause 2.2.3 above Before taking up the manufacturing of such equipments as per above clause, the bidder / his subvendors must create (or should have created) manufacturing and testing facilities at his works as per collaborator / licensor's design, manufacturing and quality control system for such equipments	Bid specification shall prevail

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
		continued		duly certified by the collaborator / licensor Further, the collaborator / licensor shall provide (or should have provided) all design, calculations, manufacturing drawings and must provide (or should have provided) technical and quality surveillance assistance and supervision during manufacturing, erection, testing, commissioning of equipments"	continued as above
275	3	2.3	Incase the contractor or the proposed sub - vendor(s).....atleast 500 MW rating, the contractor or proposed sub vendor (s) stipulated at clause 2.1 and 2.2 above. However, in this case, the contractor.....commisisioning of equipment.	Bidder requests Client to amend the criteria/clause as follows. Incase the contractor or the proposed sub - vendor(s).....atleast 150 MW rating, the contractor or proposed sub vendor (s) stipulated at clause 2.1 and 2.2 above. However, in this case, the contractor or proposed sub- vendors before resorting to design, engineering, manufacturing of proposed equipment by himself or themselves should have created manufacturing facilities at his works as per collaborator/licensor's design, manufacturing and quality control system for such equipment. Further, the collaborator/licensor commisisioning of equipment.	Bid specification shall prevail
276	3	4.0	Deemed Export Benefits	A recent Notification No. 107 (RE-2010)/2009-2014 dated 21st March, 2012 issued by Director General of Foreign Trade states that supplies to non Mega Power Project shall not be entitled to any Deemed Export benefit. In view of this circular, kindly confirm whether Deemed Export benefit needs to be considered for this project.	Mahagenco shall revert separately

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
277	3	4.5	Any change in the rate(s) of above duty(ies) applicable to the goods supplied to the project with respect to their rates as on record date due to change/expansion/abolition/withdrawal of the Deemed Export Benefits and/or Mega Power Project Policy benefits during contractual work completion period and extended contractual work completion period for the reasons attributable to the owner, if any, shall be to the owner's account. However, in the event of the such change taking place beyond the contractual work completion date, minimum of the rate applicable as on record date or as on the date of incidence of the duty shall only be payable.	In addition to the condition specified in this clause, reimbursement of statutory variations shall also be applicable in case of extension of contractual completion period due to force majeure conditions. Kindly confirm	Pl refer corrigendum No.III
278	3	5.1	All the goods to be supplied by the domestic contractor shall be consigned to: (----- name of the contractor-----) C/o. Chief Engineer /Dy. Chief Engineer (Project) Maharashtra State Power Generation Co. Ltd. Bhusawal Thermal Power Station Project Bhusawal, Dist. Jalgaon (MS) Pin - 425307	Kindly clarify the invoicing route in this case. For items which shall be self manufactured by the Contractor, if the consignee is self @ site as specified, it shall be treated as Stock Transfer and then the final sale to Owner shall be a VAT transaction, which is not the tax optimized transaction.	Mahagenco shall revert separately

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
279	3	6	Liquidated Damages	LD cap for delay in completion is not mentioned, so we would like to suggest that LD cap for delay in completion of the Project shall not exceed 10% of contract Price. And Overall aggregated LD 25% is high, please change Overall aggregated LD (total LD for Performance and LD for Delay) from 25% to 15% of Contract Price	Bid specification is clear in this regard and shall prevail
280	3	6.3	Rate of liquidated damages against shortfall in performance	Owner may consider rationalisation of the rates at the LD for shortfall in performance shall be levied as these rates are quite high. Similar rationalisation is requested in Clause 19.1 of Section-1, Volume-1 of tender specifications	Bid specification shall prevail
281	3	6.3	List of Auxiliaries for Guaranteed Power Consumption	The MD BFP is not a continuous running equipment. Hence S. No. 1 may be deleted from the list of auxiliaries to be considered for guaranteed auxiliary power consumption	Pl refer corrigendum No.III
282	3	6.3	Auxiliary power consumption	Since AHP involves dry ash disposal system, wet ash disposal system and HCSD, please clarify for Auxiliary power consumption which system we have to consider. Please clarify whether we have to consider ventilation, sump pumps, hoists.	Bid specification is clear in this regard
283	3	6.3	Auxiliary power consumption	Please clarify for Auxiliary power consumption which path (direct, stacking, reclaiming) we have to consider, whether single stream operation or double stream operation. Please clarify whether we have to consider ventilation, DE/DS system, sump pumps, hoists, elevator.	Bid specification is clear in this regard
284	3	6.3	Liquidated Damages for failure to meet Performance Guarantees	We request Owner to review the LD rates for failure to meet Performance Guarantees and rates considered for loading of Price Bid on Performance Parameters (as specified in Clause 19, Section 1).	Bid specification shall prevail

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
285	3	6.3	Heat Rate: Increase in gross turbine cycle heat rate in kCal/kWh under rated steam conditions at 76 mm of Hg (back pressure) with zero make up at 100% unit load at generator terminals.....	Since this is an EPC contract, Owner is requested to give the Bidder freedom to choose the best condenser back pressure based on most optimized design for offering the best heat rate for the turbine. Owner may please consider and give their acceptance.	Bid specification shall prevail
286	3	6.3	Guaranteed Technical Parameters and LD for failure to meet performance guarantees - TG Cycle Gross Heat rate and SG efficiency	This being a turnkey EPC tender, we request that the performance guarantee is requested on Unit Gross Heat rate basis which incorporates the TG Cycle HR and SG efficiency	Bid specification shall prevail

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
287	3	6.3	Auxiliary Power Consumption: Total auxiliary power consumption of all auxiliaries (as listed below) at 660 MW load with Zero make up, 76mm of Hg back pressure and 100% unit load with respect to the guaranteed Auxiliary Consumption as per Schedule - 7.	(1) As per Vol II, Section 8 cl. no. 1.2.5 for Performance Guarantee Schedule, 1% make up to be considered for auxiliary consumption. Please clarify, Quantity of make up water (0% or 1%) to be considered for auxiliary consumption guarantees. (2) As per Vol. I, Sec 3, cl. no. 6.3 for LD and Vol. I, Sec 1, cl. no. 19.1 for Loading for Bid Price, Auxiliary consumption are given in per kWh basis, however as per Vol. I, Sec. 1, Schedule 7 for guarantee schedule 7, auxiliary consumption is to be guaranteed in kW. Please confirm the evaluation and guarantees shall be on per kW basis. (3) As per Vol. I, Sec 3, cl. no. 6.3 for LD and Vol. I, Sec 1, cl. no. 19.1 for Loading for Bid Price, the auxiliary consumption is to be considered at 100% TMCR condition, however in the description of list of auxiliaries to be considered (Vol. I, Sec 3, cl. no. 6.3), it is specified that the individual plant and equipment are to considered at full load/capacity / design capacity. Please clarify the requirement.	Auxiliary Power consumption shall be at zero % make up. Pl refer corrigendum No.III The auxiliary power consumption shall be considered at 100% TMCR at design condenser pressure with zero% make up.
288	3	6.3	Auxiliary Power Consumption table, Sl. No. 5 - Excitation losses (in case of static excitation system with rectifier transformer)	As per Specification Vol III-B, Section-1, Cl. No. 3.3, electrical power generated at generator terminal is to be considered subtracting power taken by the exciter for heat rate and output calculations. Hence, Bidder proposes to remove excitation losses from auxiliary consumption list.	Bid specification shall prevail

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
289	3	8.3	Phased Manufacturing Programme - Weightages for different milestones of PMP & Bank Guarantee value to be submitted for PMP	As per CEA guidelines, the weightage factors shall be defined independently for Steam Generator & Steam Turbine i.e. the sum of weightages for individual equipment shall sum upto 100. Presently the bid documents stipulate combined weightages for Boiler & Turbine together which may please be amended. also pl. refer to clause 8.4	Bid specification shall prevail
290	3	9.1	Obtaining any clearance not mentioned therein, however, is required for completion of the work under this contract shall be exclusive responsibility of the contractor.	Any clearance not mentioned, but required for performance of the work under the contract should be obtained by such party in whose name the clearance/ permit/ authorisation is required to be obtained. We request you to kindly modify the clause accordingly	Bid specification shall prevail
291	3	6.3	LD for Guarantees	This being a turnkey EPC tender, we request that the performance guarantee is requested on Unit Gross Heat rate basis which incorporates the TG Cycle HR and SG efficiency	Bid specification shall prevail
292	3	2.2.2.3	"The generator to be supplied shall be manufactured assembled and tested in the factory where generator of at least 500 MW has been manufactured in the past or is under manufacturing / assembly at factory having testing facilities of international standard acceptable to technical agency / institutions to be approved by Owner	The clause may please modified to accommodate Indian manufacturing company set up to manufacture generators for supercritical projects Accordingly we request to you to add the following at the end of the para <i>"Alternately the same can also be manufactured in Indian Manufacturing Company set up as per clause 4.2.1 of Section 1 / Volume I"</i>	Mahagenco shall revert separately
293	3	2.2.3	Provenness Criteria of LPFWH: Capacity not less than 1300 MT/hr	Please modify as below: Feed Water Low Pressure Heater of a 500 MW or higher size unit	Mahagenco shall revert separately

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CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
294	3	2.2.3	Provenness Criteria of HPFWH: Capacity not less than 800 MT/hr for each string	Please modify as below: Feed Water High Pressure Heater of a 500 MW or higher size unit	Mahagenco shall revert separately
295	3	2.2.3	Provenness Criteria of LPFWH: Feed water handling Capacity not less than 1600 MT/hr	Please modify as below: Deaerator of a 500 MW or higher size unit	Mahagenco shall revert separately
296	3	2.2.3	Provenness Criteria of HP Bypass system	The HP Bypass Valves developed by us are suitable for both 500 MW sub-critical units as well as for 660 MW supercritical sets. These valves have been tested successfully at supercritical steam parameters and flow, temperature and pressure requirements and have been working for more than 2 years in 500 MW sets in the country. We interpret that our HP Bypass valves are proven. Kindly confirm.	Mahagenco shall revert separately
297	3	2.2.3	Feed water high pressure heaters - Capacity not less than 800 MT / hour for each string	Client to note that as per prevailing practice 2 x 50 % HP Heaters string can be offered. Please confirm	Mahagenco shall revert separately

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Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
298	3	2.4.1	Power cycle piping The contractor / his proposed sub vendors should have designed, engineered (including static and dynamic analysis) fabricated / got fabricated AND should have experience in fabrication and welding of main steam piping	The two conditions of this clause contradict each other as the 1st condition allows fabrication by others while the 2nd condition stipulates fabrication experience also We request you to delete the 2nd condition since fabrication is a specialised jobs done by fabricators/erection agencies Further We request you to add a new condition at the end of this clause In case the bidder / his sub vendor does not meet the requirements stipulated above in part or full but he is a regular piping design and engineering firm and currently carrying out the design and engineering plant units, may also be considered qualified provided he collaborates subcontracts / associates with a design firm / agency who meets the requirement of the clause above for the purpose of execution of design and engineering of power cycle piping system for this package. In such a case the bidder / its subvendors shall get the design / engineering documents as per technical specification duly vetted by his collaborator / sub contractor / associate for the part of design for which he is not qualified."	Mahagenco shall revert separately
299	3	2.4.4	Condensate Polishing Plant: The Contractor/subcontractor should have designed and supplied.....	Please replace "Contractor/subcontractor" with "Contractor/subcontractor or subcontractor's associate."	Bid specification shall prevail

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT					
CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
300	3	4.2.2	Exemptions in view of Mega Power Project Status: The owner has applied to Ministry of Power, GoI for issuance of the Mega Power Project Status for the Project. In the event the Project gets Mega Power Project Status, all the equipment, components, materials imported for the project shall be entitled for exemption of customs duty Whereas, if the project is awarded Expansion Unit of Existing Mega Power Project Status, Customs Duty is payable at the rate of 2.5%. However, in both the cases, Excise Duty is exempted.	We request Owner to note that Excise Duty is not exempted in case of – (a) materials going for the Civil works such as Cement, Steel (Reinforcement / Rebars) etc are not exempted either in case of Mega power project as well as in expansion Mega power project. (b) In case of Expansion Mega Power Projects exemption from Excise Duty for various systems such as Ash Disposal system, including Ash Dyke, Water intake including treatment and storage facilities and coal transportation facilities, etc. are also not available as per latest Excise Duty Circular No. 6/2011 dtd. 01.03.2011(Under Sl.No. 91C).	Mahagenco shall revert separately
301	-	-	Reference DG/BSL U-6/2011/T-1/0853 dated 3rd Feb 2012-AMENDMENT NO. 3 (IFB) Page 7 of 8, NOTES Sl. No. 2 " In case bid is submitted by the subsidiary company of the parent manufacturer where in the parent manufacturer holds equity not less than 51%.	Kindly clarify that the said clause (AMENDMENT NO. 3 (IFB) Page 7 of 8, NOTES Sl. No. 2) is applicable for joint Venture company as well.	Bid specification is clear & self explanatory in this regard

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT					
CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
302		31.4	Price preference	We understand the cl as under: a) If the supply is quoted as CIF, it will be multiplied by 0.9 and increase this amount by 1.15 for purposes of evaluation. b) If the supply is quoted as CFR, it will be multiplied by 1.005 and increase this amount by 1.15 for purposes of evaluation. Pl clarify	Bid specification clear in this regard.
303	2B	27	Terms of Payment	The terms of Payment proposed by the owner has very high retention component. We request owner to adopt 'terms of payment' being followed in NTPC Contracts and other reputed power utilities for similar sized projects. We request owner to amend terms of payment as follow : <u>Installation & Civil Services :</u> 1. Advance Payment - 10 %. 2. Prorata Payments - 80% 3. Synchronization - 5% 4. Commercial Operation - 5%	Mahagenco shall revert separately

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT					
CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
304	3 Vol II Section - 8	6.3 (1) 1.2.3	Heat Rate: Increase in gross turbine cycle heat rate in kCal /kWh under rated steam conditions at 76 mm of Hg (back pressure) with zero make up at 100% unit load at generator terminals with respect to guaranteed heat rate as per Schedule - 7. Guaranteed Turbine Cycle Heat rate in kCal/kWh under rated steam conditions, design condenser pressure with zero make up at 100% and 80 % rated load. A weightage of 4 (four) and 3 (three) shall be considered for 100 % and 80 % heat rate values for arriving at the net heat rate.	Please note that there is discrepancy in Performance guarantee schedule and Special Terms & Conditions of contract regarding Heat Rate. As Liquidated damages on Gross Heat Rate are at 100% unit load, we presume that Performance Guarantee for Heat Rate shall be only at 100% TMCR/0% MU Load. Kindly confirm.	Pl refer corrigendum No.III
305	General	27	Terms of Payment	Please ensure that the resolutions of Pre-bid queries raised against Terms of payments of Section 2A shall be applicable on Section 2 B also.	Bid specification shall prevail

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

CLARIFICATIONS TO PRE -BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I

S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
306	General	All relevant clauses on taxes & duties and Price Variation	Payment beyond contractual completion dates	Please confirm that Price variation and statutory variation in taxes and duties shall be paid to the contractor for the supplies / work done beyond the contractual completion period, if the delay in work completion is either due to force majeure conditions or due to reasons attributable to the Owner.	Pl refer corrigendum No.III
307	General	General	Soft copy of schedules	Kindly provide us editable soft copy of all the schedules (to be filled by the contractor) in MS-Word format.	Pl refer clause no. 11.0, Section-I, Volume-I
308	General	General	Type Tests	The type tests conducted on similar equipment in past 5 years by the contractor shall not be conducted again for this project. Kindly convey your acceptance	
309	General	General	Type Tests	It is suggested to introduce a schedule of type tests, where the contractor may specify the rates for conducting type tests. MahaGenco may review the prices and select the type tests to be conducted at the time of placement of LOA	
310	General	General	General	Please confirm that in case of contradiction in the specifications / terms and condition specified in Volume-1 and other Volumes of the tender document, the details indicated in Volume-1 of the tender shall prevail.	
311	Nil	Nil	Other Major Conditions to include	Please include other major Clauses viz. Change in Law, Transfer of Title, Deemed Completion of PG Test / Project etc. in bid documents	

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT					
CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENCO Reply
312	Vol-II till Vol-VIII		Drawings, Annexures, Schedules & Datasheets provided in Tender document	We request Owner to provide these documents in editable formats.	Shall be provided by Mahagenco

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

RESPONSE TO PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1

VOLUME - II

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT**Pre - Bid Queries****Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II**

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
1	Volume-II/Section-2	7.14	Rainfall data	Rainfall data provided 112mm average annually. Kindly provide rainfall intensity in mm/hr. to be considered for drainage calculation.	Rainfall intensity data shall be collected from Meteorological dept. by the bidder.
2	2	7.11	Seismic Zone : Zone III as per IS:1893	Our standard design fulfills the following seismic requirements: 0.4g in horizontal direction 0.27g in vertical direction with respect to accelerations acting directly on the generator, i.e. top of foundation where the generator is mounted. Any requirements above the standard ones would need an extra assessment. On project level (plant) there has to be done an evaluation of the site conditions regarding the seismic requirements on the top of the foundation where the generator is mounted. If the according seismic accelerations are determined, we are able to judge, if the requirements are fulfilled or if a project specific assessment is needed.	Bid specification prevails

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
				The generally required information to be provided for generator supplier is the following: - required method for seismic analysis, i.e. static coefficient method or dynamic method, - depending on method, there might be specified/prescribed additional scaling factors (e.g. load factors) or damping ratios, - classification of earthquake event and related safety factors on material properties: 7:E8) SSE (safe shutdown earthquake), b) OBE (operation base earthquake) - earthquake accelerations in horizontal (lateral and axial) and vertical direction at: a) footpoints of turbogenerator and b) centre of gravity of turbogenerator. Depending on method, accelerations to be given as scalar values or spectra. - earthquake load combination and superposition rules (e.g. combination of seismic loads with weighing factors or SRSS) - consideration of friction forces allowed? Bidder's request to confirm acceptance.D8	
3	2	7.13	Wind speed : 0 to 39 Km/hr	Kindly furnish the max. wind velocity to be considered for boiler design.	Basic wind speed is 39 m/s as per IS 875 part III
4	Vol -VI A Sec-1	4.6.6.2	The basic wind speed Vb at Bhusawal according to IS 875 (Part-3) -1987 is 39 m/s.		

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
5	Volume-II/Section-2 Volume-IV-A/Section-1 Volume-IV-A/Section-1	7.15 (II/2 4.2 (e) (Page 22)) 4.6.4 (c) (Page 75))	7.15: Wind Speed : 0 to 39 Km/hr 4.2 (e): Wind Speed : 0 to 44 Km/hr 4.6.4 (c) Wind Load : 39 m/s	As per IS 875 (Part III), the wind speed is 39 m/s. Please clarify the wind speed to be considered.	Basic wind speed is 39 m/s as per IS 875 part III
6	2	7.17	MAIN POWER SOURCE FROM GRID: 7.17 MAIN POWER SOURCE FROM GRID 7.17.1 Rated Voltage : 400kV 7.17.2 Voltage variation : ± 10 % 7.17.3 Frequency Variation : ± 5 % 7.17.4 Rated Short Circuit Level : 50 kA, Three Phase Symmetrical	As per CERC Grid Code Regulation No. L-1/18/2010-CERC dated 28-04-2010 and CEA Grid Standards 2010 the Voltage Variation of 400kV Grid is +/-5% i.e. 380kV to 420kV, Frequency Variation is 49.2Hz to 50.3Hz. Bidder requests Client to verify and revise these values accordingly. The highest voltage for 400kV system is 420kV and major equipment designs will not conform to a voltage of 440kV(400kV +10%). Similarly Voltage Variation at Generator Terminals is +/-5% and it would be outside P-Q capability of Generator to meet the voltage variation of +/- 10%.	Refer Corrigendum II Master specification Volume - II .

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
7	2	7.18	Auxiliary Power Consumption: Total auxiliary power consumption of all auxiliaries (as listed below) at 660 MW load with Zero make up, 76mm of Hg back pressure and 100% unit load with respect to the guaranteed Auxiliary Consumption as per Schedule - 7.	Bidder's optimised and Standard ratings are: Motors above 1500kW-11kV Motors below 1500kW & above 200kW - 3.3kV Motors upto 200kW: 415V The above ratings lead to effective utilisation of voltages leading to optimised design of Electrical System.	Bid specification prevail
8	Volume II / Section-2	7.18.6 (a) Page- 22 of 555	Short circuit level for; 11kV switchgear: 44kA/3sec	We propose SC level for 11kV as 40kA/3S as most of the 11kV electrical equipment are available with 40kA SC rating.	Bid specification prevail
9	Sec-2	7.18.8(a)-ii	Alternate Power source(Emergency Power Supply) to Fire Water Pumps.	Emergency Power from Plant Main DG(MCC) will not be provided for Fire Water Pumps. However, Diesel engine driven Fire Pump will be provided separately under Fire Protection Package. Pl.confirm acceptance	Confirm
10	2	7.19	The variation in voltage and frequency may be $\pm 10\%$ and $\pm 5\%$ respectively. The combined voltage and frequency variation may be $\pm 10\%$. All devices shall be suitable for continuous operation over the entire range of voltage variation without any change in their performance	Bidder's understanding that mentioned clause is not applicable for Generator. The generator voltage/frequency range is according bidder's standard proven design. Please also note that generator auxiliary equipment (AC motors) can meet the requested variation in voltage and frequency. Please confirm bidder's understanding is correct.	Please refer generator specification.

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
11	2	7.21	All electrical equipment shall be designed for the following ambient conditions (a) Maximum ambient temperature : 50°C	Bidder's understanding that this clause is not applicable for excitation panels. Bidder's Excitation panels are designed for ambient temperature of 40°C maximum which is proven and standard. To meet 50°C of ambient temperature, cabinets have to be assembled inside the room properly ventilated/air conditioned to ensure the proper ambient temperature for the panels operation. Forced air cooled cabinets dissipates approximately 30kW of heat. Please confirm bidder's understanding is correct.	Bid specification prevail
12	Volume-I Section-2A Volume-II/ Section - 11, Corrigendum-1	Cl. 15.1 (ii) Page 244 of 340 Cl. 1.13 Page 121 of 556 Page 8 of 247	all consumables like, grease, lubricating oils, chemicals, ink & graphs for recorders etc. up to satisfactory completion of trial operation. The Contractor shall also arrange any additional quantities required specifically for the Performance Guarantee Test. Supply and application of the final paints and first fill lubricants on all the equipment to be erected under this specification. Supply of LDO, chemicals, lubricating oils upto COD. Supply and application of the final paints and first fill lubricants on all the equipment to be erected under this specification. Supply of LDO, chemicals, lubricating oils/lubricants, consumables etc. upto COD.	Supply and application of the final paints and first fill lubricants on all the equipment to be erected under this specification. Supply of LDO, chemicals, lubricating oils/lubricants, consumables etc. upto reliability test. Please confirm	The clause is deleted.

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
13	3	1.2.1	Steam washing system	Normally it is not standard practice to adopt steam washing system for such large turbines. We request that this requirement be reviewed and revised suitably.	Bid specification prevails.
14	3	1.3.8, 1.4.10 Page 32 , 34 of 555	1.3.8 : Independent PLC system (DCS), 1.4.10 : Independent PLC system (DCS),	Would it be acceptable to customer If bidder quotes same hard & software for the controls of CHP/ AHP as being offered for main DCS?	Agreed.
15	3	1.3.16	Hoist	We understand that the 5T hoist referred is for maintenance area in the building. Please confirm.	Specification is self explanatory
16	Volume-II/Section-3	1.4.13 (Page 34)	Supports & Roads / Rail crossing for ash disposal piping including tunnels, culverts etc.	Kindly provide Longitudinal section drawings. Any kind of statutory approval/ permissions and right of way required for ash disposal piping including tunnel, culverts etc. are not in bidder's scope. Please confirm.	For Longitudinal section drawings please refer Addendum II Please refer Volume VI A Section 1 clause 4.4

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
17	3	1.5	Raw water pressure at TP	Please provide the pressure of raw water at terminal point.	Will be provided during detailed engineering.
18	3	1.7.2 and 1.7.3	Fuel oil transfer pumps	Please confirm availability of nozzles in the tank for the fuel oil transfer pump connection.	Confirmed
19	3	1.7.2 and 1.7.3	Fuel oil transfer pumps	Please clarify where is the controls for the transfer pumps. In cl 1.7.5 PLC is referred. Please clarify location of this PLC. Please clarify if feeders for the proposed pumps are available in the existing MCC of 500 MW plant. Interlocks for the proposed pumps will be taken from the existing tank instrumentation, please confirm.	1. Separate Transfer pump house. 2. MCC not available. 3. Level signals will be available from existing tank
20	3	1.7.2 and 1.7.3	Fuel oil transfer pumps	Please provide existing dyke area and pump house layout for reference. Please confirm space availability for the proposed transfer pumps in the area	
21	3	1.7.2 and 1.7.3, 1.7.8	Fuel oil transfer pumps	Please clarify if separate new pump house is required for the proposed transfer pumps in existing fuel oil area.	Yes.

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
22	Volume: II Section 3 Section 11	1.7.15 86	Electric Heat tracing	Per Volume III-A, steam heat tracing is specified in mechanical specification and electrical heat tracing panel is mentioned in Volume II. Please confirm that steam heat tracing for HFO is acceptable.	Vol IIIA prevails.
23	3	1.7.18	Fuel oil pump house	Generally cable spreader room is not applicable for these MCC rooms. This is because the number of feeders is very less for this area. Please review.	Bid specification prevail
24	3	1.8	Compressed air system	For mill reject system only conveying air compressors will be provided. Service air and instrument air system will be fed from the station compressed air system. Similarly for ash handling plant, service air requirement if any will be met from station air. Only conveying air compressor and instrument air compressor will be provided. Please confirm. For CHP area, separate instrument air compressors are not provided. Please review.	Bid specification prevail
25	Vol -II Sect-3 Page 41 of 555	1.8.1	Non- oil lubricated screw compressors.	we propose to consider oil injected screw compressor / Non- oil lubricated reciprocating compressor. Pl.confirm.	Bid specification prevail

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
26	3	1.11.6	Transformers	Please clarify if nitrogen blanketing system is required in addition to the spray system.	Nitrogen Injection based Fire Protection system shall be provided to Generator transformer, Station transformer and Unit Aux. Transformer, in addition to HVW Spray system.
27	3	1.11.6	Transformers	If nitrogen blanketing system is required, please confirm that it is for generator transformers only.	Nitrogen Injection based Fire Protection system shall be provided to Generator transformer, Station transformer and Unit Aux. Transformer, in addition to HVW Spray system.
28	3	1.15.2	All major transformers e.g. Generator & Station transformers, Unit Transformers, Unit Auxiliary Transformers & Station Auxiliary Transformers.	Station Transformers may not be applicable in case of GCB Scheme offered by Bidder.	Bid specification prevail
29	3	1.15.5	AC lighting & distribution boards, 220V DC distribution boards & fuse boards etc, ABT panels, control & protection panels, Synchronizing panels,	ABT type tariff metering panel is not envisaged in Bidder's scope as Switchyard is excluded. Instead Energy Accounting & Audit Meter may be Included as per Clause 3 of CEA Regulation No. 502/6/2009/DP&D/D-I dated 4th June 2010.	ABT means Auto bus Transfer

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
30	Sec-3	1.15.5	... Variable Frequency drives (if applicable) for ID fans,---ABT panels & Synchronizing panels etc. for complete plant	VFD is not applicable for ID Fan. No separate Synchronising Panel be provided. Synchronising will be part of swgr. Or ECP as per requirement. If 'ABT' means Auto Bus Transfer Panel, then it will be provided . If 'ABT' means 'Avialability Based tariff Panel' Then it should be part of Switchyard package. Pl.confirm	ABT means auto bus Transfer
31	3	1.15.6	Generator isolated phase bus ducts, HT phase segregated bus ducts (for 11kV & 3.3 kV switchgears) & LT non phase segregated bus ducts.	If Layout does not allow, Bidder may be allowed to use Cables for connections between Switchgears and Transformers.	Bid specification prevail
32	3	1.15.14, 1.15.15	Local control panels, Local push button stations and Energy saving system panel.	Bidder requests Client to clarify "Energy Saving System Panel" and scope for the same.	Refer volume IV.Sec-7.Clause No.6.21
33	Sec-3	1.15.14 & 1.15.15	 Energy Saving system panels	The scope and description are not Clear. Pl. clarify	Refer volume IV.Sec-7.Clause No.6.21
34	3	1.15.20m	Workshop	Please clarify if workshop equipment and building are included in EPC scope.	Yes, Included; list will be sent.

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
35	3	1.15.20 (m)	Workshop Equipment	Please furnish the list of workshop equipments.	Being furnished
36	Sec-3	1.15.20 (n)	 VFD equipment Building	AS VFD for ID fans are Not applicable, VFD equipment Building is not applicable.Pl.confirm	If radial fan is used, then VFD building is applicable.
37	3	1.15.20-ff	All the plants, areas, buildings etc. shown on plot plan & other drawings.	Bidder requests Client to amend this clause by excluding Electrical Work for Colony as the same is excluded in Main Scope of Work in Volume-II, Section-3, Clause No.-3.	If colony civil work excluded then colony electrical work also excluded.
38	3	1.15.21	However load flow & transient stability study which may be done on approved software.	Bidder wishes to clarify that load flow & transient stability is done on ETAP as per currently accepted Industry Practice. Bidder requests client to allow ETAP for all Electrical Studies.	Refer Corrigendum-II Master specification Volume - II
39	Sec-3	1.15.21 (a)	All the electrical system studies such as short circuit levels, voltage drops, grounding, relay setting, relay co-ordination etc & all sizing calculations such as transformers, busducts, switchgears, motors, cables, lighting, DC UPS system etc. manual calculations & E-Tap software	Following may please be noted with electrical system studies and sizing calculation viz software calculation and manual calculation: a. For Short Circuit levels, Voltage drops, Grounding, Relay setting, Relay co-ordination, Load flow and transient stability study will be done by E-Tap software. No manual calculation will provided for above studies. b. For Sizing calculation for transformer, busduct, cables, lighting, DC Battery & Charger only Manual calculation will be provided. Pl.confirm	Refer Corrigendum-II Master specification Volume - II

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
40	Volume II / Section-3	1.15.21 (a) Page- 49 of 555	All the electrical system studies such as short circuit levels, voltage drops, grounding, relay setting & relay co-ordination etc. & all sizing calculations such as transformers, bus ducts, switchgears, motors, cables, lighting, DC & UPS system etc. by manual calculations & ETAP software & their approvals & then AS BUILT. However load flow & transient stability study which may be done on approved software.	All design calculation/sizing calculation shall be carried out by approved software. We have not envisaged manual calculation at this stage however sample manual calculation can be submitted for review based on mutual agreement. Please confirm acceptance.	Refer Corrigendum-II Master specification Volume - II
41	3	1.15.21 (a)	...However load flow & transient stability study may be done on approved software.	Bidder's understanding is that the load flow and transient stability study done on ETAP is acceptable. Please confirm.	Refer Corrigendum-II Master specification Volume - II
42	Volume II / Section-3	1.16.12	Optical fiber interface between DCS and PLC /microprocessor based control in Off-site plants & Plant auxiliary area.	Connectivity between standalone PLC systems for Soot Blower with Station DCS shall be through OPC on standard twisted pair Ethernet cable.	Agreed.
43	3	1.16.26	Process plant simulator	Please clarify this requirement. Please let us know if separate simulator is to be supplied under this contract.	Separate simulator to be provided
44	3	1.16.30	All local panels, supervisory control panels / consoles.	Bidder requests client to Exclude any Back-Up Panel, Supervisory control Panelss other than Excitation System, Generator Protection, Unit Synchronisation and Bay Control Unit for Generator Bay. All Controls, Display, Mimic, Alarm & Annunciation will be built in DCS Workstations and Large Video Screen Display.	Bid specification prevails

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
45	3	1.16.38	24V DC battery & battery charger	It shall not be mandatory to feed Bidder's control system through 24VDC voltage level. As per cl. no. 4.2, page 22 of 718, section-1 of Volume:V of specification to use 2x100% parallel redundant UPS with 2 nos. of battery for 60 minute backup is envisaged for various C&I System which will be also used to feed DCS 240 VAC. Any other voltage level like 24VDC shall be derived inside the control system from AC supply.	Bid specification prevails
46	3	1.17.1	Railway siding	We request that the work towards railway siding be carried out by Mahagenco through RITES or other similar agencies as is normally adopted for other projects. These work require approvals from Railways which can be obtained by Owner directly.	Bid specification prevail
47	3	1.17.2	Spring foundations	The provision of springs for TG foundations depends on TG manufacturer practice. Please let us know if Mahagenco can accept foundations without springs for TG if the same is as per manufacturer practice.	Please refer Volume VI A section 2 Annexure I clause 7.0 (special attention)

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
48	3	1.17.5	Contour drg	Please provide ACAD or other similar data for site contour levels, if available.	Adequate information in readable format had been provided to bidders.
49			Soil investigation report	Please provide us the soil investigation report and/or borelog data, if available for the proposed site carried out by Mahagenco for reference.	Already furnished.
50	3	1.17.8.1	CW system	We understand that from the cooling tower outlet to the forebay channel can also be adopted.	Refer Volume VI A section 1 clause 4.11
51	Volume II Section-3	1.17.8.3	Mill reject system compressor house.	We may consider Mill reject handling system conveying Compressor in the AHP Compressor house. Hence, separate compressor house for MRHS system may not be required. Please confirm.	Bid Specification prevails
52	3	1.17.8.11	Ash pipes	This clause refers to existing ash disposal pipelines. Please clarify the scope to be carried out by the Bidder with respect to the existing ash pipe lines.	Please refer Addendum II to Bid specification & Volume VI A section 1 clause 4.4
53	3	1.22	One set of tools and tackles, fixtures etc. in new condition as required for regular operation and maintenance of the plant and the equipment offered.	Bidder wishes to propose that new tools and tackles shall be used for erection and commissioning of the plant and the same shall be handed over to the Client Kindly confirm.	Bid Specification prevails.

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
54	3	1.22	Tools	Certain special tools and tackles are supplied with the equipment and are used for erection and also maintenance. Such tools will be supplied in one set. After they are used for erection, they will be made to good condition and handed over to Owner.	Separate tools for maintenance & lab purpose to be provided
55	Volume-I/Section 3 Volume-III B/Section 6	Clause No. 2.4.4, Page no. 316 Clause No. 3.13, Page no. 207 of 313	Subcontractor should have designed & supplied at least on CP of MB type.... Each of these vessels shall have a min. cap. Of 500 cu.m/hr. ... The above plant should be in successful operation for period of at least one year Vendor should offer proven technology, which has successful operation track record for min. 2years in supercritical plant.	In view of the fact that no supercritical plant in India has been in operation for 2 years till now and to consider Indian suppliers also, Therefore Clause No. 2.4.4, Page no. 316 shall be considered and cl. no. 3.13 shall not be applicable. Please review and confirm.	Clause deleted. Vol I Prevails.
56	3	3.1	Power evacuation and transmission system beyond generator transformer and station transformer HV bushing. Necessary coordination with transmission package supplier shall be responsibility of the bidder under this contract.	As per Cl. 2.1.1, section-1, Vol. IV-A, page 19 of 440, "Connection from bus post insulator (BPI) to LA and then LA to bushing of generator transformer and station transformer's bushing shall be arranged by power plant EPC contractor." As per Bidder's understanding, terminal point is at the HV bushing of the Generator Transformer and station transformer. Please clarify	Bid Specification shall prevail

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT**Pre - Bid Queries****Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II**

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
57	3	4	Drains terminal point	Please inform the terminal point for the plant drains.	There will be 2 nos. of disposal points for storm water drains. The locations of the same is at bridge no. 17 & 18 of railway siding for 2 X 500 MW unit.
58	3	4	Terminal point for effluent water	Please indicate the terminal point for treated sewage water from the STP and also the water after ETP.	Treated sewage water is to be used for gardening and terminal points of the pipes shall be upto the farthest point of green belt within periphery of the plot. ETP water shall be taken to ash water sump of bottom ash handling system

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
59	3	4.6	TP for Fuel Oil, Auxiliary steam and raw water: Isolation valve on tapping shall be supplied by bidder.	1. Existing plants from where tapping are to taken are under commissioning as per Bid Specifications and hence Bidder proposes customer to supply isolation valve for all the terminal points where integration with existing system is required. 2. Terminal point for connecting return oil (from pump outlet) to tank shall be provided by customer (Not Specified in tender) 3. Indicative co-ordinates of the Terminal points on the plot plan for Fuel oil, aux steam and raw water etc and all other utilities which are connected with the existing system, to be speccified. pl. also refer to clauue 4.7 and 4.8	1. Bid Specification prevails. 2.Fuel oil : Please refer Fuel oil system P& ID. 3.Exact physical location shall be collected from site.
60	3	4.6	As per Terminal point list, tapping from header of outlet pipe from tank shall be in scope. Where as, as per P&I diagram, we have to terminal point is at tank nozzle connection.	Please provide piping arrangement drawing indicating provisions (TPs) of Fuel Oil pipe extension from existing plant tanks to 1 x 660 MW expansion.	The terminal point is tank outlet nozzle; adequate data has been provided in the specification; additional details bidder to get from site
61	3	4.7	Terminal Point for Auxiliary steam	Please specify the Pressure and Temperature of the Auxiliary Steam Available at terminal Point.pl. also refer to clauue 4.6 and 4.8	14 ata,310 deg C.

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
62	3	4.7	Aux steam	a) Please inform the pressure and temp of steam (operating and design) for the aux steam header. b) It is understood that the existing aux steam header already has tapoff made and blanked for use in the proposed unit. c) Please let us have the arrgt drg showing location of the aux steam header. d) Please inform the capacity (tph) of steam which can be sourced from the existing steam header. e) Please confirm that existing structures /pipe rack in existing plant can be used to support the aux steam piping taken to the proposed plant.	14 ata,310 deg C ; spare capacity is 70 TPH. Rest of the data will be provided during detailed engineering.
63	Volume - II/Section- 3 & Volume- VIIA2	4.7 & Process Flow Diagram: Auxiliary Steam System (PE189-PF-205, Rev P1)	Auxiliary Steam	Owner to kindly indicate the flow, pressure and temperature available at terminal point for Aux. steam system from existing plant. It may be noted that a pressure of 17 kg/cm2(a), temperature of 350 Deg C will be required at user end. Expected flow is 120 TPH considering SCAPH operation during start-up. Please therefore clarify whether we should consider auxiliary boiler separately in our scope. We intend to use existing pipe rack/sleepers for Aux steam header routing till plant boundary. Please confirm.	14 ata,310 deg C ; spare capacity is 70 TPH. Rest of the data will be provided during detailed engineering.

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT**Pre - Bid Queries****Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II**

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
64	3	4.8	RW system	Please provide drawing showing location/arrgt of the raw water tapping point.	Tentative location of tapping point for Raw water is shown in the Bid plot plan drawing. However detail arrangement is to be decided by successful bidder.
65	Volume-II/Section-3	4.8 (Page 58)	Tapping from gravity water line for 2x 500 MW units.	Please provide the coordinates for tapping of water from the water pipe line laid/ proposed for 2x500 MW unit.	The scheme is being revised and will be sent to bidders.
66	3	4.8	RAW WATER: Tapping from gravity water line for 2x500MW units. Isolation valve on tapping and complete system downstream of this tapping shall be by bidder.	Please clarify the terminal point co-ordinates including Elevation and also please confirm the Pressure available at Terminal point.	The scheme is being revised and will be sent to bidders.

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
67	3	4.11	Power supply for transfer pumps	Please clarify terminal point for power supply to the proposed fuel transfer pumps located in the existing fuel oil area.	Refer Plot plan for location & supply shown in Key SLD drawing.
68	3	4.11.2	Supply, Civil foundation, intermediate gantry foundation, supply, installation and connection of LA & bus post insulators including connectors on EHV side are in EPC contractor scope	1. Only LA & Bus Post Insulators in the immediate vicinity of Generator Transformer & Station Transformer and their Connectors are in EPC Contractor's scope. Please confirm that Bidder's understanding is correct. 2. HV Switchyard is excluded from Bidder's scope. LA, BPI & Tube Bus constitute very little scope related to HV Switchyard for which the Design & Engineering like Layout Plan & Elevation , Insulation Co-ordination, Equipment Selection and Supply etc. are already being done by Switchyard Contractor. In view of the above Bidder requests to exclude this from EPC Contractor's scope.	Bid specification prevail
69	Sec-3	4.11.2 & 4.11.3	Bus post Insulator(BPI) and HV terminal connector for GT and ST	It is requested to exclude BPI and HV terminal connector out of scope of this bid. It may be included as a part of Switchyard scope. Also Insulator for overhead conductors at A-row will in switchyard scope. Pl.confirm	Bid specification prevail
70	3	4.11.4	Inter connection of power plant earthing grids with switchyard package, earthing grids at minimum four points, also interconnection with existing earth grid 2 X 500MW units at minimum 4 points are in EPC contractor scope.	Bidder requests Customer to indicate the Co-Ordinates of the InterConnection Points of Earth Grid in Plot Plan for Bidder's Estimation.	Refer corrigendum-II Master Specification Volume - II.

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Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
71	Sec-3	4.11.4	 Interconnection with existing earth grid of 2x500MW units at min. 4 points are in EPC contractor scope.	Point of interconnection not clear as roads and other structure is coming between existing and proposed unit. Pl. specify point of inter-connection.Pl.confirm	Bid specification prevail
72	3	4.11.6	Switchyard interface	We understand switchyard controls is also provided by transmission package vendor. Please confirm. So individual switchyard equipment is not interfaced with the control room. Please provide the expected interface between the switchyard control and the plant control room.	Corrigendum-II, annexure D, Table-1,Vol-IV A.
73	Volume II / Section-3	4.11.7 Page- 60 of 555	All interconnections & interfacing between various plants is in EPC contractor's scope.	We have envisaged below ground earth grid connection of proposed plant with 500 MW earth grid at four (4) points at plant boundary.	Specification is self-explanatory
74	3	5	Land: Land free of charges as available for the Construction of Residential accommodation to be built by contractor at his own expense for his employees near site. (b) Site office, pre-assembly/ storage yard to be constructed by contractor at his own expense within plant site.	The Clause no. 4.1/4.4 of Vol-I, Sec. 2B & Clause no. 5 of Vol-II, Sec. 5 are Contradictory. Customer to organise the land for site office/ temporary structures & Lay down areas in side the plant boundaries and land for staff & labour colony at free of cost.	Volume I section 2B clause no. 4.1.1 shall prevail

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
75	Volume-II/Section-3	5.1 (Page 60)	Land, free of charges as available for the construction of: (a) Residential accommodation to be built by the contractor at his own expense for his employees near the site.	We understand that the land for the construction of labour colony inside the plant shall be provided free of charges by the Owner. Please confirm.	Volume I section 2B clause no. 4.1.1 shall prevail
76	Volume II / Section-3	5.2 Page- 60 of 555	Construction power at 11 kV AC $\pm 10\%$, 3 Phase, 50 Hz $\pm 5\%$ and Construction water shall be made available at one point near the erection site by the Owner. Regarding charges, please refer Volume-I of this specification.	Bidder requests Owner to provide construction power of capacity 3 MVA approximate, at 11kV level at one location within plant boundary. Further downstream distribution of construction power shall be in Bidder scope of work.	Volume I section 2B clause no. 4.2 and 4.3 shall prevail
77	3	-	Scope of supply	Bidder's understanding is that Hydrogen Generation Plant is out of Bidder's scope of supply. Please Confirm	Confirmed
78	4	1.2	Codes and standards	Please review the requirement to include complete code or standard in English for any equivalent materials along with the tender. An extract can be provided in such case.	Bid specification prevails
79	4	1.6	Successful Bidder shall furnish two (2) sets of latest of national/international codes and standards to owner.	Bidder clarifies that furnishing national / international standards shall not be bidder's responsibility. It is difficult to quantify the required and relevant national / international codes and standards. It call for lot of extra work and cost implications. Laos, it is not allowed by the International standards committee to take & distribute the copies of the standards. Kindly accept.	Bid Specification prevails.

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
80	4	1.6	Codes and standards	This requirement to provide copies of codes and standards is practically difficult due to following reasons: a) Copy right requirements. B) The specification does not indicate which type of standards should be furnished. For example there could be many minor standards referred in QAP or factory procedures for components. This extends to major and minor components. It is practically not possible to provide 2 sets of codes and standards for all such codes and standards. In many cases such reference to code/standard is made to only a insignificant portion of the code/standard itself. We request you to delete this requirement.	Bid Specification shall prevail
81	4	1.6	Successful bidder shall furnish two (2) sets of latest of national/ international codes and standards to the Owner	Bidder's understanding is that wherever codes and standards used are different from the specification requirement, in those cases only the codes and standards needs to be provided. Please clarify.	Bid Specification shall prevail

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
82	4	2.2	Notwithstanding the Owner's wish to receive the benefits of new, advanced and improved technologies, a prime requirement is that all the systems and components proposed shall have been already adequately developed and shall have demonstrated good reliability under similar or more arduous conditions elsewhere, at least for continuous two (2) years in two different power stations.	client to note that as clause no. 2.2.3, Section - 3, Volume 1 it is mentioned that the for the respective equipments mentioned under that clause, the equipment of desired capacity (as defined under the clause) should have been succesful operation an at least One (1) plant for a period of not less than one (1) year from the date of opening of bid. However as per the caluse 2.2 of volume 2, it is mentioned that all the systems and components shall be been in service for at least 2 years in two different power stations. Bidder understands that the criteria as defined in clause 2.2.3 of volume - 1 shall remain applicable. Kindly ammend the clause of volume 2.	Vol I shall prevail
83	Volume II/ Section- 4	2.4.3 Page- 97 of 555	Pipe/Cable trench - Not applicable	Cable trenches in transformer yard in line with Vol IV-A, Section-1, Cl. 1.8.1.e shall be allowed	Provisions of Vol IV A Section 1 Cl 1.8.1 is applicable for transformer yard only.
84	Volume-II/Section- 4	5.1.1 (Page 103)	False flooring and ceiling	False ceiling may be provided only in the Central control room, Offices, training rooms. Other areas like switchgear rooms, MCC rooms etc. false ceiling will not be considered. Please confirm.	False ceiling shall be provided as per Volume VI A section 4 clause no. 4.1c & clause no. 6
85	Volume II/ Section- 4	Annexure-C 5.1.7 Page- 104 of 555	The Control Room lighting shall be designed to provide a glare free uniform illumination. The level of illumination shall be minimum 400 LUX.	We are considering 300Lux in line with Vol IV-B, Section 7, Cl. 5.4.4.1.e	Refer Corrigendum-II, vol.II.

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT**Pre - Bid Queries****Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II**

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
86	4	6.1.4	Floor slabs	The requirement for space between floor slabs is not applicable for cable vault/cellar, MCC rooms, office areas. Please confirm.	For cable vault, the clear distance will be 3.5 m . For the rest, Bid specification shall prevail
87	Volume-II/Section-4	6.1.4 (Page 69)	The minimum clear height available between two consecutive floor slabs shall not be less than five (5) meters.	The clear gap between two consecutive floor slabs shall be based on functional requirement and minimum 3.5m shall be provided.	For cable vault, the clear distance will be 3.5 m . For the rest, Bid specification shall prevail

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Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
88	4	6.1.5	Multistorey bldg - Staircase	The number of staircase for multistorey building depends on the floor area. For smaller buildings, example single storey cable cellar+MCC room or control room, single staircase is adequate. In general the provision of number of staircase would follow TAC and relevant Indian building codes. Please review and confirm	Bid specification prevails
89	Vol II - Section 4	6.1.9	Cable racks / pipe racks shall have hand railings in walkways on both sides 'at appropriate heights.	We propose to provide single walkway with handrails on each tier.	Pipe / cable rack shall have single walk ways @centre of each tier.
90	Vol II - Section 4	6.1.9	Concept of various mechanical and electrical equipment location and building dimensions (including column-row spacing) as shown in Plot Plan/Floor Plan drawing are to be adhered as far as possible. Any departure from this suggestive layout is primarily not recommended.	Layouts and floor plans are machine specific and therefore, as per our standard practice/machine design, the TG building and Boiler layout will be different than what has been provided in the specification. For example, front mill configuration layout is completely different than what has been shown in your lay out which is on the basis of side mill orientation. Hence, if the layout meets the specific criterion of operation and maintenance space/requirements, same shall be accepted.	Bid Specification shall prevail
91	4	6.1.10	Concept of various mechanical and electrical equipment location and building dimensions (including column-row spacing) as shown in Plot Plan/Floor Plan drawing are to be adhered as far as possible. Any departure from this suggestive layout is primarily not recommended.	Statement is not clear. Owner to clarify if changes in building size, column-row spacing with respect to tender specs in view of techno-economic optimization is permitted.	Specification is self-explanatory

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Pre - Bid Queries

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
92	4	6.2.2	Mill and bunker building	We understand that being EPC contract, the Bidder is allowed to provide the dimensions of the mill building (width and length) different from those specified meeting the equipment requirements and complying with the layout guidelines of the specification. Please confirm.	Bid specification prevail
93	Vol II - Section 4	6.2.2	Mills shall be located by the side of Boiler. The width of Mill/Bunker building shall be 12.5 M and the length of the same shall be 10.5 M per Mill. A clear walkway of 1200 mm (min) shall be ensured between the mills/ its foundation/ mill reject vessel edge and inner face of mill bay column. Raw coal bunker shall be circular in shape unless otherwise approved.	As explained above, as per our standard practice, the Boiler is with Front mill/bunker arrangement in D - E bay and hence, layout shall be done accordingly. The advantage in this layout is obvious and would reduce capital cost substantially.	Bid specification prevail
94	4	6.2.9	Walkway	We request you to revise the dimension to 400 mm from column face instead of 600 mm as it is difficult to achieve at the column locations.	Bid specification prevail
95	4	12.0	Sec - 4 Cold start-up > 50 Hrs Warm Start-up 10 - 50 Hrs Hot Start-up < 10 Hrs Sec - 8 > 36 Hrs 8 - 36 Hrs < 8 Hrs	Client to note that there is a difference between the definitions of various start-up conditons as per section - 4 of the technical specification and as per section - 8 of the technical specification. Kindly resolve the discrepancy. Also refer to section 8 and clause 1.4.17 (a)	Clause No. 12.0 section -4 prevails.

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Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
96	4	12.0	PLANT LIFE AND MODE OF OPERATION (a) Cold start-up (>50hrs. shutdown): 20 per year (b) Warm start-up (between 10 to 50 hrs. of shutdown): 140 per year (c) Hot start-up (Less than 10 hrs. shutdown): 180 per year	"(a) Cold start-up (>~~36 50~~hrs. shutdown): 20 per year (b) Warm start-up (between ~~8 10~~ to ~~36 50~~ hrs. of shutdown): 140 per year (c) Hot start-up (Less than ~~8 10~~ hrs. shutdown): 180 per year" Reason: We understand start-up mode are described above according to Vol.II Section-8 clause 1.4.17 (GUARANTEES UNDER CATEGORY-III). Please confirm.	Clause No. 12.0 section -4 prevails.
97	Volume-II/ Section-4	12	The complete plant including all the equipment and systems individually and collectively shall be designed for continuous operation for an economic service life of thirty (30) years under the prevailing site conditions and for the type of duty intended. The allowable stresses shall be so selected so that life expectancy to minimum 2,00,000 hours of operation can be achieved.	Pressure parts material will be selected as per ASME using ASME published stress values which is considering 1,00,000 hrs creep life. With this approach, Bidder confirms that boiler will give expected life span of 30 years.	Bid Specification prevails.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
98	1	Volume-II/ Section-4/12	The unit would be operated on base load with cyclic load variation. The load variation is expected to be as per schedule depending on power demand. The units shall also be suitable for two shift operation, if required	We understand that the unit will be base loaded and would be operated as per the number of starts mentioned in Vol II Section-4, Cl. No. 12.0, Page 76 of 555. Hence, we do not foresee the plant being operated in a two shift operation.	Confirmed
	1	Volume-III B/ 5.6	Turbine shall be suitable for two cycle shift operation.		
	1	Volume-III B/ Datasheet A 1.6 C	Two shift operation and cyclic load variation. The steam turbine generator unit will normally operate as base load unit and in parallel with grid.		
	1	Volume-III B/ 3.1	The steam turbine generator unit will normally operate as base load unit and in parallel with grid.		
	3	Volume-III B/ 3.1.23	The plant is designed for base load service.		
	3	Volume-III B/ 3.4			
99	4	15	All paintings shall be used in accordance with the manufacturer's instructions. No thinners or other substances shall be added to the coating material without the approval of the engineer. The quality and vendor of the paints shall require approval of the owner.	Bidder has its own proven practices of painting & ensuring its quality which is based on the manufacturer's feedback and best engineering practices. We request you to remove approval of owner / engineer as mentioned.	Bid Specification prevails.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
100	4	15.4	The contractor shall select the type and colour of primer & finish coat after approval by the owner.	Bidder has its own proven practices of painting & ensuring its quality which is based on the manufacturer's feedback and best engineering practices. We request you to remove approval of owner / engineer as mentioned.	Bid Specification prevails.
101	Volume-II/Section-4	Corrigendum-1 6.1.6 (Page 70) 6.00 (Page 104)	Toilets and drinking water facility	As per standard power plant practices, toilets are not provided for unmanned buildings like e.g. DG building, Compressor building, Transfer points of CHP, etc. Please confirm.	Bid Specification prevails.
102	4	17.1	MoEF requirements	If there are any conditions for the project provided by MoEF, same shall be informed along with the specification. If any new conditions arise after the contract award which call for changes to the agreed contract specifications, same shall be subject to mutual agreement between Owner and contractor.	Bid specification prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
103	Vol II - Section 4	17.1	In case the Ministry of Environment & Forest stipulates any other conditions not specified hereunder while clearing the project, same shall be complied with by the Contractor.	This shall be complied if it is technically feasible and with price implications. However, if any changes happen, this shall be mutually discussed and finalized.	Bid Specification shall prevail
		17.2.3	Any statutory changes in stipulations regarding noise limitation that may occur in future according to Maharashtra Pollution Control Board or Central Pollution Control Board or Ministry of Environment & Forest regulation during tenure of the contract, the Contractor shall comply with the requirement.		
104	4	17.1.1b	PCB requirements	If there any specific requirements of State Pollution Authorities please inform the same with the specification.	Bid specification prevail
105	4	17.1.2c	SO2	Please review requirement for World Bank Standards for SO2. We request that this requirement be deleted.	MOEF guideline to be follow for SO2

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
106	4	17.2.1	Maximum noise level shall not exceed 85 dB (A) when measured at 1.0 M away from the noise emission source.	We understand that the specified requirement refers to the maximum surface sound pressure level emitted by the equipment at a distance of 1m, and at a height of 1.5m above normally accessible walkways and platforms. As per definition of ISO 3746, the surface sound pressure level of an equipment / installation at a distance of 1m corresponds to the average noise level emitted by this equipment in free field conditions, on a measurement surface which envelops the equipment at a distance of 1m. According to this standard, the in-situ measured noise levels must be therefore corrected for both influences of the background noise and sound reflections (especially inside buildings), in order to determine the surface sound pressure level of the equipment. Please confirm our understanding is correct. Noise measurements will be carried out during the continuous operation of the Plant at base load, which corresponds to the most significant operating conditions in terms of noise emissions.	Shall not exceed 85 dB(A) 1.0 m equipment outline.
107	Volume II Section 4	17.2.1	Maximum noise level shall not exceed 85 dB (A) when measured at 1.0 meter away from the noise emission source.	Noise level may exceed 85 dB(A) at 1.0 m distance during transient/abnormal conditions.	Shall not exceed 85 dB(A) 1.0 m equipment outline.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
108	4	17.2.2	Maximum noise level from its source within the premises shall not exceed 70 dB (A) as per Environment (Protection) Rules 1986, Schedule-III, 'Ambient Air Quality Standards' in respect of noise.	We understand that the overall noise level emitted by the Plant equipment during normal continuous operation, excluding the ambient background noise level caused by other external sources, shall not exceed 70 dB(A) at the Site property line in accordance with MoEF and CPCB rules. Please confirm.	Shall not exceed 85 dB(A) 1.0 m equipment outline.
109	4	17.2.3	Any statutory changes in stipulations regarding noise limitation that may occur in future according to Maharashtra Pollution Control Board or Central Pollution Control Board or Ministry of Environment & Forest regulation during tenure of the contract, the Contractor shall comply with the requirement. An exception will be made for the plant at startup operations and other big pressure reducing devices operating during emergency periods and for the safety valves.	For the design of the Plant, ALSTOM can consider the statutory requirements regarding noise limitation, which are in force at the signing of the Contract and will be binding..	Bid specification prevail
110	4	17.2.3	Statutory changes	If there any statutory changes resulting in modifications to the specifications after the contract award, implementation of the same shall be subject to mutual agreement between Owner and contractor. It is not practically possible to predict and assume compliance to future statutory changes.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
111	4	18.1.1	The comprehensive list of tests considered for each of the equipment/ systems shall be furnished as part of the bid.	Tests shall be conducted as per bidder's standard and proven practice. Bidder ensuring quality by giving reference of same model running world wide. Please confirm acceptance of bidder's standard and proven practice.	Bid Specification shall prevail
112	4	18.1.1	An indicative list of inspection and testing requirements for each package has been given for equipments across various volumes of this specification. Bidder shall note that these testing and inspections listed herein are the minimum requirements as perceived by the owner; the bidder shall consider this only as a general guidance and is not meant to be exhaustive. The bidder shall consider requisite testing and inspections across the equipments/systems forming the proposed power plant unit based on his own experience and in line with the current industry practices for identically rated power plant for the technology under consideration. The comprehensive list of tests considered for each of the equipment/system shall be furnished as part of the bid.	Standard ITP/QAP for major/critical items only shall be submitted as part of the bid.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
113	4	18.2.3	Before any item of plant or equipment leaves its place of manufacture, the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards. Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Contractor may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.	As per bidder's standard practice, witness points agreed with the customer are entered in the final negotiated versions of the I & T Program. The customer or his acceptance authority will be informed of the readiness for such witnessing within the period agreed upon. If in case of inspections defined as witness points, the witnessing party is unable to participate on the announced date, the inspection will be performed by an internal inspection unit, independent of manufacturing, and the work will be continued. In case of acceptance tests by official authorities, the work will be stopped until the witnessing party is able to attend. In case of inspections defined as customer hold points, the work will be stopped until the witnessing party is able to attend or witnessing is officially waived. Delays resulting from failure to respond to the notification will not be the responsibility of bidder's. In addition, the I & T Program contain information with regard to the type of quality records: for internal purpose only or quality record handed over to the customer as part of the final documentation, on completion of the contract supply. Please confirm acceptance of bidder's standard and proven practice.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
114	4	18.2.4	The contractor shall forthwith forward to the engineer duly certified six(6) copies of the Test Certificates.Distribution of six(6) copies of test certificates for approval will be two(2) copies to owner and four(4) copies to consultant.These four(4) copies will be further distributed by consultant after approval to owner,site and bidder.one copy will be retained with the consultant for record purpose. Further ,nine(9) copies of shop test certificates shall be bound with instruction manuals referred to elsewhere.Distribution of nine(9) copies of shop test certificates for approval will be Two(2) copies to owner,Three(3) copies to site,Two(2) copies to consultant,Two(2) copies to owner's library /record.	The documentation requirement are specified in varying nature,may be considered with submission of one set in soft form and two sets in hard form.	Bid Specification shall prevail
115	4	18.2.5	Under no circumstances any repair or welding of castings shall be carried out without the consent of the engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the engineer.	Bidder follows the proven Inspection & Test programmes for weld repair of the castings. Proof of the effectiveness of each major repair by non-destructive testing technique, shall be provided to the engineer.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
116	4	18.2.6	All the individual and assembled rotating parts shall be statically and dynamically balanced in the works. Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Contractor shall allow for trial assembly prior to despatch from place of manufacture.	All rotors are completely assembled and balanced at 20% overspeed prior to shipment. Please confirm acceptance of bidder's proven practice.	Bid Specification is self-explanatory.
117	4	18.2.7	All materials used for the manufacture of equipment covered under this specification shall be of tested quality.	Please clarify the intent of specification. Whether material as per code specification is acceptable.	Bid Specification shall prevail
118	4	18.2.8	All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour.	client to note that as per ASME B 31.1 the requirement of hydrotesting of the piping shall be 1.5 x design pressure. The pressure shall be continuously maintained for a minimum time of 10 min and may then be reduced to design pressure and then held for such time as may be necessary to examine leakages. Bidder requests Client to kindly amend the hydrotesting requirement inline with the code requirement.	Bid Specification shall prevail
119	4	18.2.8	All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour	Please clarify if the testing in accordance with codes / standards are acceptable.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
120	Volume II/ Section-4	19	The Contractor shall extend all possible assistance and co-operation to the Owner regarding the transfer of technology and developing expertise in the area of engineering operation and maintenance of the Plant.	The bidder shall extend possible assistance and co-operation to owner for supercritical Boiler / Turbine for operation and maintenance of the Plant. However the technology (supercritical Boiler / Turbine technology) is proprietary in nature shall not be transferred to owner.	Bid Specification prevail ; Reg Technology transfer, CI No. 45, Section 2 Volume 1 shall prevail.
121	4	ANNEXURE-A	List of standards for reference	Bidder requests client to include EN (European Standards) in the list.	Agreed.
122	4	Ann-A	List of codes/standards	The following codes/standards may also be added: a) EN b) AWWA c) VDI/VDE d) GB or eqvt	EN, AWWA and VDI/VDE are acceptable.
123	Vol II - Section 4	/ Annexure-A	List of Standards for reference	AWWA should be included	Agreed
124	4	Annexure-C, 3.0	OTHER MAINTENANCE REQUIREMENT In case the Generator stator cannot be handled by the turbine house crane, all provisions for its overhauling, including the arrangement to slide the stator on the turbine house floor, the foundation work for stator jacking / lowering assembly, dismantling of building end walls / structures etc. shall be kept.	We would like to clarify that if Strand Jack Arrangement is opted for lifting of generator stator, provision of strand jack for stator lifting shall be provided only during erection and no such provision for generator stator handling shall be provided during normal maintenance of the generator stator.	Agreed.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
125	4	Sl. No. 5.1.3(Annexure C)	Control room	The portion of floor area for control consoles/panels in the control room (indicated as 15% now) appears very low. Please review. This could be around 25-30% of floor area.	Bid Specification prevails
126	4	ANNEXURE-D	While developing the layouts, the following major layout parameters shall be ensured, as a minimum:	Being EPC Bid, Bidder shall be given flexibility to optimise layout at Bidding stage, Please confirm.	Bid Specification shall prevail
127	4	ANNEXURE-D	Floor levels in AB bay-- 0.0M,9.0M,17.0M	Floor levels at AB bay shall be 0.0M,8.5M,17.0M as per std practise. Please confirm	
128	4	ANNEXURE-D	Floor levels in BC bay-- 0.0M,9.0M,17.0M	Floor levels at BC bay shall be 0.0M,8.5M,17.0M as per std practise. Please confirm	
129	4	ANNEXURE-D	Level of Mezzanine floor 9.0m	Mezzanine floor shall be 8.5m as per std practise. Please confirm.	
130	4	ANNEXURE-D	TDBFP at Operating Floor and MDBFP at Ground Floor in AB Bay	TDBFP at Operating Floor and MDBFP at Mezzanine Floor in AB Bay	Bid Specification prevails
131	Vol II - Section 4	Specific Layout considerations (Annexure-D) Sr No. 1.0	AB bay, BC & CD bay widths : 36.0 M, 12.0 M & 12.0M	In line with OEM design and present ongoing Mahagenco project, we propose the turbine building bay width shall be as under: AB bay : 32.0 M, BC & CD bay widths : 12.0 M These dimensions are based on well established practices which meets all O&M criteria. It may also be noted that during recent bulk tender from NTPC, AB bay width has been asked as 29m. The overall cost of the project will unnecessarily increase if dimensions as specified are retained. OEM specific layout meeting specific O&M space requirement should therefore be accepted.	Bid Specification prevails

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
132	Vol II - Section 4	Specific Layout considerations (Annexure-D) Sr No. 4.0, 11.0, 12.0 & 13.0	Floor levels in B-C bay : 0.0 M, 9.0 M, 17.0 Location of Deaerator : In BC bay at 38.0 M HP Heaters/LP Heaters at Operating Floor/ Mezzanine Floor respectively in B-C Bay. TDBFP at Operating Floor and MDBFP at Ground Floor in AB Bay.	Floor levels and equipment location shall be decided based on layout concept indicated above for an optimal solution.	Bid Specification prevails
133	Vol II - Section 4	Specific Layout considerations (Annexure-D) Sr No. 15.0	Clear Head room within Main plant Building for pipes, structures & cable trays, ducts etc. : 2.5 M	Refer 1.2.1 & 1.2.2 of Annexure-C. We suggest 2.0 M head room clearance be also accepted.	2.5 m shall be minimum
134	4	Annexure-D, SR no 15	Clear Head room within Main plant Building for pipes, structures & cable trays, ducts etc. : 2.5M	Refer Vol II, Section 4, Annexure-C, Sr no 1.2(page 99 of 555), head room is specified as 2.0M. Please clarify actual requirement.	2.5 m shall be minimum

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
135	5	1.12	Apart from Boiler, proper chemical cleaning shall be carried out in following pipe lines/equipment before commissioning (a) Deaerator (b) Boiler feed suction, recirculation leak-off lines (c) Boiler Feed discharge line by passing heaters (d) Attenuation lines (e) Condensate suction & discharge piping upto de-aerator by passing the feed water heaters. (f) Fuel oil lines.	a. Deaerator will be cleaned manually. As per recommended practice, we are not taking Deaerator in chemical cleaning circuit. b. Boiler feed suction and recirculation leak-off lines will be cleaned by DM water flushing. As per recommended practice, we are not taking these pipelines in chemical cleaning circuit e. Condensate suction pipeline will be cleaned by DM water flushing. As per recommended practice, we are not taking this pipelines in chemical cleaning circuit. f. Fuel oil pipelines will be cleaned by Oil flushing followed by air blowing. As per recommended practice, we are not taking this pipelines in chemical cleaning circuit.	Bid Specification prevails
136	5	1.13	...Supply of LDO, chemicals, lubricating oils upto COD.	Please clarify the scope of LDO. LDO is startup fuel and the same should be in scope of the Owner same as coal and HFO	Clause stands deleted. Refer Volume - I
137	5	1.14.10	The successful bidder shall arrange for tower cranes as per requirement for speedy erection activities	Tower crane is not suitable for our erection philosophy. Hence this may not be treated as an essential requirement.	Bid Specification prevails

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
138	5	1.16.12	Preservation of all materials / equipment under custody of the Contractor during storage, pre-assembly & erection, commissioning etc shall be the responsibility of the Contractor. All necessary preservatives and consumables like paints etc shall be arranged by the Contractor. Necessary touch up painting, periodic application of preservatives/ paints on pressure parts/other equipment even after erection until completion of work shall be carried out by the Contractor. The Contractor shall fabricate piping, install lub oil systems and carry out the acid cleaning of fabricated piping. The Contractor shall also service the lub oil system, carry out the hydraulic test of oil coolers etc.	Lub oil pipelines will be cleaned by Oil flushing followed by air blowing. As per recommended practice, we are not taking this pipelines in chemical cleaning circuit.	Agreed
139	6	6.6	Upon review, the Owner/Engineer shall put his remarks and one of the following action stamps on the drawing/ document:	Please clarify the details of category (a), (b), (c) and (d).	Will be finalised during post-award meeting.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
140	7	2.4	The Bidder shall also furnish copies of the reference documents / plant standards / acceptance norms/tests and inspection procedure etc as referred in Quality Plans along with Quality Plans. These Quality plans and reference documents/standards etc shall be subject to Owner's approval without which manufacture shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans, Owner/Authorised representative shall identify Customer Hold Points (CHP), test/ checks which shall be carried out in presence of the Owner's Engineer or his authorised representative and beyond which the work will not proceed without consent of Owner/Authorised representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner/ Authorised representative for approval and disposal.	1. ITP's shall be submitted to client for identification of Witness Points/ document submission points. Referenced documents in I&T plan will be available at shop for reference at the time of inspection 2. No Customer Holding Point's are offered. Only 'Witness Points' are offered which shall be finalised with customer during pre-award stage. 3. Bidder has proven test plans/procedures. Bidder shall provide reference to the relevant extracts of the acceptance criterion/procedure for the test/inspection.	Will be discussed during detailed engineering.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
141	7	2.4	The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedures etc as referred in Quality Plans along with Quality Plans. These Quality plans and reference documents/standards etc shall be subject to owner's approval without which manufacture shall not proceed.	Bidder has proven test plans/procedures. As test plans are proprietary to bidder, bidder shall provide reference to the relevant extracts of the acceptance criterion/procedure for the test/inspection. Please confirm acceptance of bidder's standard and proven practice.	Bid Specification prevails
142	7	2.8	All brazers, welders etc employed on any part of the contract at Contractor's/ Sub-Contractor's works or at site shall be qualified as per ASME Section-IX or BS-4871 or equivalent international standard approved by the Owner. Such qualification tests shall be conducted in presence of Owner/his authorised representative.	Procedure Qualification / Welder qualification records at shop will be available for reference at shop. Site welder qualifications shall be furnished to client for approval.	Bid Specification prevails
143	7	2.8	All brazers ,welders etc employed on any part of the contract at contractors/sub contractors works or at site shall be qualified as per ASME section IX or BS4871 or equivalent international standard approved by the owner.Such qualification tests shall be conducted in presence of owner/his authorised representative.	Pre qualified welders/brazers with qualification data are considered as qualified welders/brazers.	Bid Specification prevails

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
144	7	2.9	All Non-Destructive Tests (NDT) shall be carried out in accordance with approved International Standard. The NDT operator shall be qualified as per SNT-TC-IA (of American Society of non-destructive examination). Results of NDT shall be properly recorded and submitted for approval.	The NDT operator shall be qualified as per SNT-TC-IA (of American Society of Non-destructive examination) / EN/ Equivalent.	Will be discussed during detailed engineering.
145	7	2.13	Repair/rectification procedures to be adopted to make any job acceptable shall be subject to the approval of the Owner.	Repairs/ rectification shall be done as per manufacturers recommendation.	Bid Specification prevails
146	7	4.2	The Contractor shall give the Engineer/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Engineer/Inspector, unless the witnessing of the tests is virtually waived shall attend such tests within fifteen (15) days of the date on which the equipment is notified as being ready for test/inspection failing which the Contractor may proceed with test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified Six (6) copies of test reports.	We propose to keep the same as 10 days or less as it has been in case of earlier projects. 15 days for each and every stage would delay the process on a large extent.	Clause stands deleted;Regarding notice for inspection, provision of CI 3, Section 2A Volume I prevail.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
147	7	4.3	The Engineer or Inspector shall within fifteen (15) days from the date of Inspection as defined herein give notice in writing to the Contractor, on any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall confirm in writing to the Engineer/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.	We propose to keep the same as 10 days or less as it has been in case of earlier projects. 15 days for each and every stage would delay the process on a large extent.	Reg notice for inspection, provision of Cl 3, Section 2A Volume I prevail.
148	7	4.4	When the factory tests have been completed at the Contractor's or sub-contractor's works, the Engineer/Inspector shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Engineer/ Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Engineer/Inspector. Failure of the Engineer/ Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.	We propose to keep the same as 10 days or less as it has been in case of earlier projects. 15 days for each and every stage would delay the process on a large extent.	Clause stands deleted;Regarding notice for inspection, provision of Cl 3, Section 2A Volume I prevail.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
149	7	2.8	For welding of pressure parts and high pressure piping, the requirements of IBR shall also be complied with.	For all IBR pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulation) shall be essentially complied with. However, other piping shall be as per relevant code.	Specification is self-explanatory

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
150	7	Annexure A	FORMAT OF QUALITY ASSURANCE PROGRAMME ANNEXURE - A	We understand that referred format is for Manufacturing quality plan. Bidder requested the following approach on quality (I & T) Plans a. For bidder's equipment (Turbine, Generator, auxiliaries, Heat exchangers, DCS) - The ITPs/ status will be provided as per Bidder's standard formats. It is not feasible to transfer these into NTPC's format b. For BOP equipment, Quality plans shall be submitted in Annexure A- format	Bid Spec prevails
151	7	2.5	No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of all previous tests/inspections by Owner's Engineer/Authorised representative and duly authorised for despatch issuance of Material Despatch Clearance Certificate (MDCC).	The requirement of MDCC shall be limited to only major equipment, the list of which can be agreed upon as part of billing break-up. For such equipment, final certificate shall be provided for purpose of issuance of MDCC. MDCC to be obtained from the customer for the major subsystems before dispatch from the factory / Supplier to the site.	Clause 4., Section 2A Volume I prevail.
152	8	1.1.8 (III)	The P. G. test shall be carried out within four (4) months after first synchronisation. If the P.G. test is conducted beyond four (4) months from first synchronisation due to any reason attributable to Owner, the deterioration in performance shall be increased by the following amount for each month or part of the month by which the period between the first synchronisation and PG test exceeds four (4) months. (i) 0.1 % for the following eight (8) months (ii) 0.06 % for the period following thereafter.	As per tender specification P. G. test shall be carried out in line with ASME PTC 6. Aging shall be considered in line with ASME PTC 6 Report. We request you to accept the bidders proposal.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
153	8	1.2.1	Efficiency of the steam generator at 100% TMCR while firing the design coal at rated steam parameters, rated coal fineness and rated excess air.	We propose to offer, Plant gross cycle heat rate at 100% TMCR (taking into account the steam generator efficiency) with 0% make-up, generator power factor of 0.85, design cooling water inlet temperature and Design coal firing (based on GCV) at rated steam parameters. For Steam parameters refer our comments/ queries raised in the pre-bid queries lotI/II. We request you to accept our proposal.	Bid Specification prevails
154	8	1.2.3	Guaranteed Turbine Cycle Heat rate in kCal/kWh under rated steam conditions, design condenser pressure with zero make up at 100% and 80% rated load. A weightage of 4 (four) and 3 (three) shall be considered for 100% and 80% heat rate values for arriving at the net heat rate.	As per Vol I, Section 3, Cl. no. 6.3, LD is applicable on Gross TG heat rate guarantee at 100% TMCR. As per Vol I, Section 1, Cl. no. 19, evaluation loading is applicable on 100% unit load at generator terminals. Also As per Vol. I, Section 1, Schedule 7 maximum gross TG Heat rate to be guaranteed. However as per this clause weightage average shall be considered for 100% and 80% heat rate values for arriving at the net heat rate. In our opinion, plant gross heat rate for EPC contract should be applicable. Please confirm.	Bid Specification shall prevail
155	8	1.2.3	Heat rate	We understand that the heat rate to be guaranteed is the gross turbine cycle heat rate. The formula for weighted average heat rate is expected to be as below $- (4 \times \text{HR}(100\%) + 3 \times \text{HR}(80\%)) / 7$ Please confirm	Confirm

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
156	8	1.2.4	Guaranteed Continuous TG output under rated steam conditions, design condenser pressure with zero make-up. Note: The condenser pressure while conducting the guarantee tests shall be measured at 300 mm above the top row of condenser tubes.	We propose 100% Gross STG power output with 0% make-up and with design cooling water inlet temperature generator power factor of 0.85 excluding excitation power, and Design coal firing (based on GCV) at rated steam parameters. We request you to accept our proposal.	Bid Specification prevails
157	8	1.2.4	GUARANTEES UNDER CATEGORY-1 Guaranteed Continuous TG output under rated steam conditions, design condenser pressure with zero make-up.	"Guaranteed Continuous TG output <u>at 100%TMCR</u> under rated steam conditions, design condenser pressure with zero make-up." Reason: We understand TG output of 100% TMCR is the guarantee item. Please confirm.	Confirmed

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
158	8	1.2.5	The total auxiliary power consumption for all specified plant auxiliaries (as listed in Volume- I, Section -3) required for continuous unit operation at 100% of rated load under rated steam conditions and at design condenser pressure with 1% make-up.	(1) As per Vol II, Section 8 cl. no. 1.2.5 for Performance Guarantee Schedule, 1% make up to be considered for auxiliary consumption. (2) As per Vol. I, Sec 3, cl. no. 6.3 for LD and Vol. I, Sec 1, cl. no. 19.1 for Loading for Bid Price, Auxiliary consumption are given in per kWh basis, however as per Vol. I, Sec. 1, Schedule 7 for guarantee schedule 7, auxiliary consumption is to be guaranteed in kW. (3) As per Vol. I, Sec 3, cl. no. 6.3 for LD and Vol. I, Sec 1, cl. no. 19.1 for Loading for Bid Price, the auxiliary consumption is to be considered at 100% TMCR condition, however in the description of list of auxiliaries to be considered (Vol. I, Sec 3, cl. no. 6.3), it is specified that the individual plant and equipment are to be considered at full load/capacity / design capacity. Please clarify the requirement. In view of above, we propose following for auxiliary power consumption, The total auxiliary power consumption for all specified plant auxiliaries (as listed in Volume- I, Section -3) required for continuous unit operation at 100% of rated load under rated steam conditions and with 0% make-up, generator power factor of 0.85, design cooling water inlet temperature and Design coal firing (based on GCV).	1). Auxiliary Power Consumption shall be at zero % make up. 2). KWh is an error; it shall be read as kW. 3).The auxiliary power consumption shall be considered at 100 % TMCR

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
159	8	1.2.5	GUARANTEES UNDER CATEGORY-1 The total auxiliary power consumption for all specified plant auxiliaries (as listed in Volume-1, Section- 3) required for continuous unit operation at 100% of rated load under rated steam conditions and at design condenser pressure with 1% make-up.	"The total auxiliary power consumption for all specified plant auxiliaries (as listed in Volume-1, Section- 3) required for continuous unit operation at 100% of rated load under rated steam conditions and at design condenser pressure with <u>zero 1%</u> make-up." Reason: We understand auxiliary power consumption is guaranteed with zero make-up condition according to Vol.I Section-1 clause 19.1 Sr. No.4 and Vol.I Section-3 clause 6.3 Sr. No.1. Please confirm.	Confrimed
160	8	1.4.1	Steam generator parameters with Blended Coal: The steam generator shall be run continuously for 168 (one hundred and sixty eight) hours with blended coal at 70:30 ratio between domestic coal and imported coal for demonstration of stable operation at rated parameters.	The proposed boiler is suitable for firing blended coal comprising 70% Indian coal & 30% imported coal. However, customer to specify the Proximate analysis, Ultimate analysis, GCV, HGI, & Ash analysis of such fuel blend & install scientific blending plant such that during demonstration test, the test fuel blend conforms to the specified fuel blend.	Please refer coal analysis furnished in corrigendum-II
161	8	1.4.1	Steam generator parameters with Blended Coal : The steam generator shall be run continuously for 168 (one hundred and sixty eight) hours with blended coal at 70 : 30 ratio between domestic coal and imported coal for demonstration of stable operation at rated parameters.	Steam generator shall run continuously during trial opration as per vol. I sec 2 (GCC), cl. No. 37.3. Since the trial run operation covers the requirement specified in this guarantee, hence separate demonstration guarantee is not required. We request you to delete the requirement of category III guarantee.	bid specification prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
162	8	1.4.2	Steam turbine generator rated capacity at 89 mm Hg Condenser pressure.	Simulating the condition of maximum condenser pressure at site and operating plant for demonstration of this guarantee is difficult. The mechanism for demonstration of the test shall be discussed and evolved during detailed engineering stage and test if required shall be done during the commissioning test and not under demonstration guarantee. We request you to delete the requirement of category III guarantee.	Since condensing and cooling water system parameters are bidder specific, this aspect will be reviewed after review of heat balance conceived by the bidder.
163	8	1.4.3	Run back capabilities. The automatic runback capability of the unit (boiler-turbine-generator) on loss of critical auxiliary equipment (such as tripping of one ID/FD/PA fan/airheater/BFP/ CEP etc) shall be demonstrated ensuring smooth and stable runback operation.	These capabilities of the plant can be checked as a part of commissioning test and hence request you to delete the requirement of category III guarantee.	bid specification prevail
164	8	1.4.4	Rate of change of load and sudden load change withstand capability The capability of boiler-turbine-generator in regard to ramp rate and step load change as specified shall be demonstrated.	These capabilities of the plant can be checked as a part of commissioning test and hence we request you to delete the requirement of category III guarantee.	bid specification prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
165	8	1.4.5	Mill capacity at rated fineness Performance testing shall be done on coal mills toward establishing its capacity specified at the rated fineness, applying corrections for the variation in coal characteristics i.e. HGI (Hardgrove Grindability Index) and total moisture. Capacity demonstration test shall be carried out for the following conditions: (a) Capacity output of one coal pulverizer (of Owner's choice) shall be demonstrated for establishing its capacity at 100% mill loading, at rated pulverized coal fineness with specified design coal with new set of grinding elements. (b) Capacity output shall also be demonstrated on four coal pulverizers (of Owner's choice) of Steam Generator, not less than the 90% of guaranteed value of (a) above, at 100% mill loading with the originally installed grinding elements in nearly worn-out condition or at the end of guaranteed wear life of grinding elements, whichever is earlier. Capacity test as mentioned at (a) & (b) above shall be demonstrated at the following conditions occurring simultaneously during testing: Coal fineness Not less than 70% through 200 mesh and not less than 99% through 50 mesh screen Test Coal Any available coal from the specified range In case the guaranteed	Fineness through 50 mesh shall be 98%.	bid specification prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
			capacity of coal pulverizers as stated above are successfully demonstrated, remaining coal pulverizers will also be considered to have successfully met the above capacity guarantee requirement. However, in the event of any of the coal pulverizers not meeting the guarantee test, all the coal pulverizers will have to be tested to demonstrate guaranteed capacity.		
166	vol- II,sec-8, pg 169-555	1.4.5	Capacity demonstration test shall be carried out -----	Capacity test of ONE mill at rated capacity (i.e 90% of the Mill max. theoretical capacity) will be done for establishing its capacity at rated pulverized coal fineness (i.e 70% through 200 mesh and 98% through 50 mesh) and specified "design coal", applying corrections for variation in HGI, Moisture and PF Fineness. The capacity test shall be done in ONE Mill after 3000 hours of Mill Operation.	bid specification prevail
167			a) Capacity output of one coal pulveriser -----100% mill loading at rated pulverised coal fineness with specified design coal with new set of grinding elements		bid specification prevail
168			b)Capacity output shall also be demonstrated on four coal pulveriser --90% of the guaranteed value of (a)--- in nearly worn out condition or at the end of guaranteed wear life of grinding elements whichever is earlier.		bid specification prevail
169	vol-II, sec-8, pg-170-555	1.4.5	Capacity test as -----during testing	Capacity shall demonstrated at the following conditions coal fineness : 70% through 200 mesh and 98% through 50 mesh at specified "design coal", applying corrections for variation in HGI, Moisture and PF Fineness, where required.	Bid Specification prevails
170			Coal Fineness : not less than 70% through 200 mesh and not less than 99% through 50 mesh.		

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
171			Test coal : Any available coal from the specified range.		
172	vol-II, sec-8, pg-169-555	1.4.5	Performance testing shall be done on each mill towards establishing its capacity specified at the rated fineness, applying corrections for the variation in coal characteristics, i.e HGI & Total Moisture.	Capacity test of ONE mill at rated capacity (i.e 90% of the Mill max. theoretical capacity) will be done for establishing its capacity at rated pulverized coal fineness (i.e 70% through 200 mesh and 98% through 50 mesh) and specified design coal, applying corrections for variation in HGI, Moisture and PF Fineness, where required.	
173	8	1.4.6	Life of mill wear parts Life of mill wear parts, in hours of operation, for the entire range of coal characteristics specified.	Wear life for grinding elements shall be 6000 hours with a coal of max. 50 YGP. Correction curve supplied by MILLS shall be used if actual coal being grinded is of a higher YGP. Wear life shall be defined as achievement 100 mm of wear on grinding rolls and 45 mm of wear on BRS.	bid specification prevail
174	8	1.4.7	No fuel oil support above 30% BMCR load It shall be guaranteed that oil support for flame stabilization shall not be required beyond 30% of BMCR load when firing the coals from the range identified. It shall be demonstrated that with any combination of mills/ adjacent mills in service, the steam generator does not require any oil firing for stable and efficient boiler operation at and above 30% BMCR loads.	The minimum stable load without fuel oil support shall be 40% of BMCR load, with two adjacent mills in service and mill loading not less than 50%	bid specification prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
175	8	1.4.8	Performance characteristics of fans The performance characteristics of FD, ID and PA fans including their capacity, head developed, power consumption and margins envisaged on capacity and head shall be demonstrated.	These capabilities of the plant can be checked as a part of Routine Test/ Shop Test or Commissioning test and hence we request you to delete the requirement of catagory III guarantee.	bid specification prevail
176	8	1.4.9	Equal load sharing of pumps/fans while running in parallel shall be demonstrated.	These capabilities of the plant can be checked as a part of Commissioning test and hence we request you to delete the requirement of catagory III guarantee..	bid specification prevail
177	8	1.4.9	Equal load sharing of pumps/fans while running in parallel shall be demonstrated	Equal load sharing of pumps/fans while running in parallel is not achievable and hence shall not be demonstrated.	bid specification prevail
178	8	1.4.10	Steam temperature imbalance It shall be demonstrated at SH and RH outlets (in case of more than one outlet) that the temperature imbalance between the outlets does not exceed 10 deg. C under all loads including transients.	The SH & RH temperature imbalance between the outlets are considered maximum 30 °C differential during steady state operation only	bid specification prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
179	8	1.4.11	It shall be guaranteed and demonstrated that the spray water flow to SH attemperation system does not exceed the value considered for design (to be indicated in the bid) while maintaining the rated SH outlet steam temperature at BMCR. It shall also be guaranteed and demonstrated that the RH temperature is maintained at the rated value without any spray water requirement, at all loads for which the specified RH steam temperature is required to be maintained at the rated value.	SH spray shall be maintained at around 4% at all operating loads. RH spray shall be zero at guarantee load of 100% TMCR only.	bid specification prevail
180	8	1.4.11	It shall be guaranteed and demonstrated that the spray water flow to the SH attemperation system does not exceed value considered for design while maintaining the rated steam temepratrue at BMCR	Please clarify the mechanism for demonstration of guarantees relating to BMCR load at site.	Will be evaluated after recepit of detailed scheme by bidder.
181	8	1.4.12	Furnace Exit Gas Temperature (FEGT) It shall be demonstrated that maximum furnace exit gas temperature (FEGT) shall be minimum 60 Deg C below the minimum initial deformation temperature (IDT) of ash. A comprehensive thermal performance test (TPT) shall be conducted for this purpose. FEGT shall be demonstrated through such TPT by indirect measurement.	The furnace exit gas temperature shall be at least 60°C below IDT at the plane downstream of the RH finish section because (1) RH finish section is a platenized surface (Sl/D of 1.15 < 1.2) and (2) the St is greater than 15" (381mm) which ASME defines as the dividing line between radiant and convective sections.	Bid specification prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
182	8	1.4.13	Air Heater exit temperature.	Since Air heater exit temperature forms the part of Steam generator Efficiency guarantee which is forming a part of category I guarantee. Hence we request you to delete the requirement of category III guarantee.	Bid specification prevail
183	8	1.4.14	Air heater air-in-leakage It shall be demonstrated that the air-heater air-in-leakage and maximum drift in air leakage do not exceed the specified value.	These capabilities of the plant can be checked as a part of Commissioning test and hence we request you to delete the requirement of category III guarantee..	Bid specification prevail
184	8	1.4.15	Electrostatic Precipitator (a) The performance/acceptance tests shall be carried out in accordance with method-17 of EPA (Environmental Protection Agency of USA) code ASME PTC. (b) The ESP air in leakage shall not be more than 1% of total gas flow at ESP inlet at the guarantee point condition and shall be demonstrated. (c) The maximum pressure drop through the ESP at the guarantee point flow condition shall not exceed 20 mmWC which shall be demonstrated. (d) The gas distribution in the various stream and fields shall be demonstrated.	(b) Air Leakage shall have impact on performance of ESP as well as auxiliary power consumption of the Fan, which are already covered in the category I guarantees. Hence we request to delete the requirement of guarantee under category III for air leakage. Air leakage can be tested as a part of commissioning test if required. (c) Pressure drop guarantee across ESP is not required to be guaranteed separately under category III, since same shall have impact on auxiliary power consumption which is covered in category I guarantees for the overall plant. We request to delete the requirement of category III guarantee for pressure drop across Air Heater. (d) The requirement of gas distribution again has impact on the overall performance of the ESP, which is covered under category III guarantee. Gas distribution shall be checked as a part of commissioning test and hence we request request to delete the requirement of category III guarantee.	Bid specification prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
185	8	1.4.16	Turbine-Generator set capability The steam turbine generator shall be capable of delivering at generator terminals the output as indicated in the heat balances under the following conditions: (a) Continuous TG output corresponding to VWO condition under rated steam conditions with 1% make up. While conducting this test, the condenser pressure measurement shall be done at 300 mm above the top row of condenser tubes. (b) Maximum continuous output at generator terminals corresponding to all HP Heaters out of operation under rated steam conditions with 1% make up.	(a) This is interpreted as an capability guarantee. The bidder shall have the right to adapt the massflow to demonstrate the output guarantee. Please confirm. (b) This capability of TG to deliver output at specified condition can be checked as a part of commissioning test and hence we request you to delete the requiriment of category III guarantee.	(a). Will be evaluated after receipt of detailed scheme by bidder (b). Bid Specification prevails.
186	8	1.4.16(a)	GUARANTEES UNDER CATEGORY-III Turbine-Generator set capability Continuous TG output corresponding to VWO condition under rated steam conditions with 1% make up.	"Continuous TG output corresponding to VWO condition under rated steam conditions <u>and at design condenser pressure</u> with 1% make up. " Reason: We understand TG output corresponding to VWO is guaranteed at design condenser pressure condition according to Vol.III-B Section-1 clause 3.4. Please confirm.	Confirmed

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
187	8	1.4.16(b)	GUARANTEES UNDER CATEGORY-III Turbine-Generator set capability Maximum continuous output at generator terminals corresponding to all HP Heaters out of operation under rated steam conditions with 1% makeup.	"Maximum continuous output at generator terminals corresponding to all HP Heaters out of operation under rated steam conditions and at design condenser pressure with 1% makeup." Reason: HTC understand Maximum continuous output at generator terminals corresponding to all HP Heaters out of operation is guaranteed at design condenser pressure condition, which is same as other guarantee conditions. Please confirm.	Confirmed
188	8	1.4.17 (a)	Start-up, Loading, Unloading and Shutdown capabilities (For Turbine Generator) Unit Start Up Start-up time (upto full load) and loading capabilities for Turbine Generator together for cold start condition (greater than 36 hrsshutdown), warm start conditions (between 8 and 36 hrs shutdown) and hot start conditions (less than 8 hours shutdown) as indicated by the contractor in the offer and accepted by the Owner shall be demonstrated ensuring that the various turbine operational parameters like vibration, absolute and differential expansion, eccentricity and steam-metal temperature mismatch etc are within design limits.	These capabilities of the plant can be checked as a part of Commissioning test and hence we request you to delete the requirement of catagory III guarantee..	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
189	8	1.4.17 (b)	Sudden Total Loss of External Load On occasions, the steam turbine generator unit may experience sudden total loss of all external load. Under these conditions, the steam turbine generator unit shall not trip but shall continue to be in operation under the control of its speed governor to supply power for the plant auxiliary load with HP-LP bypass in operation while staying within the agreed limits of steam to metal temperature mismatch, exhaust hood temperature, absolute and differential expansion, vibration and eccentricity. The same shall be demonstrated.	These capabilities of the plant can be checked as a part of Commissioning test and hence we request you to delete the requirement of catagory III guarantee..	Bid Specification shall prevail
190	8	1.4.17 (c)	Steam Metal Temperature Mismatch Limitation The steam-metal temperature differential for cold, warm and hot start up, loading/unloading and shutdown conditions shall be within the permissible limits indicated by the Bidder in the offer and accepted by the Owner.	These capabilities of the plant can be checked as a part of Commissioning test and hence we request you to delete the requirement of catagory III guarantee..	Specification is self-explanatory

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
191	8	1.4.18	Constant Pressure and Sliding Pressure Operation - The constant pressure operation from 0 to 35/40% of TMCR & 90% TMCR to VWO condition and sliding pressure operation from 35/40% to 90% TMCR in conjunction with the steam generator, HP-LP bypass system and Instrumentation & Control system shall be demonstrated. In sliding pressure mode of operation, during quick load increase, the idle control valve (s) must respond rapidly to pick up 20% of operating load, so that immediate increase of boiler pressure is not required. The load response capability shall be demonstrated in steps of 5%. Changeover from constant pressure mode to sliding pressure mode and vice-versa shall also be demonstrated.	These capabilities of the plant can be checked as a part of Commissioning test and hence we request you to delete the requirement of category III guarantee. We propose following operation concept as per standard and proven practice of the Bidder : 1) 0 to 40% TMCR: Constant Pressure Operation. 2) 40% TMCR to 100% TMCR: Pure Sliding Pressure Operation, with instantaneous output increase of 5% achieved through overload valve. This is in accordance to cl. no. 4.8 (d) of Grid Code (L/68(84)/2006-CERC, dtd: 14/03/2006). 3) 100% TMCR to 105% TMCR: Constant Pressure Operation through overload valve. The generating unit shall be capable of instantaneously increasing the output by 5%, limited to 105% TMCR as per cl. no. 4.8 (d) of Grid Code (L/68(84)/2006-CERC, dtd: 14/03/2006). No throttling is envisaged in sliding pressure operation.	Will be evaluated after receipt of detailed scheme by bidder.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
192	8	1.4.19	Generator Capability The Generator stator and rotor windings inclusive of main and neutral leads shall be provided with Class-F insulations but rated for class-B temperature rise. The maximum permissible temperature of different parts of the generator for continuous operation shall be as specified in IEC 34- 1/34-3 as applicable.	The generator is designed to operate within class B temperature rise limits acc. to IEC 60034-1 at rated cooling conditions as applicable. The temperature margin resulted from class F insulation and class B temperature rise limits provides temperature safety margin due to hot spots and generator reliability over its life time. Therefore, it is neither possible nor allowed to demonstrate the Class F insulation (155°C) by performing generator temperature rise test up to Class F insulation limit (155°C). Please note that the temperature rise test on site, if performed, is to prove that any of the measured temperatures of generator parts will not reach class B temperature rise limits acc. to IEC 60034-1 at rated load of the generator. All insulating materials used to insulate active parts of the generator are ordered from ALSTOM qualified suppliers with specified F insulation temperature class 155°C (at least) acc. to IEC 62114 and that is indicated on incoming material certificates. We request to delete the requirement of category III guarantee as specified.	Bid specification prevail
193	8	1.4.20	Short Circuit Capability The Generator shall be capable of withstanding a 3-phase short circuit at the generator terminals when operating at maximum continuous rated MVA and rated power factor, 105% rated voltage and with fixed excitation for 3 seconds as per IEC 34-4.	This requirement specified is a design requirement and not a test requirement. IEC or IEEE standards also do not require to demonstrate same at the specified conditions. Moreover, such sudden short-circuit is not normal operation condition. Hence we request to delete the requirement of category III guarantee.	Bid specification prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
194	8	1.4.21	Excitation System Performance (a) The excitation system shall be capable of supplying field forcing for Thirty (30) seconds in case of all types of faults, including close in faults of the generator. (b) The ceiling voltage shall not be less than 150% of the machine excitation voltage. (c) Nominal excitor response ratio shall not be less than 3.0 per second.	These capabilities of the plant can be checked as a part of Commissioning test and hence we request you to delete the requirement of catagory III guarantee..	Bid specification prevail
195	8	1.4.22	Capacity with Reduced Hydrogen Pressure Generator shall be capable of operating at reduced capacity at reduced generator hydrogen pressure in accordance with values furnished.	These capabilities of the plant can be checked as a part of Commissioning test and hence we request you to delete the requirement of catagory III guarantee.	Bid specification prevail
196	8	1.4.23 (a)	(a) The value of design condenser pressure to be measured at 300 mm above the top row of condenser tubes shall be guaranteed under VWO condition, 1% make-up, design C.W. inlet temperature and C.W. flow. The condenser vacuum shall be measured with a vacuum grid utilizing ASME basket tips.	Since the condenser pressure is forming part of Heat rate guarantees, separate demonstration guarantee at other conditions are not requiried. we request you to delete the requirement of catagory III guarantee. We also request you to review the pre-bid query/comment regarding the condenser design point.	Bid specification prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
197	8	1.4.23 (b)	(b) Temperature of condensate, at outlet of condenser, shall not be less than saturation temperature corresponding to the condenser pressure at all loads.	Please appreciate that even with our highly optimised tube layout and uniform steam distribution arrangement, minimum subcooling or practically zero sub-cooling may not be ruled out at certain loads and hence Temperature of condensate, at outlet of condenser, shall be near to saturation temperature corresponding to the condenser pressure at all loads. This query was also raised in the first set of pre-bid queries. Please confirm. Also the tempearature of condensate at outlet of condenser is forming part of Heat rate guarantees, separate demonstration guarantee at other conditions are not requiried. Hence we request you to delete the requirement of catagory III guarantee.	Will be evaluated after receipt of detailed scheme by bidder.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
198	8	1.4.23 (b)	Temperature of condensate, at outlet of condenser, shall not be less than saturation temperature corresponding to the condenser pressure at all loads.	Please appreciate that even with our highly optimised tube layout and uniform steam distribution arrangement minimum subcooling or practically zero may not be ruled out at certain loads and hence Temperature of condensate, at outlet of condenser, shall be near to saturation temperature corresponding to the condenser pressure at all loads. Please confirm.	Will be evaluated after receipt of detailed scheme by bidder.
199	8	1.4.23 (d)	Air leakage in the condenser under full load condition shall not exceed more than 50% of design value taken for sizing the condenser air evacuation system.	The requirements specified shall be tested as a part of Commissioning test and hence we request you to delete the requirement of category III guarantee.	Bid specification prevail
200	8	1.4.23 (e)	When one half of the condenser is isolated, condenser shall be capable of taking at least 60% T.G. load under TMCR conditions.	The capability requirement specified shall be checked as a part of Commissioning test and hence we request you to delete the requirement of category III guarantee.	Bid specification prevail
201	8	1.4.23 (f)	The capacity of each vacuum pump in free dry air under standard conditions at a condenser pressure of 25.4 mm Hg (abs) and sub cooled to 4.17°C below the temperature corresponding to absolute suction pressure shall be demonstrated. Correction curves for establishing the capacity at site conditions shall also be furnished.	The capability requirement specified shall be checked as a part of Commissioning test and hence we request you to delete the requirement of category III guarantee.	Bid specification prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
202	8	1.4.23 (g)	The air and vapour mixture from air cooling zone of condenser shall be 4.17°C below the saturation temperature corresponding to 25.4 mm Hg (abs) suction pressure. Correction curves for establishing the same at site conditions shall also be furnished.	The requirements specified shall be tested as a part of Commissioning test and hence we request you to delete the requirement of category III guarantee.	Bid specification prevail
203	8	1.4.24	Condensate Extraction Pumps (a) Each CEP set shall be capable of delivering flow and total dynamic head corresponding to run out point as specified. (b) The vibration, noise level and parallel operation of any two of the three pumps shall be demonstrated.	The requirements specified shall be tested as a part of Commissioning test and hence we request you to delete the requirement of category III guarantee.	Bid specification prevail
204	8	1.4.25	Vacuum Pump (a) Each pump shall be capable of meeting functional requirements. (b) The vibration, noise level and parallel operation of the pumps shall be demonstrated.	(a) This is already covered in cl. No. 1.4.23 (d), (f) & (g), hence delete this clause from here due to repetition of requirement. (b) The requirements specified shall be tested as a part of Commissioning test and hence we request you to delete the requirement of category III guarantee.	Bid specification prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
205	8	1.4.26	Boiler Feed Pumps (a) Each Boiler Feed Pump set shall be capable to deliver flow and total dynamic head corresponding to runout point as specified elsewhere. (b) The vibration, noise level and parallel operation of the pumps shall be demonstrated as per specification requirements. (c) Cold startup/hot startup of the unit using TDBFP with motive steam from auxiliary steam header shall be demonstrated.	(a) & (b) The requirements specified shall be tested as a part of Commissioning test and hence we request you to delete the requirement of category III guarantee. (c) Bidder requests Owner to delete this Category-III guarantee as unit start-up requirement using TDBFP is not envisaged in respective specification and customer PFDs i.e. PE-189-PF-204 & PE-189-PF-205. Auxiliary steam if considered for BFP Drive turbine operation then operation of drive turbine becomes inefficient with primary source of steam and is loss of cycle heat rate. It is therefore recommended to use 2 x 30% MDBFP for starting of the plant in case of cold startup/ Hot start up.	Bid specification prevail
206	8	1.4.27	Drip Pumps (if envisaged) (a) Each Drip Pump shall be capable of delivering flow and total dynamic head corresponding to design point as specified. (b) The vibration, noise level shall be demonstrated.	The requirements specified shall be tested as a part of Commissioning test and hence we request you to delete the requirement of category III guarantee.	Bid specification prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
207	8	1.4.28	Lube Oil Purification system capacity and purity (a) Lube Oil Purification system capacity and purity shall be demonstrated (with requisite correction curves for variation in inlet oil purity). (b) The maximum solid particle size and free moisture in the purified oil shall not exceed the specified values and quality of oil shall confirm to class 15/12 (as per ISO 4406) when centrifuging oil is heated to a temperature of not more than 65°C.	The requirement specified shall be tested as a part of Routine Test/ Type Test/ Commissioning test and hence we request you to delete the requirement of category III guarantee.	Bid specification prevail
208	8	1.4.29	Auxiliary/Equipment Cooling Water system (a) Vibration, parallel operation and noise level of all pumps at the rated duty point shall be demonstrated at site. (b) Design heat load of plate type heat exchangers and inlet and outlet temperatures of the plate type heat exchangers on the primary and secondary side to be demonstrated at site. Pressure drop across the plate type heat exchanger on the primary and secondary water circuit to be demonstrated at site.	(a) The requirement specified shall be as a part of Routine Test/ Commissioning test and hence we request you to delete the requirement of category III guarantee. (b) Design heat load shall be demonstrated however since the pressure drop across PHE has impact on auxiliary consumption of pumps and same being covered in total auxiliary consumption plant, we request you to delete this requirement from category III guarantee.	Bid specification prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
209	8	1.4.30	Condenser Cooling Water Pumps (a) Each Condenser Cooling Water pump set shall be capable to deliver flow and total dynamic head corresponding to runout point as specified elsewhere. (b) Vibration, parallel operation and noise level of all pumps shall be demonstrated at site.	The requirement specified shall be tested as a part of Routine Test/ Type Test/ Commissioning test and hence we request you to delete the requirement of category III guarantee.	Bid specification prevail
210	8	1.4.31	HP/LP Bypass capabilities The HP/LP Bypass system shall satisfy the following functional requirements under automatic interlock action. It shall come into operation automatically under the following conditions: (a) Generator Circuit breaker opening. (b) HP/IP stop valves closing due to turbine tripping. (c) Sudden reduction in demand to house load Under all these conditions while passing the required steam flows as per the relevant heat balances, the condenser shall be able to swallow the entire steam without increasing the exhaust hood temperature and condenser pressure beyond the maximum permissible value indicated by the BIDDER in his offer and accepted by the OWNER.	The requirement/ Capacity specified shall be tested as a part of Commissioning test and hence we request you to delete the requirement of category III guarantee.	Bid specification prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
211	8	1.4.32 (a)	Dissolved O2 content in feed water at deaerator outlet without chemical dosing at all loads, not to exceed 0.005 cc/litre determined as per ASTM-D-888 – Reference method-A or Indigo Carmine method.	Dissolved oxygen content in feed water at deaerator outlet shall be as per HEI. Kindly accept.	Bid specification prevail
212	8	1.4.32	(a) Dissolved O2 content in feed water at deaerator outlet without chemical dosing at all loads, not to exceed 0.005 cc/litre determined as per ASTM-D-888 – Reference method-A or Indigo Carmine method.	Our understanding is that dissolved oxygen in feedwater at deaerator outlet of 0.005 cc/litre is from 50~100% load without chemical dosing. Please clarify.	Will be evaluated after receipt of detailed scheme by bidder.
213	8	1.4.32 (c)	Continuous and efficient operation and performance of feed heating plant without undue noise and vibrations at all loads and duty conditions.	The requirements specified shall be tested as a part of Commissioning test and hence we request you to delete the requirement of catagory III guarantee.	Bid specification prevail
214	8	1.4.33	Automatic on-line Turbine Testing (ATT) system On-load testing of turbine protective equipments shall be demonstrated without disturbing normal operation and keeping all protective functions operative during the test.	The requirements specified shall be tested as a part of Commissioning test and hence we request you to delete the requirement of catagory III guarantee.	Bid specification prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
215		1.4.34	All the plant, equipment and systems shall perform continuously without exceeding the noise level over the entire range of output and operating frequency specified. Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirement of IEC 651 or BS 5969 or IS 9779. Sound pressure shall be measured all around the equipment at a distance of 1.0 m horizontally from the nearest surface of any equipment/ machine and at a height of 1.5 m above the floor level in elevation. Corrections for background noise shall be considered in line with the applicable standards.	The near field noise measurements will be performed according to the standard ISO 3746:2010 in several test points, chosen regularly distributed on an enveloping measurement surface at a horizontal distance of 1 m from the equipment outline and at a height of 1.5 m above the ground or walkways.	Bid specification prevail
216	8	1.4.35	Condensate Polishing Unit (a) Effluent quality at outlet of each vessel at its rated design flow and design service length between two regenerations (with requisite correction curves for variation in the influent quality). (b) Pressure drop across the polisher service vessel, as specified, in clean and dirty condition of resin at rated design flow.	(b) Pressure drop across vessels shall have impact on auxiliary power consumption which is covered in Auxiliary power consumption guarantees and hence request to delete pressure drop across vesseld from category III guarantees.	Agreed

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
217	8	1.4.36	Superheater and Reheater Temperature Control Test This test shall be conducted to guarantee that SH/RH temperatures are maintained within +/- 5°C of rated temperature condition from 40% to 100% TMCR including conditions: HP Heaters out of operations, HP-LP Bypass operation.	The superheat and reheat steam temperatures at SH and RH outlet shall be maintained within +/- 5°C of rated temperature condition from 60% BMCR to 100% BMCRs per the volume IIIA/Section-1/ Clause 10.4 & 10.5 / Page No 88 of 223.	50% to 100%
218	8	1.4.36	Superheater and Reheater Temperature Control Test: This test shall be conducted to guarantee that SH/RH temperatures are maintained within +/- 5°C of rated temperature condition from 40% to 100% TMCR including conditions: HP Heaters out of operations, HP-LP Bypass operation	Our understanding is that load range is 60~100% as per Cl. No. 1.12, Section 1, Volume IIIA, Page 84 of 223. Please clarify.	50% to 100%

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
219	8	1.4.37	Flue Gas Temperature demonstration The Bidder shall demonstrate that flue gas temperature at the entry and exit of various Boiler heating surfaces and also the variation across the cross section perpendicular to gas flow do not exceed the values considered for the pressure parts design at all loads of boiler.	Since the flue gas temperature at entry & exit of various boiler heating surfaces/ variation of the same across a cross-section perpendicular to gas flow are influenced by many operating parameters that could vary from those used for arriving at the average (Bulk) temperatures considered for design and since pressure parts design is on the basis of metal temperatures resulting from bulk fire side/ fluid side temperature / fluid mass flux etc., demonstration / guarantee of flue gas temperature at entry & exit of various boiler heating surfaces / variation fo the same across a cross-section perpendicular to gas flow, is practically not feasible. However this specification may please be deleted.	Bid specification prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
220	8	1.4.39	For Balance of Plants, functional guarantees like capacities and parameters (except power consumption at individual system level) shall be demonstrated as per the specification furnished under respective sections forming part of this specification. Wherever applicable, Owner may, at his sole discretion, consider shop test result as primary indicators of the performance.	We request you to furnish the details on the guarantees required under this category to limit the extent of category III guarantees.	These have been covered under respective package specifications.
221	8	1.4.40	Utility Consumption Bidder shall have to indicate and demonstrate utility (e.g. DM Water, Clarified Water etc) consumptions.	Utility consumption is normally not guaranteed due to various reasons, including multitude points of consumption which are not under the control of the contractor. We request you therefore to delete this requirement from guarantee.	Bid Specification shall prevail
222	8	1.5.1	Steam Generator Efficiency: The steam generator efficiency (by loss method) shall be determined as per the requirements of BS EN 12952 - 15, 2003 (by loss method)	The boiler performance test shall be conducted in accordance with ASME PTC 4.	PTC 4 Confirmed
223		1.5.3	Performance/ Acceptance test for Steam Generator: The performance test shall be conducted in accordance with the latest version of ANSI PTC 4.0.....		

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
224		1.5.3	The measurement and computation of heat losses shall be carried out as per stipulations of ASME PTC 4.0		
225	8	1.5.7 (b)	Combined pressure drop in condenser tube, water box and inlet and outlet piping shall be measured in between intake and discharge point of the C.W. system with cleanliness factor of 0.9 and COLTCS in service.	It is not understood why pressure drop is included in the performance test for condenser. client to note that since the auxiliary power guarantee is already given by the Bidder and secondly since it is a full EPC project hence such performance testing of the condenser is not applicable.	Agreed
226	8	1.5.1	The steam generator efficiency (by loss method) shall be determined as per the requirements of BS EN 12952 - 15, 2003 (by loss method).	The boiler performance test code shall be ASME PTC 4. Please confirm.	PTC 4 Confirmed
227		1.5.3	The performance tests shall be conducted in accordance with the latest version of ANSI PTC 4.0.		
228		1.5.3	The measurement and computation of heat losses shall be carried out as per stipulations of ASME PTC 4.0.		

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
229	8	1.5.1 (a)	The steam generator efficiency (by loss method) shall be determined as per the requirements of BS EN 12952- 15, 2003 (by loss method) and other stipulations brought out hereunder.	Two different test codes are specified for Boiler performance test in the tender specification. Bidder shall carry out the performance test for boiler efficiency with ASME PTC 4 only.	PTC 4 Confirmed
	8	1.5.3	The performance tests shall be conducted in accordance with the latest version of ANSI PTC 4.0 except for the specific requirements brought out herein below.		
230	8	1.5.1 (b)	The guaranteed efficiency shall comply with following limiting parameters with design coal firing: (i) Excess air at economizer outlet at 100% TMCR load: 20% (minimum) (ii) Corrected flue gas temperature (at 100% TMCR load):135 Deg C or as predicted by the bidder at air preheater outlet.	Since the Boiler shall be designed with 15% excess air the boiler efficiency guarantee shall be furnished with 15% excess air. Please accept .	
231	Volume-II/ Section- 8	Cl . No 1.5.3	The efficiency tests shall be carried out with the steam generator operating at the guaranteed point condition i.e. corresponding to 100%, 75%, 60% TMCR, or at the agreed loads	Steam generator operating Guarantee point is 100% TMCR. Hence Performance/ Acceptance test for efficiency shall be carried out at Guarantee point i.e. 100% TMCR only. Please confirm.	
232	vol II, sec - 8, pg 183-555	1.5.4	Corrections shall be applied to the tested efficiency to correct it to the design conditions for variations in the following parameters only, - v) Moisture in Coal.	In addition to Moisture the PF fineness variation and HGI correction also shall be applied to arrive at the corrected mill capacity.	Agreed.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
233	8	1.5.5	ESP test	The test for ESP will also be carried out along with the plant performance test. Please review and confirm.	Bid specification prevail
234	Section – 8	1.5.5,Page 184 of 555	Outlet dust concentration of ESP with one field out in each stream while firing worst coal shall be 50 mg/Nm3	We interpret that the ESP shall be designed for outlet dust concentration of 50mg/Nm3 while firing 100%BMCR-WC with all fields in service and guaranteed for a dust concentration of 50mg/Nm3 at 100% TMCR-WC firing condition with one field out of service i.e. in line with Cl:11.0 of datasheet-A. Kindly confirm.	Please refer Data sheet A, Vol IIIA , Section 2, Sl. No.11 (a)
235	Section – 8	1.5.5,Page 184 of 555	Outlet dust concentration of ESP with one field out in each stream while firing worst coal shall be 50 mg/Nm3	ESP shall be designed for a dust concentration of 50mg/Nm3 while firing 100%BMCR-WC with all fields in service and guaranteed for a dust concentration of 100% TMCR-WC firing condition with one field out of service i.e. in line with Cl:11.0 of datasheet-A	Please refer Data sheet A, Vol IIIA , Section 2, Sl. No.11 (a)
236	8	1.5.5	Performance / Acceptance Test for Electrostatic precipitator : The Performance Test for ESP will commence after a min. period of 3000 Hrs of continuous operation after completion of Trial Run.	Performance test for ESP will be carried out along with PG testing of the complete unit i.e. within 3 months from the date of 1st synchronisation.	Bid Spec prevails

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
237	8	1.5.6	Corrections to the test results for steam turbine shall be applied as per the correction curves provided. When the system is properly isolated for a performance test, the unaccounted leakages should not be more than 0.1% of the design throttle flow at that load. However, during the test, if it is found that the unaccounted for leakage is more than 0.1% of design throttle flow at that load, then heat rate will be increased by an amount equal to half the difference between actual unaccounted for leakage expressed as percentage of design throttle flow at that load and 0.1% (allowed by the code).	The unaccounted for leakages shall be limited to 0.3% of designed throttle flow. Bidder will provide a correction curve to correct measured heatrate Vs leakages. Leakages will be calculated based on the following formula. $m_{LS} = m_{FW} - m_{losses}$	Bid Spec prevails
238	8	1.5.7	Combined pressure drop in condenser tube, water box and inlet and outlet piping shall be measured in between intake and discharge point of the C.W. system with cleanliness factor of 0.9 and COLTCS in service.	Pressure drop across condensing plant shall have impact on auxiliary power consumption which is covered in Auxiliary power consumption guarantees and hence we request you to delete the requirement of separate guarantee on the pressure drop.	Agreed
239	9	2.1	The Bidder shall indicate and include in his scope of supply all the necessary start-up, commissioning and recommended spares in addition to mandatory spares as specified elsewhere in the specification	As per this clause, recommended spares to be included in the scope of supply, however at other clause it is mentioned to be quoted separately. Please clarify the scope of recommended spares.	Recommended spares to be quoted separately.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
240	Vol II, Sec 9	2.1.5	The bidder shall guarantee supply of spare parts, which will be made based on manufacturer's drawings on special order from owner for 30 years after commissioning of the plant.	During the first ten years of the plant operation, ALSTOM PAC commits itself to support the customer with spares and service. Beyond ten years, Spares and service can be offered "on request" basis through a separate dedicated maintenance contract.	Bid Specification shall prevail
241	Vol II, Sec 9	2.1.6	Warranty period of all kind of spares shall be six thousand (6000) hours of operation, except normal wear or eighteen months from the date of receipt at site, whichever is later.	Defect liability period shall be same as specified in GCC (Vol I, Section 2) clause no. 44.14. Please confirm.	Confirm. (This clause is deleted)
242	Section: 9	2.1.6 Page 194 of 555	Warranty period for all kinds of spares shall be 6000 hours, except normal wear or 18 months from the date of receipt at site, whichever is later.	Kindly note that the Warranty period for all kinds of spares shall be 6000 hours, except normal wear or 18 months from the date of receipt at site, whichever is earlier.	Volume 1 Section 2 Cl 44.1.4 shall prevail.
243	9	2.2	Recommended spares	Bidder's recommended spares are already included in the given specification Mandatory spares list. Hence, no additional recommended spares are envisaged. Please confirm bidder's understanding.	Bid Specification is self-explanatory.
244	9	2.4	Mandatory spares parts	Mandatory spares will be provided as per applicability of bidder's design.	Bid Specification shall prevail
245	Section: 9	2.4.2 Page 195 of 555	During finalisation of detailed engineering.... , then the owner/consultant shall revise the list for compliance by the contractor without any cost implication.	Owner is requested to finalise the spares list at this stage.	Bid Specification prevails

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
246	Vol- II Sect-9,	Annexure - A Page 197 of 555	Mandatory spares List (Mechanical)	We do not find list of mandatory spares for Mill Rejects Handling System in the mandatory spares list of tender technical specification. You may kindly consider inclusion of the same	Agreed ; list will be furnished to bidders.
247	9	PG 204 OF 556	Mandatory spares	We understand that where "sets" are specified, 1 set refers to requirements of one equipment; for example in case of ID fan bearings, 1 set refers to 1 set of bearings for 1 no. ID fan. Please confirm.	Specification is self explanatory. It means that bidder has to supply one set of mandatory spares for each equipment.
248	9	20 PG 244 OF 556	Mandatory spares for drain cooler	Client to note that the mandatory spares for the drain cooler are applicable only if an external drain cooler is offered otherwise the section is not applicable. Kindly confirm.	Specification is self-explanatory
249	9	23 PG 245 OF 556	Condenser Tubes - 10 %	Client to note that there is actually no requirement for providing 10% extra tubes separately for the condenser as the condenser is already designed at VWO, 1% MU heat load condition and the plant will actually operate at much lower heat load and hence even there is some tube leakage there will not be any effect on the turbine output at 100% TMCR guarantee case. Accordingly kindly delete the requirement.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
250	Section: 9 Volume: III-C	4.2.1 Page 259 of 555 4.9 Page 181 of 245	Complete set of Drive Gear Box unit Drive shall consist of hydraulic motor and power pack unit without any gear box.	Complete set of drive gear box unit is not applicable because the Slew drive is hydraulic motor and power pack unit without any gear box.	Will be evaluated after receipt of detailed scheme by bidder.
251	Section: 9 Volume: III-C	43.1 Page 259 of 555 5.9.15 Page 181 of 245	Complete set of Drive Gear Box unit The bucket wheel drive shall be through high torque low speed hydraulic motor without reduction gear unit.	Complete set of drive gear box unit is not applicable because the Bucket wheel drive is hydraulic motor unit without gear box.	Will be evaluated after receipt of detailed scheme by bidder.
252	Section: 9 Volume: III-C	43.2 Page 259 of 555 5.9.15 Page 181 of 245	Coupling Assembly The bucket wheel drive shall be through high torque low speed hydraulic motor without reduction gear unit.	Coupling assembly is not applicable because the Bucket wheel drive is hydraulic motor unit without gear box & fluid coupling.	Will be evaluated after receipt of detailed scheme by bidder.
253	Section: 9	5 page 263 of 555	Idlers: Belt width 1800 mm	Idlers for suitable belt width shall be provided as per quantity mentioned in tender specifications.	To be taken up during bid evaluation stage

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
254	Section: 9	8 page 263 of 555	Vibrating Grizzly Feeder	No Vibrating grizzly feeder is required in CHP. Please confirm.	To be taken up during bid evaluation stage
255	9	5.8.4 PG 268 OF 556	Mandatory Spares of Crusher	Please confirm whether list of spares given for crusher in tender specifications are for ring granulator type or impactor hammer reversible type since type of crusher is mentioned differently in tender specifications & mandatory spares list.	For Impactor .
256	9	PG267/270 OF 556	Mandatory speares - Vibrating Grizzly feeder and Rack & pinion gate.	Spares for the vibrating grizzly feeder, rack and pinion gate have been listed in the mandatory list which to be supplied by the bidder but same were not shown the flow diagram as well as in specifications. Please clarify the contradiction and furnish the revised mandatory list for CHP if so required.	Vibrating feeder is shown in the Process flow diagram PE-189-PF-226. Rack and pinion gate along with Rod gate is required below grizzly hopper for which spares shall be provided.
257	9	1.2.7 PG 298 OF 556	Travelling water screen bearings-1 set	please note that as per technical specification there is no travelling water screen envisaged, whereas the spare list indicates travelling water screen bearings. It appears the spares for trvelling water screen with bearings is indicated inadvertantly, hence may please be deleted Please clarify.	Not applicable

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
258	9	1.7-1.11 PG 319 OF 556	Complete valves assembly : 100% of each type, size and class	Please clarify whether one (1) spare valve or 10% of each type, size and class is to be supplied. 100% seems to be a typographical error.	10 % of each type and size
259	Volume II Section-9	Pg No. 349 of 555 Pg No. 354 of 555	Sr. No. 1.0 :- EOT Crane Sr. No. 4.0 :- Miscellaneous EOT Crane & Hoist	Spares covered under sr. no. 4 are more elaborate and complete as compared to spares covered under sr. no. 1. Please check and confirm that the spares considered are adequate for sr. no. 1(EOT Crane).	Sl. No. 4 shall be followed.
260	9	1.3.10 PG 398 OF 556	Mandatory spares: Magneto optical disk (MOD) drive unit: 2 no.	Is this equivalent to a floppy drive. Owner / Consultant to note that floppy drives are not a standard part of the PC systems and its use is becoming obsolete. Please clarify the requirement.	It is not a floppy drive. It is a high capacity storage device.
261	9	1.11 PG 400 OF 556	Mandatory Spares: PCs: 2 no's of each type & model.	Please clarify the requirement. Is it Computers (PC) or OWS?	It is OWS.
262	9	1.0 Annexure E.	SPECIAL TOOLS AND TACKLES FOR ELECTRICAL EQUIPMENTS	The offered generator will be delivered with special tools as per its standard and applicability. If any more items should be included - detail description is required of each item mentioned in Annexure E. bidder's request to elaborate following items: Cutter trolley, Inner trolley, Rail, Sheet, Half ring, Ring, Screw, Segment, Supporting ring. Please confirm acceptance of bidder's standard and proven practice.	Bid specification prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
263	9	G 443 OF 55	Tools & Tackles list	Maintenance Tools & tackles list is not specified in the tender specification. Please furnish the same	Being furnished
264	9	2.1.6	Warranty period of all kind of spares shall be six thousand (6000) hours of operation, except normal wear or eighteen months from the date of receipt at site, whichever is later.	Defect liability period shall be same as specified in GCC (Vol I, Section 2) clause no. 44.1.4. Please confirm.	Confirmed.
265	9	2.1.6	Warranty period for all kinds of spares shall be 6000 hours, except normal wear or 18 months from the date of receipt at site, whichever is later.	Kindly note that the Warranty period for all kinds of spares shall be 6000 hours, except normal wear or 18 months from the date of receipt at site, whichever is earlier.	Volume 1 Section 2 Cl 44.1.4 shall prevail.
266	9	GENERAL	Mandatory spares	For certain equipment, for example motors or instruments, the spares are specified under the equipment as well as under electrical section. We understand that whenever spares are specified under the equipment category it need not be repeated under the general category also. Please confirm.	Confirmed
267	Section 9	General	Spares list is in pdf format.	Kindly provide the whole list in editable (word) format.	Readable format has been provided to bidder
268				Please note that certain items mentioned in the mandatory spares list may not be applicable as the equipments are OEM specific. Instead equivalent quantity of OEM applicable items will be provided as spares.	List will be finalised during detailed engineering.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
269	10	Ann-A	RW analysis	Please inform the turbidity + suspended solids to be considered for design of pretreatment plant.	Clariflocculator shall be designed considering TSS : ≤ 2000 ppm Centrifuge & Thickener shall be designed considering TSS : 1000 ppm
270	10	Annex C	Analysis of coal: Imported coal	Please provide the imported coal ultimate and proximate analysis (not the range) and Blended coal ultimate and proximate analysis (70% Indian coal: 30% Imported coal) along with ash analysis. Please understand that in the absence of imported coal analysis, it is difficult to conduct design and performance check. We have, however, assumed the same and arrived at the blended coal analysis. The same is also enclosed at sheet Vol II-Annex. You may please send your consent in order to proceed.	Being furnished
271		Annex C-Notes- 2	Annex C-Notes- 2		

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
272	10	Ann.C	Analysis of coal: Worst Coal F.C. - 25.50, Vol. matter - 21.56, Moisture - 12.00, Ash - 41.20, Total - 100.26 HHV = 3500 kcal /kg	The worst coal proximate analysis: 1. The sum total is 100.26, Kindly clarify. 2. Pl confirm the HHV 3500 kcal/kg is on ARB	
	10	Ann C	Boiler and auxiliaries shall also be suitable to operate continuously at Design / Rated parameters for 100 % BMCR condition for fuel of 30 : 70 ratio of IMPORTED : Indigenous Coal	3. Kindly provide the analysis of imported coal most likely to be fired on ARB basis including HGI in addition to the range of coal.	
273	10	Annexure - C	Coal Analysis for imported coal: Fixed Carbon --30-55 % Volatile matter -- 25-40% (ADB) Moisture -- 10% Max (ARB) Ash -- 8 - 14% max(ADB) HHV -- 5500 - 6500 (ARB) Kcal/kg	MahaGenco is requested to provide the value of the constituents of imported coal analysis (not the range) and Blended coal analysis (70% Indian coal:30% Imported coal) along with ash analysis. Also, all the constituents shall be indicated in ARB basis. However in the absence of imported coal exact element analysis, we have assumed the same and arrived the blended coal analysis. The same is also enclosed for your review and concurrence. Refer Annexure-1	
274	10	Annexure - C Note - 2	Boiler and Auxiliaries shall also be suitable to operate continuously at Design/ rated parameters for 100% BMCR condition for fuel of 30:70 ratio of imported: indigenous coal as specified		

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
275	11	1	For approval of any vendor ,other than as indicated in enclosed list,the bidder has to submit credentials for scrutiny and approval of MAHAGENCO.The contractor shall note that the equipment shall be in successful operation for similar duty condition and similar application for minimum one year from the date set for bid opening.the bidder shall note that it is the "sole discretion" of MAHAGENCO to approve the vendors.	Vendor credentials for critical items only shall be submitted. Desired evidence for all items in support of successful operation of one year being qualifying requirement shall be possible for predefined items only.	Bid specification prevail
276	11	1.5, 1.36 and 1.40	Approved makes of BFP, CEP and BFPDT	We are a regular manufacturer of BFP, BFPDT and CEP for 500 MW and 660 MW sets. We possess required manufacturing facilities and technology for manufacture of these equipments. Therefore, at S. No. 1.5, 1.36 and 1.40, for the suppliers of BFP, BFPDT and CEP (respectively), kindly include our name in the list of approved makes.	Bid specification prevail
277	Vol- II Sect-11, Page 495 of 555	36	Mill Reject Handling System.	Considering limited number of vendors, additional vendor M/s Melco India Pvt Ltd, an approved vendor is being proposed for consideration. Please confirm.	Bid specification prevail
278	11		Vendor list	Please suggest atleast three approved makes for the given below euipments: -Auger coal sampling unit -Split case bearings	Bid specification prevail

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 VOLUME-II

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
279	Volume II	General		In case of conflict between Volume II requirements vis-a-vis detailed specifications given in Volume III to Volume VIII, we presume that the detailed specifications shall prevail. Please confirm.	Volume III to VIII shall prevail.
280	Volume-II	General - works related to ash pond	-	Ash pond bund (for Bottom ash lean slurry and HCSD) construction, levelling of ash pond area, pond excavation, compacting, lining of pond, service road, lighting are excluded from bidder's scope. Please confirm.	Refer Volume II Section 3 Cl 3 (Exclusion).
281	Volume-II/ Section - 11,		LIST OF APPROVED VENDORS	Additional vendor shall be added apart from the list given in the bid document. Additional vendors shall be approved if they meet the provenness criteria mentioned in Volume I, Section 3, page 309, Cl. No. 2.0. Acceptance is requested.	Specification is self-explanatory

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-II Annex

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation		Bidder's Query / Stipulation		Resolutions
Bhusawal Coals:			Auxiliary Power Consumption: Total auxiliary power consumption of all auxiliaries (as listed below) at 660 MW load with Zero make up, 76mm of Hg back pressure and 100% unit load with respect to the guaranteed Auxiliary Consumption as per Schedule - 7.				
	Parameter	Unit	Design coal	Worst Coal	Coal Blend	Imp. Coal	Bidder shall refer reply revised
			(Indian)	(Indian)	70% DC + 30% Imp. C	(Not to be considered for boiler design)	
	Prox. Analysis						
	Total H2O	% W	10.8	12	10.6	10	
	Ash	% W	33.76	41.2	28	15	
	VM	% W	26.61	21.56	28	33	
	FC	% W	28.83	25.24	32.9	42	
	Ult. Analysis						

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-II Annex

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation		Bidder's Query / Stipulation		Resolutions
	Total H ₂ O	% W	10.8	12	10.6	10	analysis of coal furnished in Corrigendum - II
	Ash	% W	33.76	41.2	28	15	
	C	% W	40.34	35.87	46	59	
	H	% W	2.61	2.66	3	4	
	S	% W	0.7	0.6	0.7	0.8	
	N	% W	0.97	0.72	1.2	1.8	
	O	% W	10.82	6.95	10.5	9.4	
	HHV	Kcal/kg	3731	3500	4300	5700	
	HGI		55	50	55	55	
Performance Guarantee: TMCR with DC							
Design / Selection: BMCR / TMCR with WC							
Boiler suitable to fire Coal Blend comprising 70% DC + 30% Imp. Coal.							
(Note: Coal Blend comprising 70% WC + 30% Imp. Coal would be less onerous)							

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

RESPONSE TO PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1

VOLUME - III A

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
1	1	1.12	Superheater & Reheater Outlet Steam temperature control range shall be Within $\pm 5^{\circ}\text{C}$ for all loads from 60 % to 100 % range BMCR	This requirement of control range is not inline with the requirement of Clause No. 4.0 of datasheet Page No. 85 of 223 which describes Boiler control range shall be 50% to 100% BMCR.	Clause No. 4.0, data sheet A prevails.
2	1	2.1	Primary fuel – 100 % coal (Indigenous coal / Indigenous blended with IMPORTED coal on 70:30%)	Kindly provide the value of the constituents of imported coal analysis (not the range) and Blended coal analysis (70% Indian coal:30% Imported coal) along with ash analysis. Also, all the constituents shall be indicated in ARB basis.	Representative analyses of Imported coal furnished; please refer Corrigendum - II
3		3.1	The steam generator and auxiliaries shall be designed for indigenous Worst coal and the coal to be considered for performance guarantee shall be Design Coal; However, the Owner intends to use IMPORTED coal blended with the DOMESTIC coal whenever the need arises. The boiler and auxiliaries shall be suitable for generation of 100% BMCR capacity with rated pressure and temperature for a fuel mix of 70:30 ratio between DOMESTIC (Indian) coal and IMPORTED coal.	However in the absence of imported coal exact element analysis, we have assumed the same and arrived the blended coal analysis. The same is also enclosed for your review and concurrence. Refer Annexure-1	

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project
Pre - Bid Queries
Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
4	I	2.2.4	Steam generator structure, water circulation system, water-steam separator system with two or more separators and a storage vessel for collecting the separated water.	Alstom standard design is with two (2) nos. of Integral Separator cum Storage Tank for a 660 MW power plant capacity.	Bid Specification shall prevail
5		5.47	Minimum Two (2) steam separators along with a drain collection vessel at the evaporator outlet shall be provided.		
6	1	2.2.6	Two stage attemperation system for superheaters including 2 x 100% pneumatic control station.	Single stage De-SH shall be provided for superheater and single interstage De-SH shall be provided for Reheaters.	Bid Specification shall prevail
7	1	2.2.6	Two stage Attemperation system for superheaters including 2 x 100% pneumatic control stations. Each control valve shall have one motor operated upstream isolating valve and one manually operated downstream isolating valve. Quick acting block valve (Pneumatically operated) shall be provided on the common supply header for each attemperation control system. One non-return valve shall be provided on the spray water line near the spray point and one flow nozzle shall be provided on each spray water line downstream of the control station	Due to very high pressure we shall provide motor operated bulk valve on the common SH spray line as per ASME TDP-1 requirement for sure shut off.	Bid Specification shall prevail
	1	5.6.7	SH Spray system for attemperation consisting of valves, pipelines and accessories shall be adequately sized for the maximum requirement. Suitable IX solenoid operated pneumatic block valves shall be provided to close in the event of unit trip out to prevent any water leakage.....flow. Location of spray water tapping from the feed water system shall be selected by the Bidder.		

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
8	1	2.2.7	Emergency attemperation system for reheater in which arrangement of control stations shall be similar to that of Super Heater Control stations.	Single stage De-SH shall be provided for superheater and single interstage De-SH shall be provided for Reheaters.	Bid Specification shall prevail
9	1	2.2.8	Economiser sytem with connecting pipes headers etc with non return valves and motor operated valves with integral by pass.	In super critical boilers feed water isolation at eco inlet is not provided to keep the feed piping design pressure at optimum value. Kindly clarify whether the isolation requirement is to be envisaged..	economiser inlet valve is not required
10	1	2.2.11	The primary and secondary steam coil air preheater(SCAPH) with condensate collection tanks, control valves	Since SCAPH in primary stream will not be in operation during oil firing /start -up, it is proposed to provide SCAPHfor secondary side only. Please confirm	Agreed.
11	1	2.2.11	Primary and secondary steam coil Preheater with condensate collecting tanks,control valves for supplying steam along with necessary controls	Since bidder has proposed to provide 2 nos of trisector RAPH , SCAPH is not required for Primary air.	Agreed.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
12	1	2.2.12	Start-up drain and vent regulating valves and isolating valves shall ... at superheater and reheater outlets, lowest set pressure safety valves on the water separators shall be provided with silencers.	For once through supercritical boilers start-up vents are not envisaged since the boiler will be started with HP-LP bypass in operation. The vent valves provided will be used for air release purpose only during boiler filling. Hence motorised valves and silencers are not necessary.	Bid Specification shall prevail
	1	2.3.1.4	All vent pipes and safety valves escape pipes to a level of 1 meter above SG house roof.		
	1	2.3.2.5	Start-up drain and vent regulating valves with motor drives	As per the bidder standard the vent pipe shall be routed to the safe location.	
	1	2.3.2.6	Start-up drain and vent isolating valves with motor drives		
	1	2.3.2.8	All start-up vents, lowest set pressure spring loaded safety valves on Superheater outlet and Reheater outlet shall be provided with silencers.		
	1	5.25.2.3	The start-up vent lines shall be provided with one motorised isolating valve and one motorised regulating valve.		

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project
Pre - Bid Queries
Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
13	1	2.2.12	Electromatic relief valves at superheater and reheater outlets, lowest set pressure safety valves on the water separators shall be provided with silencers.	Inline with ASME guidelines for once through boilers Electromatic relief valves are only provided on SH outlet and no requirement of ERV at RH outlet. Further the plant is equipped with HP-LP bypass system which controls the reheater pressure and hence ERV is not required at RH outlet functionally. However spring loaded safety valves shall be provided at RH inlet and outlet. Also ERV at RH outlet is not mandatory as per IBR though IBR does not cover super critical boilers. In view of the above ERV in the RH outlet is not required both as per code and functional requirement.	Shall be considered as per regulatory norms.
	1	2.3.2.7	Electromatic Relief Valves shall be provided on SH and RH outlet,		
14	1	2.3.1.15	Provision of Auxiliary Steam for initial requirement from existing units (2x500MW) along with necessary piping, valves and fittings from auxiliary steam header of existing units (2x500 MW) is covered in Bidder's scope along with their drains, steam trapping equipment etc.	As per the Specification Clause, our understanding is that there is no provision of Auxiliary Boiler. Steam requirement for 660 MW unit shall be drawn from existing units. Under above circumstances, please note that supercritical unit require aux steam during start-up. Therefore please confirm the followings: - whether existing plant can feed the required aux. steam to this new supercritical unit of 660 MW @ approx. 70 tph, 16 bar, 250 degC - 660 MW unit can't start if aux. steam from existing plant is not available.	70 TPH steam @ 14 ata & 310 deg C is available at the TP.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
15	1	2.3.1.7	Steam Generator fill lines from Boiler Fill Pumps discharge line near Steam Generator area (in the Compressor room) and from the discharge of Boiler Booster Pump inside station building during start ups.	Boiler filling will be done by boiler fill pumps located near DM water storage tanks and no separate filling line is envisaged from discharge of boiler booster pump (BFP booster pump).	Bid Specification shall prevail
16	1	2.3.2.2	Feed check valve and isolating valve with motor drive; the feed check valve location to be ahead of isolating valve in the direction of flow. Isolation valve & feed check valve at economiser inlet.	client to note that the feed check valve shall be located at the downstream of the HP heaters. However there is no requirement to provide an isolation valve at such location as per Bidder's standard & proven practice. It shall be further noted that as per IBR amendment dated March 12, 2007 to regulation 520, feed water discharge piping for feed water system without economizer inlet isolating valve can be designed. Kindly confirm the acceptance.	Isolation valve at economiser outlet may be deleted; rest of the scheme will be evaluated after receipt of detailed scheme by bidder.
17	1	2.3.2.10	MSSV	we understand that the bypass line referred here is small capacity bypass for equalising. Please confirm.	motorised regulating as well as isolation valve for charging shall be provided.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project**Pre - Bid Queries****Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A**

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
18	1	2.3.2.10	AC motor driven main steam stop valve with separate bypass line with one motor operated isolating and one regulating valve.	Some integral bypass valves will be provided for Large size gate valve, if necessary as per valve supplier recommendation. Basically, motor bypass valves are not provided.	
19	1 1	2.3.3 2.7	Thermal insulation for hot surfaces to limit the surface temperature to 60 deg C. ensure skin temperature of not more than 60°C with ambient temperature of 45°C and Steam Generator at 100% MCR.	The temperature differential between the surface temperature and ambient temperature should be 20 - 25 °C in order to have an optimum thickness with air velocity of 1 m/s.	Bid Specification shall prevail

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
20	1	2.3.1.2	Drain collection headers and drain connections to the flash tank. Flash tank shall be provided with condensate collection tank with condensate Drain Transfer Pump to STG Condenser.	As per bidder standard drain is circulated from water separator drain tank to following	Will be evaluated after receipt of detailed scheme by bidder.
	1	2.3.1.8	Steam Generator draining facility from bottom ring header and other drains. Connection piping between steam separator and storage vessel, storage vessel to boiler flash tank, flash tank to drain collection tanks, drain collection tanks to condenser etc.	(1) To Economizer through BCP. This operation is normally used to recover the heat from the drainwater to the feed water with BCP. (2) Directly feed to condenser . Drain water shall be recovered to condenser directly through WDC valve during BCP not in operation or during swelling at start-up operation.	
	1	5.5.1	To facilitate start-up of the steam generator, an atmospheric flash tank	Hence drain collection tank along with condensate pump is not required. However	
	1	5.26	Boiler start-up Recirculation Pump and drain system with start-up drain re-circulation pumps shall be provided and the start up drains.....atmospheric flash tank, drain receiving tank, 2 X 50% condensate transfer pumps, valves etc.	Boiler flash tank is provided to receive other drains from boiler. From Boiler flash tank this drain shall be led by gravity to Boiler Blow Down pit. And from Boiler Blow Down pit this drain shall be pumped to CMB.	
21	1	2.3.5.9	Elevator	As there is only one boiler in the plant, please review requirement to have two elevators. We feel one elevator for the boiler would be adequate.	Bid Specification shall prevail

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
22	1	2.3.5.12	Interconnecting platform shall also be provided between the steam generator and bunker buildings at three elevations.	Interconnecting platform between Boiler and station building shall be provided at one elevation. Preferably at feeder elevation as per our arrangement.	Bid Specification shall prevail
23	1	2.12	Gravimetric raw coal feeders with drives and raw coal chute to mills including suitable chute bypassing mill for emergency bunker evacuation.	Bidder shall provide belt type gravimetric coal feeder as it is proven for large size power plants and bidder has many reference plants with belt type feeders. Further the boiler layout has been standardised with belt type feeder and hence bidder request owner to accept belt type gravimetric feeder for this proposal.	Bid Specification shall prevail
	1	5.16.2	The coal pulverising and firing system shall consist of medium speed coal mills with drives, Gravimetric coal feeders with drives		
	1	5.16.3.2	Each coal mill shall be provided with a separate Gravimetric coal feeder.		
	1	5.16.27.1	Feeder type: gravimetric, all metallic rotary feeder,RC feeder for each mill		
24	1	2.13	Pulverisers and motors with handling devices: No. of pulverisers shall be N+2 as described in data sheet A	We propose One (1) mill as standby at 100% TMCR with worst coal.	Bid Specification shall prevail
25		5.16.3.1	Each coal mill shall be designed with 15% margin over coal mill flow at BMCR with worst/design coal whichever, as per specified design criteria works out maximum. Total number of mills shall be N+2 where N=6 (minimum) for 100%TGMCR operation with worst coal.		

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project
Pre - Bid Queries
Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
26	1	2.13	Pulverisers and motors with handling devices. Number of Pulverisers shall be N+2 as described in Datasheet - A.	The number of mills shall be decided as per bidder standard based on the coal properties, boiler design parameters, mill size etc. Bidder propose the mill selection criteria as follows: N+2 at 100 % BMCR with design coal N+1at 100% BMCR with worst coal firing N= No. of operating mills, In line with the clause no 1.4.5 (b) maximum mill loading is considered as 90 % .	Bid Specification shall prevail
	1	Data sheet-A.	Number of pulverisers: N+2		
	1	Sr.No:14.2	Each coal mill shall be designed with 15% margin over coal mill flow at BMCR with worst / design coal whichever, as per specified design criteria works out maximum. Total number of mills shall be N+2 where N = 6 (minimum) for 100% TGMCR operation with worst coal.		
	1	5.16.3.1	Maximum loading of the mill with worst coal and design coal (for sizing which ever is higher) :85% at 100% BMCR		
	8	Data sheet-A. Sr.No:14.6 1.4.5 (b)	Capacity output shall also be demonstrated on four coal pulverisers (of Owner's choice) of Steam Generator, not less than the 90% of guaranteed value of (a) above, at 100% mill loading with the originally installed grinding elements in nearly worn-out condition or at the end of guaranteed wear life of grinding elements, whichever is earlier.		
27	1	2.23	Load carrying oil burner with a total capacity sufficient to produce up to 30% Boiler maximum continuous rating (BMCR).	The minimum stable load without fuel oil support shall be 40% of SGMCR load, with two adjacent mills in service and mill loading not less than 50%	Bid Specification shall prevail

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
28		3.4	The design of Steam Generator shall be such as not to call for oil support for flame stabilisation above (30%) rated output while firing entire range of coal		
29		3.7	The Steam Generator and all interconnected piping shall be designed for full load operation as base load. However, plant and equipment shall be capable to operate continuously up to a reduced load of 30% BMCR with coal without oil support.		
30		2.2	Coal start -up fuel - LDO upto 10% BMCR, beyond 10% upto 30% HFO.		
31		2.3	Capacity of oil burners for load carrying - Upto 30% BMCR (Without Coal firing)		
32	1	2.23	Load carrying oil burner with a total capacity sufficient to produce up to 30% Boiler maximum continuous rating (BMCR).	LDO burners shall be designed for 10% BMCR of boiler heat output and the HFO burners shall be designed for 30% BMCR of boiler heat output basis.	2.23. Confirmed. 5.22.1.1 : Specification is self-explanatory
	1	5.22.1.1	The Oil Firing System shall include Heavy Oil System to be used up to 40% rated output for support to stabilize coal firing.		
33	1	2.5.1 (c) 13.8	Electrically operated guillotine type gas tight isolations: Before and after each regenerative air heater on both flue gas and air side Double multi louvre type isolation dampers shall be provided before and after each regenerative air heater on air side	Kindly confirm whether double multi louvre type isolation dampers can be provided on the gas side also from layout considerations.	Bid Specification shall prevail

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
34	1 / 29	3.10	The Steam Generator and auxiliaries shall perform continuously within the specified noise limit 85 db at a distance of 1.0 M.	The noise level from non continuous operating valves (like PCV, WDC valve etc,) may exceed 90dBA The noise level for safety valves including ERV shall be limited to 115dBA with silencer. Noise level around Mill will be 90dBA.	85 dB at a distance of 1 m from equipment shall be for continuous operating equipment.
35	1	3.14	Steam Generator shall be capable to undertake forced cooling under emergency.	This point is not clear. Please elaborate. However furnace cooling can be done by using the fan during boiler shut process.	Bidder's understanding is correct.
36	1	3.2	The boiler and auxiliaries shall be suitable for generation of 100% BMCR capacity with rated pressure and temperature for a fuel mix of 70: 30 ratio between DOMESTIC (Indian) coal and IMPORTED coal.	The coal blending (70 % Domestic and 30% imported) shall be considered based by Heat basis. Please confirm.	Shall be on weight basis.
37	1	3.2	The Steam Generator shall be capable of starting and picking up load without HP-LP bypass system with whole range of specified coal.	Once-through steam generator requires high water quality and if the boiler start-up is done without HP/LP bypass large amount of make-up water will be injected and it is difficult to keep high water quality during start-up . Hence it is not recommended for boiler start-up without HP-LP bypass system in operation.	Agreed.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project
Pre - Bid Queries
Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
38	1	3.6	The Steam Generator shall be designed for continuous operation with all the High Pressure Feed Water Heaters out of service,.....temperature, under such conditions. However, during cold start-up, feed water temperature may go down to 110 Deg C and even less at the time of black start (i.e. in absence of auxiliary steam). The superheater and reheater temperature control system shall be designed to maintain the rated steam temperature with the HP heaters out of service from 60% BMCR to 100% BMCR.	The boiler is not designed for all HP heaters out condition as the feed water temperature will be very low under such condition which will reduce the mill drying capacity. However the boiler is designed with One train HP heater out of service @ 100 % TMCR output and the boiler can be operated at reduced load with all HP heaters out of service with rated steam temperature.	Bid Specification shall prevail
39	1	5.2.6	The furnace walls shall be either spiral wound and vertical tubes or vertical rifle tubes, as per the manufacturer's practice.	As per Vol II, Sec 3, cl. No. 1.1.1, furnace/evaporator shall be with vertical wall. Bidder's standard design for furnace is with both spiral wall (Lower furnace) and vertical wall (Upper furnace) tubes design. Please confirm the acceptance.	Vol IIIA Section 1, Cl 5.2.6 prevails.
40	1	5.2.9	Coal bunkers	The storage capacity of 16 hours for the bunkers is quite large and would result in a very large structure. For other similar projects capacity of 10 to 12 hours is being adopted. Kindly review.	Bid Specification shall prevail
41	1	5.2.9	Sixteen (16) Hrs storage of coal in bunkers shall be considered for structural design.	Twelve (12) hrs storage of coal in bunkers is considered. Please confirm	

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project					
Pre - Bid Queries					
Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
42	1	5.4.9	The design pressure shall be at least 1.05 times the maximum operating pressure or highest set pressure of the spring loaded safety valve for full discharge, or as required by IBR/ international Codes, whichever is higher. The design temperature shall be at least 40°C above the maximum fluid temperature for convection zones and 50°C for radiant zones.....time. This margin shall be equal to at least 5% of the maximum operating pressure with evaporator tubing without scaling or actual expected increase in pressure drop in water wall/ evaporator section, whichever is higher.	Design pressure for once-through boiler is decided according to ASME regulation where the design pressure is lower than the safety valve set pressure. The design temperature for un-heated parts (not within gas path) will be 15-20 C above maximum fluid temperature as per IBR requirement, For heated zones the design temperature will be as per metal temperature calculation.	Shall be considered as per regulatory (IBR/ ASME) provisions.
	1	Data sheet-A. Sr.No:8.1	Steam water separator Design pressure:1.05 times of maximum continuous operating pressure or highest safety valve set pressure whichever is higher.		
	1	Data sheet-A. Sr.No:8.2	Design Steam temperature :+ 40°C (minimum).		
43	I	5.5.1	The condensate from the condensate collection tank shall then be transferred to the condenser by the provision of 2 X 100% condensate transfer pumps for minimizing the make- up water requirement	We propose to provide 2 X 50% condensate transfer pumps. Please confirm,	Bid Specification shall prevail

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
44	1	5.5.1	ATMOSPHERIC FLASH TANK : The condensate from the condensate collection tank shall then be transferred to the condenser by the provision of 2 X 100% condensate transfer pumps for minimizing the make-up water requirement.	2 X 100% condensate transfer pumps will be considered. Please confirm.	
45		5.26	START-UP RECIRCULATION AND DRAIN SYSTEM: The start up drains shall be routed to the main condenser in the TG area through necessary atmospheric flash tank, drain receiving tank, 2 X 50% condensate transfer pumps, valves etc.		
46	1	5.6.5	The superheater shall be of proven design, made of seamless tubes and shall be designed to maintain superheat steam temperatures at superheater outlet between 50% BMCR to 100% BMCR under all operating regimes.	As per Vol III-B, Section I, cl. No. 3.6 and 1.12, Super heater and rehaeter temperature control range is required as 60% BMCR to 100% BMCR. Whereas as per clause no 4.0, 5.8.1 and 5.6.5 same is requiried as 50% BMCR to 100% BMCR. We are considering that The superheat and reheat steam temperatures at SH and RH outlet shall be maintained at rated value from 60% BMCR to 100% BMCR rating. Please confirm	Clause 5.6.5 is correct.
47	1	5.6.5	The super heater shall be of proven design, made of seamless tubes and shall be designed to maintain superheat steam temperatures at superheater outlet between 50% BMCR to 100% BMCR under all operating regimes	Please clarify whether the required steam temperature control range has to be considered as 60% TMCR (control load) to 100% BMCR.	

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
48	1	5.6.5	The super heater shall be of proven design, made of seamless tubes ... superheater outlet between 50% BMCR to 100% BMCR under all operating regimes.	Superheater and Reheater outlet temperature shall be maintained at rated value from 60% BMCR load to 100% BMCR load.	
	1	5.6.6	Superheater outlet temperature shall be maintained at ... The steam Generator shall have minimum superheat attemperation flow during TMCR operation.	As per bidder standard spray flow SH is maintained at all loads. SH temperature control is achieved by water fuel ratio and further by spray. Further spray water for SH attemperation is taken from economiser outlet and hence overall heat rate is not affected.	
	1	5.7.2	The Reheater outlet steam temperature shall be maintained at specified value from 50% to 100% Boiler MeR....spray shall be provided for emergency control.		
	1	5.8.1	The outlet temperature of SH and RH shall be guaranteed ... out of operation and HP - LP bypass operation.		
	1	Data sheet- A. Sr.No:1.12	Superheater & Reheater Outlet Within Steam temperahre control range: $\pm 5^{\circ}\text{C}$ for all loads from 60 % to 100 % range BMCR		
	1 / 179	Data sheet- A. Sr.No:4	Boiler control range shall be 50% to 100% BMCR. Minimum load with separator running dry shall be 30 % BMCR.		
		1.4.36	Superheater and Reheater ...40% to 100% TMCR including conditions: HP Heaters out of operations, HP-LP Bypass operation.		
49	1	5.7.2	Primary reheat steam temperature control system shall utilise the tilting of burners.	Our offer envisages opposed wall firing with gas biasing dampers at economiser outlet in the divided backpass for Reheat steam temperature control.	MAHAGENCO will revert.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
50		22.1.1	Arrangement of burners : Corner fire with Tilting arrangement		
51	1	5.8.1	The outlet temperature of SH and RH shall be guaranteed to be maintained within $\pm 5^{\circ}\text{C}$ of the rated temperature condition from 60% to 100% BMCR.....	Please clarify whether the required steam temperature control range has to be considered as 60% TMCR (control load) to 100% BMCR.	50% to 100 % BMCR
52	1	5.9.4	Provision of space shall be kept for at least 20% addition of additional economizer surfaces in future. This space provision shall be over and above the gap provided between two horizontal banks of heat exchanger for the purpose of maintenance. Structure/hanger design shall be suitable for loads due to these additional surfaces (filled with water) also.	As per bidder standard , no space for future installation of economizer heating surfaces is envisaged.	Bid Specification shall prevail
53	1 / 53 1 / 90	5.11.9 Data sheet-A. Sr.No:13.1	The Air Heater shall have peripheral duplicate A.c. drive to be able to run the air heater at the rated RPM in the event of failure of one of the Air Heater drives. Air Heater:Rotary Regenerative, Tri-sector type or Bisector Type. Each with two peripheral AC motor drive and one independent air motor drive along with one air receiver of minimum 10 minutes capacity.	As per OEM standard centrally mounted motor drive shall be provided.	Bid Specification shall prevail
54	1 / 56	5.12.4	Cross-connections with sufficient number of power operated dampers shall be provided such that, to the limits of their capacity, the Steam Generator may continue to operate safely following the loss of any one F.D. fan, I.D. fan or air heater (if applicable).	Cross-connection duct at FD and PA fan outlet shall not be provided due to layout constraints. However Cross connection shall be provided at ESP outlet for ID fans.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
55	1	5.12.16	Piezometer rings to measure fan inlet air for PA and FD fan shall be supplied.	The primary air measurements are provided at respective mill inlet and the secondary air for combustion is measured at hot air duct to burners from airheater outlet. Hence kindly clarify whether additional air flow measurement at fan suction is to be provided.	Not Required.
56	1	5.15.1	The Bidder shall furnish Soot Blowers for the Furnace, Superheaters, Reheaters, Economiser and Air Heater, complete with all piping and accessories, including valves, controls and control panels. Short retractable rotary wall blowers shall be provided for the Furnace; long fully retractable rotary soot blowers for Superheaters, Reheaters and Economizers and sweep action blowers shall be provided for the regenerative Air Heaters.	As per bidder standard, for low gas temperature zone (ex. Economizer), Semi retractable soot blowers will be applied which will clean the entire heating surface. For Airheater semi retractable type soot blower shall be provided as per OEM standard.	Bid Specification shall prevail

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Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
57	1	5.16.3.1	Each coal mill shall be designed with 15% margin over coal mill flow at BMCR with worst/ design coal whichever, as per specified design criteria works out maximum. Total number of mills shall be N+2 where N=6 (minimum for 100% TMCR operation with worst coal)	The coal mills shall be selected based on the following: a) Mills with Static classifier and Max. mill loading 90% . b) Total no of Mills - 7 c) At 100% BMCR with worst coal - No standby mills d) At 100% BMCR with Design coal -1 mill as standby e) At 100% TMCR with worst coal - 1 mill as standby f) At 100% TMCR with design coal - 1 as mill standby	Bid Specification shall prevail
58	I	5.16.3.1	Each mill shall be designed with 15 % margin over coal flow at BMCR Total no of mills N+2 where N = 6 minimum at 100 % TGMCR with worst coal	Considering the mill loading limited to 85 % capacity and each mill catering to 4 burners, the number of burners with 6 mills being 24 it is suggested that the maximum heat input to burner shall be 60 million.- please confirm.	Bid Specification shall prevail
59	1	5.16.4	The coal mills and bunker bays shall be arranged on the steam generator left and right sides.....	As per the bidder standard, the coal mills and bunkers will be provided at the Boiler front. Similar coal mill and Bunker layout arrangement has been accepted in various projects worldwide.	Bid Specification shall prevail

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
60	1	5.16.5	Two coal isolation gates shall be provided at each bunker outlet....	Rod gates shall be provided at bunker outlet and a motor operated isolation gate shall be provided at coal feeder inlet.	Bid Specification shall prevail
	1	5.16.27.6	The guillotine gate of Rotary feeder (between bunker and feeder) shall be motor operated. The provision for manual operation shall also be kept.		
61	1	5.16.09	The classifier provided at the mill outlet for screening the pulverized coal shall be a dynamic classifier with provision to adjust the fines size to suit the combustion requirement.	Considering fuels to be fired in the boiler, OEM recommendation is to use static classifier for mills. Please confirm.	Bid Specification shall prevail
62	vol-III A, Sec-1,pg 65-223	5.16.9	The classifier provided at the mill outlet for screening the pulverised coal shall be a dynamic classifier with provision to adjust the fines size to suit the combustion requirment.	For fineness of 70% through 200 mesh and 98% through 50 mesh static classifier would meet the requirement. Hence dynamic classifier is not envisaged and not being provided.The blades of Static classifier can be manually adjusted to adjust the fines size to suit the combustion requirments.	Bid Specification shall prevail
63	vol-III A, Sec-1,pg 64-223	5.16.16	Classifiers of the pulveriser shall be adjustable with the mills on operation to permit fineness of the fuel to be maintained under any condition. Classifier wear parts shall be suitably lines with ceramin.	Pulverisers are provided with static classifiers which can be adjusted manually with the mills in operation to permit fineness of the fuel to be maintained under any condition. For large changes, the ring-roll setting or increase in spring compression etc. need to be carried out, taking shutdown on mill.The classifier blades/ vanes are made of suitable wear resistant material and hence, separate lining is not provided over them.	Bid Specification shall prevail

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Pre - Bid Queries

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
64	vol-III A, Sec-1,pg 65-223	5.16.23	Bidder shall clearly describe in the proposal, the means provided to measure the coal level in the mill.	The offered Mills works on a different principle and hence, coal level measuring is not applicable for this type of Mill.	Bid Specification shall prevail
65	vol-III A, Sec-1,pg 65-223	5.16.24	Suitable device for coal flow distribution as required shall be provided by the bidder.	There are four discharge valves provided at Mill outlet for coal air flow distribution as required. Further distribution for Boiler requirement is taken care in pulverised coal pipes.	Bid Specification shall prevail
66	1	5.16.27.4 (a)	The feeder shall be of all metal construction. There shall be only one rotating part in the feeder to reduce wear & tear/maintenance and power consumption.	Since bidder proposes to provide the gravimetric type belt feeder, there are two rotating parts in the feeder. One is for belt drive and other is for clean out conveyor drive.	Bid Specification shall prevail
67	Vol IIIA,Sect-I Page 67 of 223	5.17.2	Two mill reject storage silo with worst coal & 24 Hrs stoorage capacity.	As per normal practice ,capacity of mill rejects storage silo is selected considering 1% of actual coal fired at 100 % BMCR with 16 Hrs storage capacity. Pl.confirm acceptance.	Bid Specification shall prevail
68	1 Pg No. 67 & 68 of 223	5.17.2, 5.17.6 (b),(C),(d)	Two Mill reject silos (one for each coal mill bay).....100% PLF with worst coal & 24 Hour storage capacity.	For Front Mill arrangement, one number of silo is required which will be sized for 12 hrs effective storage capacity. Please confirm.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
69	1 Pg No. 68 of 223 & Pg No. 69 of 223	5.17.6 (g) Volume III- C Crusher Datasheet- A Sr. No. 2.2	Maximum size of mill reject....(-) 40mm* In case bidder expects higher size....suitable capacity crusher shall be provided for bring down the size of rejects to (-)40mm.... Coal output size : 95% (-)20mm with fines not less than (-)3mm.	As per Crusher datasheet - A, Sr. No. 2.2, 95% of coal is (-) 20 size and 5% coal size is higher than 20mm. Also in pyrite hopper, provision is made to handle oversize mill rejects particles of more than 40 mm size through oversize reject chute, provided above grid. Hence, crusher may not be required for mill reject handling system. Please confirm.	Bid Specification shall prevail
70	Vol IIIA, Sect- I Page 68 of 223	5.17.6 i)	Inlet/ outlet** valves of mill reject discharge hopper - Pneumatically operated knife edge gate valve.	One (1) No. pneumatically operated isolation valve shall be provided at pyrite hopper inlet and 1 (no.) manual operated isolation valve at pyrite hopper outlet. Pneumatic operated valve has been envisaged at inlet of conveying vessel in line with earlier executed projects. In addition a Manual isolation valve at the outlet of pyrite hopper has been envisaged before the pneumatic vessel inlet valve which will remain open under normal operation. This valve shall be closed only in case of downstream equipment is to be attended. Please review and confirm.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
71	Vol IIIA, Sect-I Page 68 of 223	5.17.6 n)	Piping = MS IS:3589	Conveying / instrument Piping as required shall be provided as IS: 1239 heavy grade for pipe sizes up to 150NB. Please requested to confirm.	Bidder's undersatnding is correct; specification stands amended.
72	1	5.23.12	Expected wear life of ID fan components shall not be less than 25000 hours from the date of commissioning.	The expected wear life of the ID fan blade shall be achieved considering the dust burden of 150mg/Nm3.	Bid Specification shall prevail
73	Volume III A, Section - 1	Process Flow Diagram - Feedwater System / 5.25.2.4	MOV at the inlet of economiser	As per the IBR amendment Reg 520, boiler feed water discharge piping can be designed without economizer inlet valve for maximum sustainable pressure (not with shut off pressure) by providing suitable mechanical safety provisions.	Not Required..
74	1	5.25.2.5	Motor operated (M.O.) main steam stop valves shall be provided with M.O. bypass valve (integral) at SH outlet.	Some integral bypass valves will be provided for Large size gate valve, if necessary as per valve supplier recommendation. Basically, motor bypass valves are not provided.	motorised regulating as well as isolation valve for charging shall be provided.
75	1	5.25.2.7	Start-up vents, Super-heater and Re-heater safety valves shall be provided with silencers. The sizing of the Boiler Safety Relief valves 5 be as per IBR stipulation.	The sizing of the safety valve shall be in accordance with ASME guidelines. IBR does not state about the supercritical boiler safety valve selection.	Bid Specification shall prevail

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Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
76	1	Volume-III A/5.25.1 5	Silencers for all the safety valves on Pressure Vessels, superheater and reheater separately shall be provided in order to minimise the noise nuisance when the valve lifts.	1. Silencers for all Safety valves are normally not provided and hence not being envisaged for this project e.g. Deaerator, HP & LP Heaters, GSC etc. Please confirm acceptance. These safety valves will be activated during commissioning stage/ plant start-up only for testing purposes. Safety valves popping during normal operation for such applications would be extremely rare and hence silencers are not provided.	Bid Specification shall prevail
77	I	5.26	Boiler start-up Recirculation Pump and Drain system with start- up drain re- circulation pumps shall be provided and the start up drain shall be routed to the main condenser in the TG area through necessary atmospheric flash tank, drain receiving tank, 2 X 50% condensate transfer pumps, valves etc.	We propose to provide 2 X 50% condensate transfer pumps. Please confirm,	Bid Specification shall prevail
78	1	5.26.1 c)	(c) The start-up drain water recirculation system along with pipes/valves/flash tanks, Condenser etc. shall be sized in such a way that Steam Generator start up is possible, even with start up recirculation pump out of service.	Considering the reliability of Boiler circulation pump and also the design requirement of starting the boiler through low load start up system without boiler circulation pump, we propose to adopt 1 x 100 % Boiler Circulation Pump. Please confirm acceptance.	
79		5.26.3	Boiler start-up drain recirculation pumps and their motors shall meet the following requirements: (a) Number of pump : 2 X 100% (sized for maximum flow)		

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
80	I	5.26.3	The design temperature shall be at least 40 deg.C above the maximum fluid temperature for convection zone and 50 C for radiant zone	Design temperature margin of 40 C is not applicable for economiser zone - pl confirm	Bid Specification shall prevail
81	1	5.26.3	a) 2 x 100% (sized for max flow). b) gland less zero-leakage type with overhung impeller. c) Submerge type with wet stator with water coolers. Motor for steam generator start-up recirculation pumps shall be a wet motor, specifically designed by the pump manufacturer.....	Bidder will provide one BCP sized for about 25%BMCR flow. As per bidder standard the boiler can be started even BCP is out of operation. Hence stand by BCP is not required and not provided.	Bid Specification shall prevail
	1	Data sheet- A. Sr.No:12	2 x 100% Boiler circulation pumps for initial start-up/ low load operation.		
82	1	5.27.1	Aux steam header	We understand Bidder can offer two aux steam headers (high temp and low temp) or single aux steam header design. Please confirm.	Spec is self explanatory
83	1	5.27.1	Auxiliary steam system shall consist of one (1) auxiliary pressure reducing station (APRS) and a desuperheater on the steam line tapped off from the main steam line.	The steam for the auxiliary steam system shall be tapped from CRH Steam instead of the main steam line. The tapping of steam from main steam line will result in loss of high temperature steam.	Bid Specification shall prevail
84	1	5.27.3	The interconnection between auxiliary steam systems of the adjacent unit shall also be provided with separate isolating valves on both the sides and with required steam trapping equipment.	Manual Isolating valves shall be provided on both ends of HT and LT Aux steam header for future unit connection. Please confirm	Will be evaluated after receipt of detailed scheme by bidder.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
85	1	6.1	Maximum Design pressure : As per NFPA but shall not be less than ± 660 mm WC at 67 % yield strength.	Maximum Design pressure : As per NFPA but shall be within ± 660 mm WC at 67 % yield strength.	Bid Specification shall prevail
86	1	6.11	Power Supply System	Power supply distribution will be decided during detailed engineering. Please clarify whether CHP Switchgear is that of the existing plant or new plant. If existing switchgear is to be used, please furnish details.	Specification is self-explanatory
87	1	8.2	Design Temperature: Design Steam temperature + 40°C (minimum).	Design Temperature of Water Separator shall be as per standard supercritical boiler design practice	Bid Specification shall prevail
88	1	10.7	Tube and header materials: Design Metal Temperature: Upto & including 550° C :Alloy steel to ASME SA-335:P-11/ P-12/P-22/;ASME SA213:T-11/T-22/or equivalent Upto & including 600° C: Alloy steel ASME SA-335/P-91/ 92; SA213 T-91/92 or equivalent	Design Metal Temperature: Upto & including 550° C :Alloy steel to ASME SA-335:P-11/ P-12/P-22/;ASME SA213:T-11/T-12/T-22/or equivalent Upto & including 600° C: Alloy steel ASME SA-335/P-91/ 92; SA213 T-22/T-91/92 or equivalent, Austenitic stainless steel	Clause suitably amended; please refer Corrigendum- II
89	1	14.1	Pulverisers Type : Vertical Spindle, Bowl Mills.	Pulverisers Type can be : Vertical Spindle, Bowl Mills/ Vertical Spindle, Roll Wheel	Bid Specification shall prevail
90	1	14.6	Maximum loading of the mill with worst coal and design coal (for sizing which ever is higher) - 85% at 100% BMCR	Max. Mill loading of 90% at 100% BMCR with worst coal and design coal may please be accepted.	Bid Specification shall prevail

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
91	Sec- 1	14.8	PULVERISERS Input coal size to pulveriser 20 mm and below with 15% excursion up to 35 mm.	As per Volume – IIIA , Section – 1, Cl. No. : 14.8, Input coal size can be only up to 20 mm, However 15% excursion upto 35 mm is accepted.	
92	1	14.8	Input coal size to pulveriser : 20 mm and below with 15% excursion up to 35 mm.	Maximum Coal particle size at inlet of coal mills can be 50mm depending on mill design.	Bid Specification shall prevail
93	vol III-A, sce- 1, pg -94 of 223	14.9	Expected Output coal size from pulveriser - 70% through 200 mesh (75 micron) and 99% through 50 mesh (300 micron)	Pulveriser offered are equipped with static classifier which will achieve 70% through 200 mesh and 98% through 50 mesh. This will not result in unburnt carbon loss and will meet the boiler requirements.	Bid Specification shall prevail
94	1	12	2 x 100 % boiler recirculation pumps for initial start up / low load operation	The circulation pump is required to be in operation only during start up. Even when the pump is not available the boiler can be started up. Kindly clarify the need for 2x 100 % recirculation pumps.. Normally for similar boilers one pump is provided.	Bid Specification shall prevail
95	1	20.4	Maximum speed :1000 rpm	FD Fan Maximum Speed : 1500 rpm	Bid Specification shall prevail
96	1	21.1	Flue gas velocity : Maximum 13 m/sec.	Flue gas velocity : Maximum 13 m/sec before ESP. After ESP 16 m/sec	Bid Specification shall prevail
97	1	22.1.1	Arrangement of burners : Corner fire with Tilting arrangement	Arrangement of burners : Corner fire with Tilting arrangement / Alternatively Front or Rear wall fired burners as per Boiler designer's standard practice.	MAHAGENCO will revert.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
98	I	5.5(datasheet)	Maximum heat input per burner = 55 million	Considering the mill loading limited to 85 % capacity and each mill catering to 4 burners, the number of burners with 6 mills being 24 it is suggested that the maximum heat input to burner shall be 60 million.- please confirm.	Bid Specification shall prevail
99	1	data sheet A	Minimum load with separator running dry shall be 30% BMCR	Minimum once through load with separator running dry shall be 35% BMCR (i.e SGMCR).	Bid Specification shall prevail
100	1	data sheet A	Maximum loading of the mill with worst coal and design coal (for sizing which ever is higher) – 85% at 100% BMCR	Max. Mill loading shall be 90% at 100% BMCR with worst coal and design coal.	Bid Specification shall prevail
101	1	data sheet A	Expected output coal size from Pulveriser – 70% through 200 mesh (75 micron) and 99% through 50 mesh (300 microns)	The output fineness that we are proposing for mill selection is 70% through 200 mesh & 98% through 50 mesh. Please confirm.	Bid Specification shall prevail
102	1	Datasheet 1.12	Within ± 5 °C for all loads from 60 % to 100 % range BMCR	Please clarify whether the required steam temperature control range has to be considered as 60% TMCR (control load) to 100% BMCR.	Shall be 50 to 100 % BMCR
103	1	Data sheet-A. Sr.No:3	Boiler operation with H.P/L.P bypass: Boiler operation shall be capable of cold start-up without bypass. The plant shall be designed for modified sliding pressure operation. The Steam Generator and the auxiliaries shall operate continuously for a power supply frequency variation between 47.5 Hz and 51.5 Hz. In case of load rejection, Boiler firing rate shall be brought down to 60% BMCR.	As per our supercritical boiler design HP /LP bypass valve shall be in operation during cold start-up. Please confirm your acceptance	Agreed.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
104	1	Datasheet 4.0	Boiler control range shall be 50% to 100% BMCR.	Please clarify whether the required steam temperature control range has to be considered as 60% TMCR (control load) to 100% BMCR.	Bid Specification shall prevail
105	1	Data sheet-A. Sr.No:6.2	Maximum gas velocity before gas flow changes direction:10 m/s	Maximum average gas velocity shall be 10 m/sec in upper furnace (before gas flow changes direction).	Bid Specification shall prevail
106	1	Data sheet-A. Sr.No:7.1	Excess Air at APH inlet : 20%	Bidder will design the boiler with 15% of excess air. Bidder's technology partner has lot of reference installations with 15 % excess air for large capacity boiler.. However the draft system shall be designed for 20 % excess air.	Bid Specification shall prevail
107	1	Data sheet-A. Sr.No:7.3	Unburnt Combustibles at Economiser outlet as % of Fly Ash to be considered for determining boiler efficiency : 1.5 %	Since bidder will provide the advance burner system the the unburnt Combustibles at Economiser outlet as fly Ash is less than 1.5% as specified in the tender specification. Hence bidder should determine the boiler efficiency considering the actual unburnt combustibles.	Bidder shall consider 1%.
108	1 1	Data sheet-A. Sr.No:10.1 Data sheet-A. Sr.No:11.2	Convection pass gas velocity: Max 10 m/s Economiser Gas velocity:Max 10 m/s	Maximum average gas velocity shall be 10 m/sec.	Bid Specification shall prevail

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
109	1	Datasheet 10.5	RH temperature variation; By burner tilting with supplementry water spray	For boiler equipped with burners mounted on walls (non tilting type) ,temperature control methods other than burner tilting will be employed.	Bid Specification shall prevail
110	1	Datasheet 21.5	Duct plate; minimum thickness : 8mm for gas duct 6mm for air duct	Following Duct thickness is proposed. Gas duct : 7mm before ESP 6mm after ESP Air duct : 5mm Kindly confirm. This is adopted for other similar power stations in India.	Bid Specification shall prevail
111	1	Data sheet, Item 14.1	Coal mill	We understand that the vertical spindle, medium speed MPS type mills are also acceptable.	Bid Specification shall prevail
112	1	Data sheet Item 14.5	Mills- Wear life of grinding components	Please review the wear life requested for the grinding components. The value is very high for Indian coals.	Bid Specification shall prevail
113	1	Data sheet- A. Sr.No:14.10	Pulveriser Noise level : Not exceeding 85.0 DBA at a distance of 1.0M	Noise level around mill will be 90 dB(A) at a distance of 1.0 m.	Bid Specification shall prevail

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
114	1	Data sheet-A. Sr.No:17.5	PA fan margins test block: Margins over theoretical calculated requirement at 100% BMCR with worst coal having highest moisture, considering 10% leakage in air heater.	Bidder understands theoretical air shall be calculated as follows 1. 100 % BMCR firing worst coal 2. Ambient temperature - 27 deg C and 60 % RH 3. AH leakage - Actual leakage Further the margin shall be applied over theoretical air arrived as above and with power supply frequency - 50 Hz shall be 1. Head - 30 % 2. Flow - 25 %	Bid Specification shall prevail
115	1	Data sheet-A. Sr.No:19.4	ID fan: Maximum Speed 600 rpm	The ID fan shall be selected with maximum speed of 750 rpm as per OEM standard. The no. of stages can be single or two.	Bid Specification shall prevail
116	1	Data sheet-A. Sr.No:19.5	ID fan capacity: (i) Excess air-20% over Stoichiometric air. (ii) Air heater air in-leakage - Primary air leakage 15% and Secondary air leakage 10%. (iii) Air in leakage- 1 % of ESP inlet gas flow and 2% through ducts	(ii) Since bidder will provide the trisector air heater in the proposed project the total airheater leakage (primary + secondary) is about 6%. Hence for the ID fan selection the total airheater leakage shall be considered instead of primary air and secondary air leakage separately. (iii) Since we ensure the air ingress through the duct is zero same shall be considered for ID fan sizing.	Bid Specification shall prevail

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
117	1	Data sheet-A. Sr.No:20.6 (vi)	FD fan Margin(Test Block): (i) Head - 30% (Over theoretical Requirement) (ii) Capacity - 20% (Over theoretical equipment)	Bidder understands theoretical air shall be calculated as follows 1. 100 % BMCR firing design coal / worst coal 2. Ambient temperature - 27 deg C and 60 % RH 3. AH leakage - Actual leakage Further the margin shall be applied over theoretical air arrived as above and with power supply frequency - 50 Hz shall be 1. Head - 30 % 2. Flow - 20 %	Bid Specification shall prevail
118	1	Data sheet-A. Sr.No:21.1	Duct flue gas velocity: Maximum 13 m/ sec.	We propose to apply flue gas velocity as follows Boiler to ESP - 15 m/s ESP to chimney - 20 m/s	Bid Specification shall prevail
119	1	Data sheet-A. Sr.No:21.2	Duct Air velocity: Maximum 16 m/ sec.	We propose to apply air velocity as follows Cold air - 15-20 m/s Hot air - 20 m/s	Bid Specification shall prevail

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
120	1	Data sheet-A. Sr.No:21.5	(i) Minimum thickness - 8 mm in gas duct. (ii) Minimum thickness - 6 mm in air duct. (iii) Corrosion allowance of 1.5 mm shall be considered for stress calculation.	We propose to apply the duct thickness as follows: 1. Hot and Cold Air duct - 5 mm 2. Gas ducting - 6mm 3. Material - SA36 or equivalent 4. Corrosion allowance shall not be considered for stress calculation.	Bid Specification shall prevail
121	1	Datasheet :Note 6(page 106)	Mill turn down ratio shall normally be 4:1.	Mill turn down ratio shall be 2:1, as minimum 50% mill loading is recommended.	Bid Specification shall prevail
122	1	Data sheet Item 122.1.1	Burners	We understand that the wall fired burners (opposed wall firing) without tilting arrangement as per boiler manufacturer standard technology is also acceptable.	Bid Specification shall prevail
123	1	Note-1.0	BMCR capacity	Normally the BMCR of boiler is considered as 102% of the turbine VWO steam flow plus continuous steam requirement for auxiliary systems at that load. The specified capacity of 110% of TMCR appears high. Please review and confirm.	Bid Specification shall prevail
124	1	DATA SHEET-A NOTES: 1.0	Steam flow at 100% Boiler Maximum Continuous Rating (BMCR) shall be 110% of Turbine Maximum Continuous Rating (TMCR) flow.	As per CEA guideline, Steam flow at 100% Boiler Maximum Continuous Rating (BMCR) is 107% of Turbine Maximum Continuous Rating (TMCR) flow. Please clarify if CEA guideline is acceptable.	Bid Specification shall prevail

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
125	1	General	-	Mill Reject Handling System specification i.e. design criteria is not available. Please provide details for Mill reject handling system.	Please refer Corrigendum - I
126	1	General	Specification does not state requirement.	Oily water drain from pit in transfer pump house shall be transferred to near by oily water pit in dyke area of fuel oil storage tank of existing plant. Kindly Confirm.	Will be evaluated after receipt of detailed scheme by bidder.
127	1	General	Specification does not state requirement.	Since the return line temperature for HFO will be high, and consequently will raise the FO day tank temperature over a period of time, hence we propose HFO cooler in long recirculation line from Boiler to HFO day tank. This equipment is required for system safety. Please confirm.	The bidder shall consider as required for the system
128	1	Volume- IIIA/ Datasheet- A Note 1.0	Steam flow at 100% BMCR shall be 110% of TMCR flow.	Owner may kindly recheck this requirement since the boiler will be unnecessarily over sized. As generally followed, 100% BMCR can be 107% of TMCR flow, which would be adequate for the purpose.	Bid Specification shall prevail
129	1 Page 51 of 247	Corrigendum-1/		Amendment through corrigendum-1, Sr. No. 2 of Pg. No. 51 of 247 is contradictory with specification clause no. 5.17.6 (e) of Volume III-A of 1 % of mill capacity. Please note that mill capacity is selected with margin. Hence does not required extra margin of 125 % of mill reject generated as per mill capacity.	Bid Specification shall prevail

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
130	2	2.1	ESP swgr	HT Switch Gear is not applicable in ESP. HT supply will be fed to the ESP Unit transformers from HT switchgear in turbine building.	Specification is self-explanatory
131	2	2.8	The ESP housing shall be minimum 8 mm thick''	The value appears to be on the higher side. As per APIL standard design the same should be max. 6 mm thick.	Bid Specification shall prevail
132	2	2.8	ESP casing	The ESP housing thickness will be decided based on the yield strength of the plate considering adequate factor of safety. Normal practice is 6 mm for the casing which is adopted for other similar power stations in India. Please review.	Bid Specification shall prevail
133	2 page 114 of 223	2.8	Casing plate thickness. ESP housing shall be minimum 8 mm thick.	As per industry practice, casing plate thickness should be 6 mm. Please confirm acceptance.	Bid Specification shall prevail
134	2	4.1	For ESP, Guillotine type gas-tight dampers shall be provided on inlet & outlet so that one bank can be maintained while the others are in service. For this purpose, double isolation with intermediate venting may be used, if required as an alternative.	Guillotine Type damper shall be considered on inlet / outlet of ESP as per standard practise. Kindly clarify the intent of specifying double isolation with intermediate venting in the specification.	Double isolation valve with intermediate venting requirement is deleted.
135	2	4.1	ESP sections	For optimised duct layout and equal distribution of flue gas from APH exit, four parallel pass capable of independent operation may be sufficient. Please review.	Bid Specification shall prevail

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
136	2	4.2	Each ESP section shall be arranged for scavenging the flue gas out.	Process of scavenging is not clear to us. Please clarify.	Spec is self explanatory
137	2	4.2	Aerodynamic distribution system to be utilized in place of perforated plates to reduce RMS deviation over mean velocity below 15%.	Alstom standard design uses perforated gas distribution screens with baffles at inlet. Gas distribution criteria is as per ICAC-EP-7 Criteria and shall be checked during GD test.	Will be evaluated after receipt of detailed scheme by bidder.
138	2	4.2	ESP	Alternately the following may also to be permitted: Perforated plates will be used with deflection baffles, after evaluation of flow pattern using CFD, to ensure effective retention capability and uniform flue gas distribution across the cross section of the ESP.	
139	2 page 115 of 223	4.2	Aerodynamic distribution system to be utilized in place of perforated plates to reduce RMS deviation over mean velocity below 15%.	Without affecting performance of ESP, the RMS deviation can be allowed upto 20%. Please confirm acceptance.	
140	2	4.2	Aerodynamic distribution system to be utilised in place of perforated plates to reduce RMS deviation over mean velocity below 15%.	With a view of ensuring an even distribution of the incoming gas flow throughout the cross-section of the Precipitator and to reduce the overall pressure loss to optimum level, specially punched/perforated gas distribution plates at the inlet cone of the Precipitator can also be provided.	

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
141	2 page 116 of 223	4.3.1	Hopper plate thickness	As per industry practice, hopper plate thickness should be 6 mm. Please confirm.	Bid Specification shall prevail
142	2	4.3.2	The ash handling system valves and piping shall be supported from the hopper flange and hopper wall through suitable hanger connection.	Supporting of ash handling equipments shall be as per design	Bid Specification shall prevail
143	2	4.3.2	Hoppers shall be welded from steel plates, suitably stiffened and not less than 10 mm thick	The value appears to be on the higher side. As per APIL standard design the same should be max. 6 mm thick.	Bid Specification shall prevail
144	2 page 116 of 223	4.3.3	The thermostatically controlled heating elements shall be designed adequately to maintain ash temperature near hopper outlet above dew point between 120 to 150°C.	The range may please be limited to 90-120 deg C as this range is enough to maintain the flow ability of ash.	Bid Specification shall prevail
145	2 page 116 of 223	4.3.3	Hopper heater shall be panel type	Tubular type hopper heaters may please be allowed as an alternative.	Bid Specification shall prevail
146	2	4.3.5	Provision shall be kept for truck entry below hoppers for emergency ash unloading in trucks	Clearance req. below ESP hoppers to be confirmed by the client.	3.5 m (minimum)
147	2	4.3.6	Level indicator switch of approved quality shall be installed on the hopper for indication of ash level	Capacitance type level switch shall be considered as per our standard practice. Please confirm acceptance.	Spec is self explanatory
148	2	4.3.7	The bidder shall provide necessary arrangements for fixing fluidizers in hopper.	Provision for fixing fluidizer in ESP hoppers shall be provided. However fluidizer and it's arrangement shall be supplied by others.	Bid Specification shall prevail

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
149	2	4.8	Anti-sway devices shall be provided to prevent shifting and swinging of the frames.	As per Alstom standard practice Anti-sway device is not envisaged in APIL design.	Bid Specification shall prevail
150	2 page 119/126	Collecting Electrodes / Data Sheet A, 4.11 & 12.0	Specific collecting area 300 mm 250m ² /m ³ /sec	For 400 mm inter electrode spacing the SCA shall be 187.5 m ² /m ³ /sec.	Bid Specification shall prevail
151	2	4.16	ESP swgr	HT Switch Gear is not applicable in ESP. HT supply will be fed to the ESP Unit transformers from HT switchgear in turbine building.	Specification is self explanatory
152	2	11	ESP guarantee	We understand that for ESP performance guarantee test point 100% TMCR, design coal, one field out of service- <50 mg/Nm ³ . In SI No. 2.0 it is "design coal" and sl. No. 9.0 it is "worst coal". Please confirm.	Please refer Data sheet A, Vol IIIA , Section 2, SI No. 11(a)
153	2	22.0	Head room below ash hopper is 5.0M (Indicative)	Height of ash hopper outlet flange above boiler area floor level, EL (+) 3.5/ EL (+) 2.5 is sufficient to meet specification requirements, depending on type of ash evacuation system finalised.	Height of ash hopper outlet flange above boiler area floor level, EL 3.5(minimum)

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
154	Section - 2 Page 125 of 223	DATA SHEET - A 1.0 & 2.0,	Guarantee Unit loading- 100% TMCR Type of coal-Design coal	We interpret that ESP shall be designed for outlet dust concentration of 50mg/Nm ³ while firing 100%BMCR-WC with all fields in service and guaranteed for a dust concentration of 50mg/Nm ³ at 100% TMCR-WC firing condition with one field out of service i.e. in line with Cl:11.0 of datasheet-A. Kindly confirm	Please refer Data sheet A, Vol IIIA , Section 2.
155	Section - 2 Page 126 of 223	DATA SHEET - A, 11.0,	Outlet dust concentration with (a) one field out of service in each gas path with worst specified coal under 100% TMCR condition (b) all fields operating in each gas path with worst coal firing under 100% BMCR condition <50 mg/Nm ³		
156	3	1.1 & 1.5.1	Clause 1.1 : Supply of fuel oil (HFO) to boiler up to the load of 30 % rated output for support to stabilize coal firing. Clause 1.5.1 : The HFO shall be supplied through pressurizing pump & heater-sets for stabilization of pulverized coal combustion up to 40 % rated output.....coal firing.	We presume that HFO shall be used to support flame upto a load of 30% BMCR only.	The HFO system shall be sized for load carrying upto 30 % BMCR. Boiler minimum stable load without oil support shall be 40% BMCR.
157	3	1.1	HEAVY FUEL OIL SYSTEM The Fuel oil system for the plant is meant for supply of fuel oil (HFO) to the boiler upto the load of 30 % rated output for support to stabilize coal firing.	Please confirm our understanding as below: 1. Load carrying capacity of the HFO system is 30% BMCR. 2. Boiler min stable load without oil support is 40% BMCR. 3. Load carrying capacity of the LDO is 10% BMCR.	The HFO system shall be sized for load carrying upto 30 % BMCR. Boiler minimum stable load without oil support shall be 40% BMCR.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
158	3	1.5.1	HFO system	We understand that the rated output here means TMCR. Please clarify.	It means BMCR
159	3	1.5.1	The HFO shall be supplied through pressurising pump & heater-sets for stabilisation of pulverised coal combustion upto 40% rated output...	Please confirm our understanding as below: 1. Load carrying capacity of the HFO system is 30% BMCR. 2. Boiler min stable load without oil support is 40% BMCR. 3. Load carrying capacity of the LDO is 10% BMCR.	The HFO system shall be sized for load carrying upto 30 % BMCR. Boiler minimum stable load without oil support shall be 40% BMCR.
160	3	2.4	HFO system	Please clarify if electric heat tracing can be offered instead of steam tracing.	Bid Specification shall prevail
161	3	3.3	Oil water separator	Please review if a common oil water separator in the ETP area can be provided which can handle oily waste from fuel oil area and also other areas.	Bid Specification shall prevail

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
162	3	3.3 & 3.6	As per clause 3.3 oily water separator shall be provided. Also, as per clause 3.6 two (2) recovery pumps shall be provided to recirculate oil from oil water separator to HFO tanks. As per P & I diagram of Effluent Treatment System (PE-189-PI-250) oily water waste from fuel oil storage area shall be transferred to common oily water pit in ETP area.	We propose to proceed as per the following: Oily water waste from Fuel oil pressurizing pump house area and day tank dyke area shall be transferred to common oily water pit in ETP area as mentioned in ETP scheme. Hence, Oily water separation tank, recovery pumps shown in FO P&I D (PE-189-PI-252) will not be required. Further, drain oil from drain oil tank of Fuel oil day tank and pressurizing pump house area shall be transferred to HFO day tank by 2 X 100 % drain oil pump.	Bid Specification shall prevail
163	3	4.1	LDO tank	Please clarify capacity of LDO day tank.	500 m3
164	3	4.2.1	LDO transfer pump	Please review capacity specified. This appears to be high. HFO pump capacity specified is 125 cum/h only.	Bid Specification shall prevail
165	3	Volume - IIIF/4.5.2 (d) 6.1.10	As per Volume - IIIF, The strainer shall have screen of stainless steel (AISI 316) construction..... Where as as per Volume - IIIA, The strainer shall have screed of stainless steel (AISI 304) construction.	The strainer with screen of stainless steel (AISI 304) construction will be considered. Please confirm	AISI 316 shall be considered.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project
Pre - Bid Queries
Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
166	3	6.2.14	Surface Preparation and Painting	Painting for HFO storage tank shall be followed as per standard practice for non coastal projects which is as follows: Internal(Surface Preparation blast clean to SA2.5)) ,Primer Not Applicable, Finish 2 coats of double boiled linseed oil) External (Surface Preparation Hand power/power toolcleaning/wire brushing to ST2 , primer 2 coats of zinc phosphate primer (IS2074) of min 30 microns DFT each, Finish Not applicable as tank shall be insulated) Underneath (Surface preparation Blast clean to SA2.5, Primer 1 coat of high built coal tar epoxy suitably pigmented, DFT 80-100microns, Finish not applicable, total DFT 80-10 microns). Pl.confirm.	Bid Specification shall prevail

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project**Pre - Bid Queries****Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A**

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
167	3	6.2.14	Surface Preparation and Painting	Painting for LDO storage tank shall be followed as per standard practice for non coastal projects which is as follows: Internal(Surface Preparation blast clean to SA2.5)) ,Primer Not Applicable, Finish 2 coats of double boiled linseed oil) External (Surface Preparation Hand power/power toolcleaning/wire brushing to ST2 , primer 2 coats of zinc phosphate primer (IS2074) of min 30 microns DFT each, Finish 2 coats of synthetic enamel (IS2932) paint of 20-25 microns DFT each, total DFT 70-80 microns) Underneath (Surface preparation Blast clean to SA2.5, Primer 1 coat of high built coal tar epoxy suitably pigmented, DFT 80-100microns, Finish not applicable, total DFT 80-10 microns). pl.confirm.	Bid Specification shall prevail

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
168	3	6.3 Volume VII-A2/Dwg. No. PE-189-PI-252	Heating steam shall be converted to hot condensate, which shall be brought to auxiliary flash tank from where it will be drained to WTP or area drainage. As per P&ID Condensate drain pump is shown.	Condensate drain from Auxiliary flash tank shall be drain to nearest area drain by gravity. Hence, condensate pump may not be required. Please examine and confirm.	Bid Specification shall prevail
169	3	6.4	Dyke area: The width of the dyke is calculated considering 10 m clearance from tank to dyke on both sides. The out to out clearance maintained in two tanks.	Dyke area shall be provided as per OISD 118.PI.confirm.	Bid Specification shall prevail
170	3	Data Sheet-A Fuel Oil Transfer Pumps (Sr No. 18.0)	LDO transferring pump(Body steam jacketed type)	Steam Jacketed type body may not be required for LDO transfer Pumps. Please confirm	Bidder's understanding is correct.
171	3	Data Sheet-A HFO Heater (Sr No. 18.0)	MOC of tubes SA 285 GR.C or superior as per manufacturer standard.	SA 285 Gr C material is not applicable for tubes. Tubes will be of seamless SA 179 material.	Bidder's understanding is correct.
172	4	1	In course of startup of chemistry excursions, all volatile type of treatment by use of ammonia and hydrazine injection shall be used.	AVT chemical dosing during startup conditions consisting of hydrazine and ammonia dosing system has been specified as per tender requirement. It may please be note that for oxygenated treatment system, hydrazine dosing (reducing agent) is not recommended. PI.confirm.	It is to confirm that Oxygen dosing is required. But when the DO exceeds 0.015 cc/lit, Hydrazine dosing is required.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	RESOLUTION
173	4	1.2.1.1	Residual dissolved oxygen present in feed water at downstream of Deaerator can be detrimental to feed cycle equipment. In order to control the same, continuous injection of dilute solution of hydrazine is envisaged at outlet of Deaerator (suction of Boiler Feed Pumps). Provision shall be kept to inject hydrazine at outlet of Condensate Polisher.	For supercritical plants and also as per our std practice, AVT (O) combined with OT is generally used and same is also required as per the tender vol. III-B sec 4, clause no. 1.1 "oxygen injection system." However tender also calls for hydrazine dosing for oxygen scavenging, which is in contradiction with the requirement. Please confirm.	It is to confirm that Oxygen dosing is required. But when the DO exceeds 0.015 cc/lit, Hydrazine dosing is required.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

RESPONSE TO PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1

VOLUME - III B

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
1	1	1.16	type of foundation-conventional or spring supported	We understand that the STG foundation shall be Conventional or Spring supported as decided by the bidder. Please clarify.	Specification is self-explanatory, both rigid type and spring type support are acceptable
2	1	2.1.3	Duplex type Turbine digital electro hydraulic (DEH) governing system including governors, load limit device, low vacuum tripping device, bearing protective devices, solenoid trip etc as specified hereinafter and all equipment mounted/local instruments (pressure, temperature, level switch, primary sensing device etc.), as required	Load control will be carried out by Electrohydraulic governing system as per standard and proven practice of Bidder.Hence, load limiter device is not applicable as per bidder's design. Please confirm acceptance of bidder's design.	Bid Specification shall prevail
3	1	2.1.10	Turbine Local gauge board	As per bidder's standard practice, gauge board will be provided on control panel only. Please confirm acceptance of bidder's standard practice.	Bid Specification shall prevail
4	1	2.1.16	DC solenoid operated vacuum breaker valve with air lock relay and with provision for remote operation	Bidder standard and proven practice to have Motorized Vacuum Breaker with AC power supply. Please confirm acceptance of bidder's standard practice.	Bid Specification shall prevail
5	1	2.1.17	One (1) portable centrifuge of adequate capacity shall be provided.	We understand that one (1) no of portable centrifuge is common for both the MD BFPs. Kindly confirm.	Confirm

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
6	1	2.1.17 & 2.1.18	Two (2 x 30%) motor driven boiler feed water pumps complete with,..... ON/OFF low load recirculation feed control valve, mobile cradle, integral.....	Employer to note that as per clause 2.1.2 (k) of section 3, Vol III B, it is mentioned that modulating type recirculation control valves are required for BFP recirculation however as per clause 2.1.17 & 2.1.18 On/ OFF type recirculation control valve are required for the BFP. We understand that modulating type recirculating control valves are to be provided with hydraulic/ pneumatic actualtor as per standard and proven practice of the Bidder. Kindly confirm.	Clause 2.1.2(k) shall prevail.
7	1	2.1.20	3 x 50% capacity motor driven condensate extraction pumps along with all accessories, drives, suction strainers, associated piping & valves along with One canister drainage pump.	We understand that the cannister pump mentioned here is required for the draining out the waste from the CEP pit. Owner to note that the drains from CEP pit shall be removed as per standard drian philosophy of the Bidder with the help of submersible pumps. Kindly confirm.	Bid Specification shall prevail
8	1	2.1.23(a)	Condenser make-up water system- (a) 2 x 100% make-up water pump, 2 x100% boiler fill pumps and condensate storage tank	We understand that the tanks in Cl. 2.1.23(a) page 16 of 308, Vol-III B and in Cl. 2.2.9 page 19 of 308, Vol-III B are same and are referred to Condensate Storage Tank. Please clarify.	Bidders' understanding is correct.
9	1	2.1.37 (a)	Complete hardware and software, Push button stations, <u>Hand-auto stations</u> , Status indication for turbine generator control systems.	Requirement of "Hand -auto stations" in specification is not clear. Request you to elaborate the same.	It means Auto- Manual stations

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PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
10	1	2.1.37	The scope of Instrumentation & Control shall include but not be limited to the following, as elaborated in Volume V. (g) Electro-hydraulic Governor with mechanical backup.	Electronic backup for electrohydraulic governor is provided as per bidder's proven practice. Mechanical backup is not applicable as per bidder's design. Please provide acceptance of bidder's standard design.	Bid Spec is self-explanatory
11	1	2.2.4	Bolt-heating device, tongue wrenches etc.	Pre Tensioned hydraulically expansion/elongated bolts are used as per bidder's standard and proven practice. Expansion/elongation bolts are provided with hydraulic stretching devices for pre stretching. Please confirm acceptance of bidder's standard practice.	Bid Specification shall prevail
12	1	2.2.8	Type of foundation for turbine and generator shall be of Conventional or spring supported RCC	We understand that the STG foundation shall be Conventional or Spring supported as decided by the bidder. Please clarify.	Specification is self-explanatory
13	1	2.2.9	A reserve feed water tank-cum-condensate surge tank of adequate capacity, with provision for filling, supplying make-up to Condenser hot well, boiler filling, receiving dumped condensate, supplying gland sealing water, overflow and vent through seal pots etc	We understand that the tanks in Cl. 2.1.23(a) page 16 of 308, Vol-III B and in Cl. 2.2.9 page 19 of 308, Vol-III B are same and are referred to Condensate Storage Tank. Please clarify.	Bidders' understanding is correct.
14	1	3.2.a&d/1.18	Pressure drop in extracion and Reheat circuit.	As this is an EPC contract, the pressure drops selection can be optimised by the bidder for the better performance. Please review and advise.	Bid Specification shall prevail

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PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
15	1	3.2(e)	The Auxiliary steam flow tapped from CRH steam line shall be minimum 1% of Throttle flow and.....	Steam required for Auxiliary purpose for our standard 660 MW set from CRH line is 'x' T/hr. Hence, balance of steam between 1% & 'x' T/hr will be taken as boiler blow down. Please confirm that this is acceptable to MahaGenco	Specification is self-explanatory
16	1	3.2 (e)	The auxiliary steam tapped from cold reheat steam line shall be minimum 1% of throttle steam flow and the make-up system shall accordingly be designed.	Please clarify the design make-up quantity. it is 1% or 3% ?	1%.
17	1	3.3	Heat rate will be defined as follows..	It is clarified as follows, 1. Guaranteed HBDs will be based on 0% Mu condition only. So Mm and Hm need not be indicated. 3. The spary water tap off for super heater is at the economiser inlet .Hence Msx is not applicable .	1. Bid Specification shall prevail
18	1	3.4	The Bidder shall state the maximum continuous capability of the Turbine with valves wide open (VWO) and indicate the maximum flow passing ability of the machine corresponding to rated steam parameter and at rated condenser vacuum at 77 mm Hg absolute.	We understand that VWO condition as defined by tender is, when throttle steam flow is 105% of steam flow of TMCR condition and not 105% TMCR load. Please clarify.	VWO is 105% TMCR Load
19	1	3.6	The Turbine Generator unit shall be designed to operate satisfactorily under prevailing climate. It shall be suitable for indoor installation on reinforced concrete foundation mounted on springs and dampers.	We understand that the STG foundation shall be Conventional or Spring supported as decided by the bidder. Please clarify.	Specification is self-explanatory

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
20	1	3.10	The radiated sound level of the Turbine-Generator train shall not exceed 85 dB(A) when measured at a distance of one (1) meter in plan or elevation from the outline of the Turbine Generator at the shaft centerline elevation at any load considering the background noise of the other machine and auxiliaries.	Generator expected A-weighted surface sound pressure level of $L_{pA}=90(A)$ when measured 3ft (1m) in horizontal plane and at an elevation of 5ft (1.5m) from grade.	Bid Specification shall prevail on the noise level. The measurement is from the outline of the equipment.
21	1	3.10	The radiated sound level of the Turbine-Generator train shall not exceed 85 dB (A) when measured at a distance of one (1) metre in plan or elevation from the outline of the Turbine Generator at the shaft centreline elevation at any load considering the background noise of the other machine and auxiliaries. The radiated sound level of all auxiliaries supplied with the Turbine Generator shall not exceed 85 dB (A) when measured at a distance of one (1) metre from the noise emanating surface. For valves & orifices, the measurement shall be made one (1) metre down stream of the devices and one (1) metre from the surface of the pipe for any combination of pressure drop and flow.	As required in Section 8 - Clause 1.4.34 of the Master Specifications (Vol. II) regarding the Noise Performance Guarantees, the near field noise levels will be measured at 1 m distance from the equipment outlines, and at a height of 1.5 m above the floor or walkways level. As per clarification about Section 4 - Clause 17.2.1 of the Master Specifications (Vol. II) regarding Noise Level Requirement, the correction for the influence of the background noise will be done, if applicable, as per procedures of ISO 3746:2010. Furthermore, the noise measurements will be carried out during the continuous operation of the Plant at base load.	Bid Specification shall prevail on the noise level. The measurement is from the outline of the equipment.

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Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
22	1	3.10	The radiated sound level of the Turbine-Generator train shall not exceed 85 dB (A) when measured at a distance of one (1) metre in plan or elevation from the outline of the Turbine Generator at the shaft centreline elevation at any load considering the background noise of the other machine and auxiliaries. The radiated sound level of all auxiliaries supplied with the Turbine Generator shall not exceed 85 dB (A) when measured at a distance of one (1) metre from the noise emanating surface. For valves & orifices, the measurement shall be made one (1) metre down stream of the devices and one (1) metre from the surface of the pipe for any combination of pressure drop and flow.	AS per CEA guidelines,"the noise level for continuously operating equipment shall not be more than 85 dB(A) at a distance of 1m and at a height of 1.5 m from any equipment except TG. Noise level for Turbine generator shall not exceed 95 dB(A)". The same guidelines will be followed. Pls confirm.	
23	1	5.1	The Steam Turbine shall be of Supercritical, Condensing, Reheat and regenerative, tandem compound, multi-cylinder design (not less than 3) with separate HP, separate IP and separate LP casing(s) OR combined HPIP and separate LP casing(s), nozzle and throttle governing, horizontal type coupled to a directly driven AC Generator. The ranges of steam parameters and Turbine Generator output have been indicated in Datasheet-A.	As per bidder's design only throttling governing is envisaged. Please confirm acceptance of OEM design.	Bid Specification shall prevail

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Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
24	1	5.1	The steam turbine shall be... of nozzle & throttle governing.	Our steam turbine shall be of throttle governing type. Please convey acceptance	Bid Specification shall prevail
25	1	5.4	The Turbine shall be capable of permitting a maximum sustained steam pressure of atleast 10% over the design Turbine inlet steam pressure.	Bidder would like to clarify that over pressure operation is not envisaged for this plant and hence no pressure margin shall be provided over the design turbine inlet steam pressure. We understand that operation capability mentioned in the datasheet-A is the continuous 105% output with the rated steam pressure corresponding to VWO condition shall be 660 MW + 5%, i.e. 693 MW. Please confirm that Bidder's understanding is correct and amend the specification accordingly.	Overpressure requirement as per IEC -45 shall be complied with.

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Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
26	1	5.4	TURBINE TYPE AND RATING The Turbine shall be capable of permitting a maximum sustained steam pressure of at least 10% over the design Turbine inlet steam pressure.	"The Turbine shall be capable of permitting a maximum ~~sustained~~ steam pressure of <u>at least</u> ~~5~~ <u>10</u>% over the design Turbine inlet steam pressure <u>in accordance with IEC-45 requirement.</u>" Reason: Please reconfirm your requirement regarding overpressure operation. According to IEC-45 clause 6.2, "The average initial pressure at the turbine inlet over any 12 months of operation shall not exceed the rated pressure. In maintaining this average, the pressure shall not exceed 105% of rated pressure". If 10% overpressure operation is required please advice the operating conditions. Such overpressure operation is not envisaged in our plant design philosophy including boiler and turbine, and we consider it unnessary.	Provisions as per IEC-45 shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
27	1	5.5	The turbine shall be capable of accepting variation in steam temperature and pressure as per IEC-45 in case continuous over pressure is likely.	Bidder would like to clarify that over pressure operation is not envisaged for this plant and hence no pressure margin shall be provided over the design turbine inlet steam pressure. We understand that operation capability mentioned in the datasheet-A is the continuous 105% output with the rated steam pressure corresponding to VWO condition shall be 660 MW + 5%, i.e. 693 MW. Please confirm that Bidder's understanding is correct and amend the specification accordingly.	Bidders understanding is correct.
28	1	5.6	Turbine shall be suitable for two cycle shift operation	Tender requirement is not clear. Please elaborate the same.	It is clarified that the turbine is meant for base load operation.
29	1	6.1.1	The casing shall be designed for hydrostatic test pressure of at least 150% of the Design pressure.	Hydraulic pressure test not possible for Gland Seal Casings due to geometry constraint.	Bid Specification shall prevail
30	1	6.1.1	The casing shall be designed for hydrostatic test pressure of at least 150% of the Design pressure. The casings shall be free from sharp corners, sudden changes in section and other features, which may result in unnecessary stress concentration. H.P. Cylinder shall be double casing type.	As per bidder's proven practice, hydraulic test is not considered. The risk is mitigated by bidder's NDT philosophy and design. Bidder ensuring the quality of the equipments by giving reference of same unit in operation world wide. Please confirm bidder's proven practice.	

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
31	1	6.1.1	The casing shall be designed for hydrostatic test pressure of at least 150% of the Design pressure.	As per bidder's proven practice, hydraulic test is not considered. The risk is mitigated by bidder's NDT philosophy and design. Bidder ensuring the quality of the equipments by giving reference of same unit in operation world wide. Please confirm bidder's proven practice.	
32	1	6.1.3	The casing drains shall be provided with temperature sensing devices to ensure proper evacuation of drains.	Turbine Internal drains are controlled based on load. Before attaining 15 % internal drains remain open irrespective of Condensation and close afterwards. Accordingly temperature sensing devices are not envisaged as standard and proven practice.	Bid Specification shall prevail
33	1	6.1.4	The Steam Turbine casings shall be horizontally split at the centreline.	HP turbine casing shall be as per OEM proven design. Please confirm.	Bid Specification shall prevail
34	1	6.1.5	The LP turbine Outer casing shall be provided with a manhole on both sides of the turbine	In offered Machine, man hole is provided on Cross Over Pipes & not on LP outer casing. Please confirm that this is acceptable to MahaGenco	Will be evaluated after receipt of detailed scheme by bidder.
35	1	6.1.8	Thermocouples shall be provided on High pressure (HP) and intermediate pressure (IP) valve blocks and on HP & IP turbine cylinder top and bottom casing to indicate metal temperatures to enable evaluation of thermal stress levels.	Thermocouples will be provided as per bidder's standard practice. Please confirm acceptance of bidder's standard practice.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
36	1	6.1.8	Thermocouples shall be provided on High pressure (HP) and intermediate pressure (IP) valve blocks and on HP & IP turbine cylinder top and bottom casing to indicate metal temperatures to enable evaluation of thermal stress levels.	As per bidder's design thermal stress levels are monitored through startup probes provided on HP\IP turbine inner chest and loading/unloading margins are calculated internally through stress calculation. Valve block temperature measurement is not envisaged for Turbine Stress evaluation, hence not envisaged as per standard and proven practice. Please provide acceptance of bidder's standard and proven practice.	Bid Specification shall prevail
37	1	6.1.10	When jack screws are used as a means of parting contact on faces, the mating face shall be counter-bored to receive the jack screw in order to prevent subsequent scoring due to improper fit caused by marking.	As per alstom standard practice dog point jacking screw with chrome eletroplating as per ISO 4042 are used, which can ensure the scoring do not occur at parting plane (on machined surface).Please confirm acceptance of bidder's standard practice.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
38	1	6.1.13	Bolts, nuts and studs used for the Turbine casing flanges and main Turbine valve bonnets etc., shall be with milled threads and of special alloy steel properly treated. Provision shall be made for electrical heating of the bolts to facilitate setting & loosening. In addition, the supplier shall indicate the design feature incorporated to prevent the seizure of nuts, studs, which will facilitate their easy removal after operating the machine. Bolts shall be designed to distribute the load evenly on all the threads without stress concentration. All the joints shall have sufficient flexibility to remain tight with rapid changes of temperature. Before shipment, each bolt shall be thoroughly examined and inspected to ensure freedom from any defects.	As per bidder's standard proven practice bolts are not electrically heated instead hydraulically tightened pre-tensioned elongation bolts are used. Please confirm acceptance of bidder's standard practice	Bid Specification shall prevail
39	1	6.1.14	Necessary quantities of assorted bolt heaters , torque or other wrenches, extensometers, bolt thread lubricator shall be included in the proposal as part of maintenance tools and tackle. The proposal shall specify bolt loading and strains and shall state the estimated period in which retightening or replacement of the bolts will be required and shall furnish detailed data, method and instruction for this purpose.	As per bidder's standard proven practice bolts are not electrically heated instead hydraulically tightened pre-tensioned elongation bolts are used. Please confirm acceptance of bidder's standard practice	Specification is self-explanatory

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
40	1	6.1.15	The springs supports of turbine on the foundation shall be designed considering.....	We understand that the STG foundation shall be Conventional or Spring supported as decided by the bidder. Please clarify.	Specification is self-explanatory, both rigid type and spring type support are acceptable
41	1	6.2.1	Alternatively, the rotor could also be of proven welded construction. & If the HP-IP or IP-LP rotor is of welded type, only one weld is permissible between the rotors	OEM's standard & proven design is with welded rotor only. Number of welds shall be as per OEM design. Further, it shall be noted that Bidder has separate HP, IP & LP modules & there is no welding involved for HP-IP or IP-LP.. Also refer to clause 6.2.2	Bid Specification shall prevail
42	1	6.2.2	After machining and heat treating the temporary deflection shall be within the limit of clearance or 50 microns (whichever is smaller) and permanent straightness shall be assured at all operating temperatures.	As per bidder's practice, Heat stability test is not carried for welded rotors. Heat stability tests are only done on monoblock rotors which exceed a delivery weight of 32 tons when quenched in vertical position and on 5 tons when quenched in horizontal position. Rotors are made of high alloy raw material (Cr Mo W V Nb N steel) supplied by experienced suppliers, poured by ESR to reduce segregation in the forgings.	Bid Specification shall prevail
43	1	6.2.4	Critical speed of composite rotor and blade assembly shall not be within $\pm 15\%$ of operating speed.	As per bidder's design and proven practice the critical speed of the combined turbine and generator rotor shall not lie within a range of + 15% or - 10% of the operating speed of 3000 rpm. Please consider bidder's proposal.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
44	1	6.2.8	Facility for wet steam washing of turbine casings and rotors shall be provided with a tapping from nearby piping and procedure for the same shall be furnished by the bidder.	Wet steam washing system for turbines is not recommended by the bidder. Pl. refer to clause 2.1.13 also	Will be evaluated after receipt of detailed scheme by bidder.
45	1	6.2.8	Forced cooling system of turbine system shall be provided so that the turbine block can be cooled during emergency for quick access.	A system for emergency cooling will be provided as per bidder's practice. Please confirm acceptance of bidder's practice.	Specification is self-explanatory
46	1	6.3.3	LP Turbine shall have stand-alone type blades capable of sustaining -5% & +3% grid frequency variation.	LP last stage blades shall be as per OEM's standard design.	Bid Specification shall prevail
47	1	6.4.1	The exhaust hood shall be equipped with pressure relief bursting diaphragms (piercing type) designed to rupture at a specified internal pressure so as to limit the exhaust hood pressure within a safe margin. The diaphragms should be of sufficient area to pass the maximum L.P. exhaust steam plus flash steam entering the condenser.	As per bidder's design exhaust hood is equipped with pressure relief rupture disc. The rupture disc has sufficient area to allow 10% of nominal flow to pass. Please confirm acceptance of OEM design.	Specification is self-explanatory

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
48	1	6.5.2	The rotor axial position shall be maintained by a thrust bearing assembly of adequate capacity. The design of the thrust pads shall be such as to get adequate lubrication and to maintain the required film of oil at the contact surfaces at all times. Proper arrangement shall be made to maintain oil pressure under all load conditions of operation. The design shall incorporate arrangements for monitoring thrust bearing metal temperatures. Devices shall be provided for annunciation of an impending failure of the turbine thrust bearing. Additional switches shall be provided for alarm and trip of the unit in case of a thrust bearing failure.	Bidder provides axial displacement monitoring to allow for alarm and trip in case of abnormal axial displacement for whatever reason and exceeding owner's requirement. Please confirm acceptance of bidder's standard and proven practice.	Bid Specification shall prevail
49	1	6.7.3	A suitable by-pass of the Gland Steam Condenser to the exhausters shall also be provided along with desuperheater. A standby gland steam evacuation system shall also be provided. This standby system shall be used during the outage of the gland steam condenser for de superheating and to exhaust the steam to atmosphere outside the turbine building.	As per bidder's standard practice and recommendation instead of separate standby gland steam evacuation system, steam side bypass along with desuperheater arrangement shall be provided which will be used during the outage of the gland steam condenser. Please confirm acceptance of bidder's standard practice.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
50	1	6.9.1	(b) Mechanical position indicator to show valve open / close / travel and signal switches to indicate valve position (open or close). These signal lamps shall be mounted on valve testing panels and shall also be duplicated on the turbine generator supervisory panel.	As per bidder's standard and proven practice, valve open/close/travel position is remotely available on Operator station for monitoring. Valve Testing is carried out remotely (not vide local testing devices) and accordingly Mechanical position indicator and signal lamps are not part of bidder's standard offering. Please provide acceptance of bidder's standard and proven practice.	Specification is self-explanatory
51	1	6.9.1	The valves shall specifically include the following features: (a) Devices to trip the Generator and close all non-return and isolating valves on the extraction lines, when these stop valves are closed.	Tender requirement is not clear. Please elaborate the same.	Specification is self-explanatory
52	1	6.9.4	They shall also be fail-safe and automatic closure of valves shall take place under conditions of loss of auxiliary power, hydraulic/pneumatic pressure etc.	As per bidder's practice power assisted NRV shall closes on reverse of steam flow or in case of trip. It does not close on loss of air pressure supply, auxiliary power etc. Please confirm acceptance of bidder's standard practice.	Will be evaluated after receipt of detailed scheme by bidder.
53	1	6.9.4	Double valves shall be provided on all extraction lines.	The number of Extraction NRV will be provided as per the ASME TDP-2008 guidelines. As per that all extraction lines except to deaerator will be provided with one (1) NRV (Quick closing type) can be provided.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
54	1	6.9.4(a)	Double valves shall be provided on all extraction lines except for extraction line to LP Heater-I in Condenser neck. For extraction line to de-aerator, both the NRV's shall be power operated type.	NRVs in each extraction line will provided as per bidder's safety guidelines and standard proven practice. Please confirm acceptance of bidder's standard proven practice.	Bid Specification shall prevail
55	1	6.9.4(b)	One of these valves shall be hydraulic/pneumatic swing check/ piston lift type quick closing valves. These valves shall be operated by means of solenoid impulses. They shall be suitable for on load testing individually.	As per bidder's standard and proven practice, Onload group testing facility will be provided. Please confirm acceptance of bidder's standard proven practice.	Bid Specification shall prevail
56	1	6.9.4(c)	The material of the valves shall be compatible with the material of the piping on which the valve is mounted. However, the material shall not be inferior to the following : NRV's on CRH line and on extraction lines to HP heater : ASTM A 217 WC9 Other NRV's : ASTM A 217 WC6.	Based on pressure temperature parameters of the extraction lines, material grade WC6 for HP heaters & CRH and grade WCB for other heaters is recommendation as per bidder's proven practice. Please confirm acceptance of bidder's proven practice.	Material compatibility shall be checked during bid evaluation after reviewing the steam cycle conceived by bidder.
57	1	6.10	Vacuum breaker valve with pneumatic actuator shall be of gate type with provision of sealing.	As it is vacuum service, bidder's standard practice and suitability for vacuum service, Wafer type butterfly valve. Better sealing tightness is achieved with Wafer type butterfly valve. Please confirm acceptance of bidder's standard and proven practice.	Bid Specification shall prevail
58	1	6.11	Duplex type electro-hydraulic speed control system.....	Tender requirement is not clear. Please elaborate the same.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
59	1	6.11.1	Speed governor The speed-sensing element shall respond to small speed variations so as to keep the dead band within 0.02% of rated speed, at any power output.	We understand as per Volume V, Section 3B, Cl. No. 3.13(b), permissible speed variation to keep dead band within 0.06% of rated (Instead 0.02%). Also as per IEC-45-1 guideline, dead band is within 0.06% of rated speed.	Clause 6.11.1 (Vol III B) shall prevail.
60	1	6.11.1	The speed droop or speed regulation shall be adjustable within 2 to 8% rated speed.	As per IEC-45-1 guideline, speed regulation shall be adjustable within 3 to 8% rated speed.	Bid Specification shall prevail
61	1	6.11.3	Speed Changer The Turbine shall be provided with a speed changer to control its speed or power output within limits, locally and remotely operable from the Turbine Generator supervisory panel. The speed changer provided shall be capable of adjusting (manual/auto) the speed of the turbo set to any value in the range 95% to 105% of rated speed, to facilitate synchronising of the Generator with the bus	As per bidder's design, speed regulation and load control is part of redundant Digital Elctrohydraulic governing system and accordingly Speed changers are not applicable. Please provide acceptance of bidder's standard and proven design.	Bid Specification shall prevail
62	1	6.11.4	Load Limiting Device Turbine shall be equipped with a local/remotely operated load limiting device. The motor for the remote control of the load limiting device shall operate on D.C. power supply. A remote position indicator shall be provided for indication of the setting of the load limit on the turbine generator supervisory panel.	As per bidder's design, speed regulation and load control is part of redundant Digital Elctrohydraulic governing system and accordingly Speed changers are not applicable. Please provide acceptance of bidder's standard and proven design.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
63	1	6.12	OIL SYSTEM The Turbine set shall be provided with complete self-contained Oil Systems. The system shall supply oil for the lubrication of the Turbine and Generator bearings, for actuation of various components of governing and control system, hydraulic turning gear, seal oil etc. The Control Oil System may be separate from the Lube Oil System. The grade of oil to be used with complete specification for both Control System and Lube Oil System shall be stated along with Bid. While developing the layout, Bidder shall locate the oil tanks/coolers and route the piping in such a way that the installation becomes safe against possibility of any fire hazard and all efforts shall be made to improve layout during detail design without any price implication to the Owner. Control Fluid System (a) 2 x 100% AC motor driven Control Fluid pumps mounted vertically in Fire resistant control fluid tank supplying oil for control function viz. servomotors/actuators of control valves or for the operation of protective devices for TG set.	Fire resistance fluid shall not be provided in combine oil system. Please confirm the bidders understanding.	Specification is self-explanatory
64	1	6.12	the control oil system may be separate from lube oil system..	Please confirm bidder's understanding on acceptance of combine lube and control oil system.	Specification is self-explanatory

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT**PRE - BID QUERIES****Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-B**

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
65	1	6.12.1(b)	one (1) booster pump or suitable oil injector to pressurize main oil pump suction.	Main oil pump is gear driven type hence additional booster pump is not required as per bidder's proven design. Please confirm acceptance of bidder's proven design.	Specification is self-explanatory
66	1	6.12.1(c)	an adequately sized portable pump for line testing shall be provided on permanent basis.	Bidder shall offer 1x100% Auxiliary oil pump, and One shaft driven lube oil pump and DC Emergency oil pump to provide adequate redundancy in pumps. Hence additional pump is not required as per bidder's standard and proven design. Please confirm acceptance of bidder's standard and proven practice.	Bid Specification shall prevail
67	1	6.12.1(e)	One (1) D.C. motor driven Emergency Oil Pump with drive motor and motor starter suitable for operation on 220V D.C. voltage with voltage variation from 190 V to 240 V D.C.	DC motors and voltage variation will be provided as per IEC standards. Please confirm acceptance of IEC standard.	Bid Specification shall prevail.

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
68	Section-1 (Page 41 of 308)	6.12.1	OIL SYSTEM (a) One (1) Main Oil Pump driven from Turbine shaft supplying oil, for ... (b) One (1) Booster Pump ... (c) Two (2) full capacity A.C. Motor driven auxiliary oil pumps ,,, An adequate sized portable pump (d) Two full capacity jacking oil pumps ,,, (e) One (1) D.C. motor driven Emergency Oil Pump ...	OIL SYSTEM (a) Two (2) full capacity A.C. Motor driven main oil pumps ,,, (b) Two full capacity jacking oil pumps ,,, (c) One (1) D.C. motor driven Emergency Oil Pump ... [Explanation] As of the Lubrication Oil System, sufficient equipment arrangement is provided. For this purpose, instead of turbine shaft driven main oil pump, AC motor driven pump is prepared with a standby pump. Shaft driven pump system is the complex system and only a limited maker can cope with. This means it is hard in the future the maintenance of shaft driven main oil pump system as well as to achieve spare parts.	Bidder should follow as per bid specification (d) Two full capacity jacking oil pumps one of this pump shall be driven by AC motor and other one should be DC driven motor ,,, (e) One (1) D.C. motor driven Emergency Oil Pump ...
69	1	6.12.3	...The outer surfaces of all piping in the reservoir and the inner surface of the tank shall be coated with corrosion resistant paint.	As per bidder's design, offered piping is made of stainless steel material hence painting is not envisaged on stainless steel material. For the inner surface of tank, it is protected by anti corrosion WD40 coating. Please confirm acceptance of bidder's practice.	Specification is self-explanatory

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
70	1	6.12.3	It shall be provided with removable stainless steel basket strainers and at least two oil level indicators out of which one should be visible from Turbine operating floor.	As per bidder's practice, level indicator which is mounted on lube oil tank shall not be visible to operator from Turbine operating floor, however remote indication will be available on operator's stations in control room (DCS) through level transmitters. Please confirm acceptance of bidder's standard practice.	Bid Specification shall prevail
71	1	6.12.4	The Oil System for the Turbine set shall include adequate number of shell & tube type Oil Coolers.....	Bidders standard design is with plate type heat exchanger. Request you to incorporate the same as an option in technical specification.	Bid Specification shall prevail
72	1	6.12.4	Manually operated lockable type valves shall preferably be provided on the oil side of the coolers to facilitate change over from one Oil Cooler to the other without interfering with the unit operation.	We understand that requirement is for 3 way valve. Please confirm that bidders understanding is correct.	Specification is self-explanatory
73	1	6.12.5	The oil return lines from bearings shall be provided with illuminated sight fittings.	As per bidder's standard practice sight glass is used at place of illuminated sight fitting. Please confirm acceptance of bidder's standard practice.	Bid Specification shall prevail
74	1	6.12.6	Filters shall be provided at immediately upstream of all bearings and Generator seals.	As per bidder's design duplex filter is sufficient to filter oil. Hence filter immediately upstream of all bearings and Generator seals is not applicable as per bidder's standard practice. Please confirm acceptance of bidder's practice.	Bid Specification shall prevail

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
75	1	6.12.7	2x100% purifier for turbine unit lube oil system and	As per bidder's standard practice and requirement , 1x100% coalescer type purifier will be provided to provide continuous and safe operation. This will be as per Bidder's standard and proven practice. Please confirm acceptance of bidder's standard practice.	Bid Specification shall prevail
76	1	6.12.7	Oil Purification Units	Please clarify if the bidder can propose the Lube oil purifier of coalescer type (Static) as per their standard practice.	Bid Specification shall prevail
77	1	8.2	...with an inlet hydraulic/ pneumatic actuated, modulating control valve, a bypass line with MO control valve , isolating valves etc.....	As per bidder's practice bypass line will be equipped with MO inching valve. Please confirm acceptance of bidder's standard practice.	Bid Specification shall prevail
78	1	8.2	...Another hydraulic/pneumatic actuated, modulating control valve shall be provided in the exhaust line from Header to condenser.....	Bidder's understanding that "exhaust line from header to condenser or any suitable location as per optimized cycle." Please confirm bidder's understanding is correct.	Bid Specification shall prevail
79	1	9.1 (a)	The minimum leakage class of HP & LP bypass system shall be Class V with full stroke operating time of the order of three (3) sec.	Employer to note that the quick opening and closing time for the HP & LP bypass system shall be of the Order of three (3) sec. however the modulating operating time of the HP & LP bypass system shall be of the order of close to 20 sec. Kindly confirm.	Bid Specification shall prevail

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT**PRE - BID QUERIES****Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-B**

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
80	1	9.8	Valves shall be so selected that the noise level is below 85 dB (A) at a distance of 1.0 M.	Owner to note that the noise level for the HP/LP Bypass control valve shall be relaxed to 95 dBA at a distance of 1.0 m from the equipment since the bypass operation is not a normal operating condition.	Agreed
81	1	9.8	Valves shall be so selected that the noise level is below 85 dB (A) at a distance of 1.0 M.	Employer to note that for the operation of the HP & LP Bypass system the noise level shall be allowed upto 95 dB (A) at a distance of 1.0 m since this is not a normal operating condition.	Agreed
82	1	Volume-III/ 9.8	HP/LP bypass Valves shall be so selected that the noise level is below 85 dB (A) at a distance of 1.0 M.	Noise limit of 95 dBA for HP/LP bypass valves at 1 m distance during bypass operation may please be accepted.	Agreed
83	1	10	TURBINE AND INTEGRAL PIPING DRAINS	Owner to note that for all the drains which are routed to the condenser hotwell, instead of providing separate HP & LP flash tanks, Bidder shall provide flash boxes which shall be attached to the condenser as per standard and proven practice of the Bidder. Kindly accept.	Bid Specification shall prevail
84	1	10	TURBINE AND INTEGRAL PIPING DRAINS	Keeping turbine safety in view, bidder's standard practice is only the turbine integral drain leads to condenser flashbox & external drain leads to atmospheric flash box. Please confirm acceptance of bidder's standard practice.	Bid Specification shall prevail

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT**PRE - BID QUERIES****Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-B**

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
85	Sec-I	10.2	Pg 50/308, para 2 & 3: reg. critical piping drains from MS, CRH, HRH, HP/LP Bypass	While para 2 specifies these drains to be led to HP & LP flash tanks, para 3 specifies drains from MS, HP/LP bypass to be led to unit flash tank. Bidder shall lead the drains from MS and HP bypass to atmospheric unit flash tank, while the drains from CRH, HRH & LP bypass shall be led to condenser flash tank. please confirm.	Will be evaluated after receipt of detailed scheme by bidder.
86	1	10.7	The main valve shall be suitable for throttling and the second valve shall provide complete isolation....	Regulation is not feasible as per standard operation of drain valve. Offered drains valves will be supplied with on-off type. Please confirm acceptance of bidder's request.	Bid Specification shall prevail

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT

PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
87	1	11.4 11.6	INSULATION AND TEMPERATURE LIMITS The Generator stator and rotor windings inclusive of main and neutral leads, shall be provided with class F insulation but rated for class B temperature rise. The maximum permissible temperatures of different parts of the generator shall be as specified in IEC 34-1, 34-3 as applicable. The Generator shall be capable of continuous safe operation at rated output and power factor under any of the following conditions: (a) Terminal voltage variation of +_ 5% of the rated value. (b) Frequency variation within 47.5 to 51.5 Hz. (c) Absolute sum of combined voltage and frequency variation of 5%.	Bidder's shall offer proven and standard generator design. Bidder's shall furnish provenness certificate of same module running world wide. Please confirm acceptance of bidder's proven design.	Bid Specification shall prevail
88	1	11.8	ASYMMETRICAL SHORT CIRCUIT WITHSTAND The Generator shall also be capable of withstanding, without injury, any other short circuit at its terminals provided the integrated product of $(I_2)^2 \times t$ shall be upto ten (10), where "I₂" is negative sequence current and 't' is the duration of fault in seconds, and the maximum phase current is limited to a value which does not exceed the maximum phase current obtained from 3 phase fault.	The proposed generator has directly cooled rotor windings and following IEC 60034-1 standard its design meets short-time negative-sequence current capability $(I_2)^2 \times t$ of 5.5 p.u.s. Please note that according to IEC 60034-1, the value of 10 p.u.s is required for indirectly hydrogen cooled rotors. Please confirm acceptance of bidder's proven and standard design.	ASYMMETRICAL SHORT CIRCUIT WITHSTAND The Generator shall also be capable of withstanding, without injury, any other short circuit at its terminals provided the integrated product of $(I_2)^2 \times t$ shall be calculated as per IEC 600034 and value shall be equal to or more than 5.7. Refer corrigendum (II).

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Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
89	1	11.8.1	The Generator shall be capable of continuous safe operation with a negative sequence current upto 8% of the rated current, provided none of the phase current exceeds the rated current.	The proposed generator has directly cooled rotor windings and following IEC 60034-1 standard its design meets continuous negative-sequence current capability up to 6.4%. Please note that according to IEC 60034-1, the value of 8% is required for rotors of generators with rated power below 350MVA. Please confirm acceptance of bidder's proven and standard design.	Unbalanced Load The Generator shall be capable of continuous safe operation with a negative sequence current upto 6.6 % of the rated current, provided none of the phase current exceeds the rated current. As per IEC 600034 Refer corrigendum (II).
90	1	11.9	VOLTAGE WAVE FORM: When tested on open circuit and at rated speed and voltage, the telephone harmonic factor of the turbine-generator shall not exceed 1.5% as per IEC 60034.	According to the latest edition of IEC60034-1, section 9.11.2, the total harmonic distortion (THD) of the line-to-line generator terminal voltage will not exceed 5%, when tested on open-circuit and at rated speed and voltage. Please confirm.	1. Total Harmonic Distortion (THD) in the voltage wave form as per IEC 60034-1. 2. Voltage and Current harmonic factor of the turbine-generator shall not exceed as per IEEE 519.
91	1	11.11	CAPACITY WITH ONE GAS COOLER OUT OF SERVICE In the event of one gas cooler being out of service, the generator shall be capable of carrying at least 75 % of rated load continuously, without the permissible temperature of the machine being exceeded.	Following IEC 60034-3, the offered generator is capable of carrying 67% of rated load continuously, without the permissible temperature of the machine being exceeded. Please confirm acceptance of bidder's proven and standard design.	Bid Specification prevails.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
92	1	11.11	In the event of one gas cooler being out of service, the generator shall be capable of carrying at least 75% of rated load continuously, without the permissible temperature of the machine being exceeded.	With outage of one cooler and with 10% of tubes plugged, the generator shall be capable to deliver 2/3rd of rated output without the permissible temperature of the machine being exceeded. Please accept & confirm.	
93	1	12.2	The stator core shall be fabricated out of best quality CRGO so that losses are minimum.	Bidder's standard bases on non-grain oriented cold-rolled sheets all over the manufacturing portfolio of offering generator module. Please confirm acceptance of bidder's proven and standard design.	Refer corrigendum (II)
94	1	12.2	Magnetic screens shall be provided to reduce the end zone heating by leakage flux.	The generator casing is in natural way a magnetic shield for internal electromagnetic field generated by the stator therefore as per manufacturer proven standard, magnetic screens are not assembled. Please confirm acceptance of bidder's proven and standard design.	As a intrinsic design feature it is allowed. However bidder should give details in the offer supporting this claim.(Deviation)
95	1	12.3	Ripple springs shall be provided below the slot wedges to compensate for any future shrinkage and ensure permanent firm seating of the bars in the slot during operation.	The Bidder's proven stator slot wedging system comprises of adequately seated double-tapered convex-concave wedges with inserts under them locking stator bars in firm position in slots. Please confirm acceptance of bidder's proven and standard design.	Bid Specification shall prevail

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT**PRE - BID QUERIES****Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-B**

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
96	1	12.4	The seal off bushing shall be porcelain type and complete with silver plated terminal connectors.	The bushings design will meet DIN 48124 Part 2 standard. The bushings are of moulded resin-insulated type. Please confirm acceptance of bidder's proven and standard design.	Bid Specification shall prevail
97	1	12.6	The retaining rings shall be floating type, shrunk on rotor body and prevented from axial movement by snap rings/locknuts.	The generator has retaining rings of a floating type, shrunk onto rotor but prevented from axial movement by a bayonet locking system, which the standard proven product & practice. Since the generator design is proved by many units of similar design, many years in operation and since these were established on the basis of technical considerations and can not be changed. Please confirm acceptance of bidder's proven and standard design.	Bidder should furnish details of bayonet locking system in the technical offer. (Deviation)
98	1	12.7	The generator shall be provided with end-shield mounted self-aligning journal bearings.	As per bidder's standard design, the rotor is supported on two-pedestal bearings. The coupled-on slip ring shaft at the NDE is supported by a third pedestal bearing at the end of the shaft. Please confirm acceptance of bidder's proven and standard design.	Bearings mounted in the end - shield are preferred. Bidder shall provide the detail write up and proven record of the equipment offered to various customers during last 5 years.

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Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
99	1	12.9	Hydrogen shall be circulated in the generator in closed circuit by the axial fans/compressors located on rotor shaft at either end.	The design of offered generator is with one radial-flow type fan, which circulates the hydrogen in the generator and is shrunk onto the shaft at non-driving end, just outside the active length. Bidder has proven generator design which is in operation for many years world wide, Please confirm acceptance of bidder's proven and standard design.	The specified system is preferred by owner Bidder may furnish the detailed write up along with proven record (documents) with offer to various customers during last 5 years.
100	1	12.10	The enclosure shall be natural air ventilated with intake filters to clean the cooling air and discharge filters to prevent discharge of the dust from brushes to the turbine room.	The slip rings and brush gear are cooled by a closed-circuit cooling air circulation inside their casing. The cooling air is circulated by a twin-impeller, radial-flow fan mounted on the shaft, between the two slip rings. The air passes through coolers, filters and a humidifier mounted in the upper part of the slip ring casing. Please confirm acceptance of bidder's proven and standard design.	Accepted
101	1	12.10	Provision shall be made for easy change of slip ring connection for uniform wear of slip ring.	Slip rings polarity changed is not realised in brush gear but in excitation system (off-load, manually). Please confirm acceptance of bidder's proven and standard design.	Refer corrigendum(II).
102	1	12.11	TEMPERATURE MEASUREMENTS	As per proven bidder standard, all temperature detectors would be 3-wires, single RTDs. Please confirm acceptance of bidder's standard practice.	Bid Specification shall prevail

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PRE - BID QUERIES

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
103	1	12.11	In addition to the ETD's, temperature switches shall be provided as required for alarm and interlocks.	No local temperature switches are assembled as per bidder standard proven practice. Signals from ETD's are led to control cubicles that do not include any local indicators. All signals are led to and controlled by DCS. Please confirm acceptance of bidder's standard practice.	Agreed.
104	1	12.12.2 12.12.3	The system comprises of oil tanks, defoaming chambers, vapour extractors, pumps, coolers, filters, interconnecting pipes, fittings, valves, gauges, thermometers. A Control and monitoring panel complete with annunciation shall be furnished. Damper tank for supply of oil to seal oil system under emergency condition may be considered. Seal Oil System shall have connection to turbine main oil system for make-up and also for excess return. The turbine main oil system shall also serve as a back-up to seal oil system. The H2 side oil drain shall be suitably degassed before being returned to main oil system.	Bidder's seal oil system is separated from lubrication oil system. Oil from lubrication oil system can not be used for sealing purposes. In this case a DC motor driven seal oil pump to be powered from uninterruptible power supply, which should be always available. Please confirm availability of uninterruptible power supply.	Specification is self-explanatory
105	1	12.12.3	Seal Oil System shall have connection to turbine main oil system for make-up and also for excess return. The turbine main oil system shall also serve as a back-up to seal oil system. The H2 side oil drain shall be suitably degassed before being returned to main oil system.	As per bidder's standard and proven design a separate lube oil and seal oil skid is used. Please confirm acceptance of bidder's standard and proven design.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
106	1	12.13	Two (2) full capacity refrigeration type H2 - drier with in-situ reactivation facility shall be provided. The arrangement shall be such that one drier can be taken out of service for reactivation without affecting the system performance in any way.	Single gas drier system (silica gel type). Silica gel regeneration by using hot air is provided instead of refrigeration type. Please confirm acceptance of bidder's standard practice.	Refer corrigendum-II
107	1	12.13	A manually operated vent valve shall be provided for discharging casing hydrogen to atmosphere in case of emergency to a location outside the building top.	Discharging process is automatic. Manual operation can be processed with 3 valves. Please confirm acceptance of bidder's standard practice.	Confirmed. Bidder to ensure vent out discharge casing hydrogen to atmosphere in case of emergency to a location above the building top and process is automatic and also manual provision. Refer corrigendum (II).
108	1	12.15.3.2 (a)	(ii) Thyristor convertor with 100% redundancy along with gate firing circuits	Bidder's offer will not include 100% redundancy of power converter as according to bidder's experience and philosophy it is not necessary. Bidder's standard excitation system are designed as n-1 or n-2 system (where n is a number of power converters). In such design the fault of one (in n-1 configuration) or two (in n-2 configuration) power converters does not affect the proper operation of excitation system. Bidder kindly asks for acceptance of the clarification.	corrigendum issued for N+2 system (where N is a number of power converters for rated full load capacity). Refer corrigendum (II).

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
109	1	12.15.3.2 (b)	(ii) Protection: ... Suitable lamps indication shall also be provided to indicate the defective 'thyristor'.	The each defective thyristor will be indicate as alarm signal on LCP. Bidder kindly asks for acceptance of the clarification.	Bid Specification shall prevail
110	1	12.15.3.2 ©	(iii) Gate Firing... b. It shall be able to shift the gate pulse in the time over a range of about 150 electrical degrees under a signal from the regulator.	In bidder's solution of power converters the gate pulses could be changed in range 10 to 140 electrical degrees. Bidder kindly asks for acceptance of the clarification.	Bid Specification shall prevail
111	1	12.15.3.2 ©	(iii) Gate Firing... (iv) Pulse Transformer :.... : Their amplitudes shall be depending upon the trigger characteristics, approximately (+) 3 to (+) 20 V peak against cathode.	The trigger parameters are selected according to used thyristor and his characteristics. Bidder kindly asks for acceptance of the clarification.	Bid Specification shall prevail
112	1	12.15.3.2 (e)	(i) Field Breaker : The generator field breaker shall be of DC, multi pole air break type...	Bidder's standard is that above 2000A DC field current the one pole DC breaker is used. Please confirm acceptance of bidder's standard practice.	Bid Specification shall prevail
113	1	12.15.3.2 (e)	(i) Field Breaker : ...discharge contacts.	Bidder's de-excitation system is composed of the thyristor (semiconductor switch) connecting the de-excitation non-linear resistor to the generator rotor. Bidder kindly asks for acceptance of the clarification.	Refer corrigendum(II)

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
114	1	12.15.4 ©	Load angle limiter	In bidder's Excitation System, the automatic regulator (AVR) based on the generator power diagram. In AVR there isn't the load angle limiter option, however the generator power diagram including the load angle limiter. Please confirm acceptance.	Refer corrigendum(II).
115	1	12.15.4 (g)	Rotor temperature transducer/transmitter with remote mounted indicating recorder	Bidder's standard is that standard 4...20mA signal corresponding to rotor winding temperature will be transmitted to superior station Please confirm acceptance..	Ageed.
116	1	12.15.8 (f)	There shall be provision for changing polarity of rotor magnetic field	Please clarify the requirement since the generator envisaged is a two pole generator.	Refer corrigendum (II).
117	1	Datasheet-A, 1.3,	The turbine steam temperature and operating mode	Bidder would like to clarify that over pressure operation is not envisaged for this plant and hence no pressure margin shall be provided over the design turbine inlet steam pressure. We understand that operation capability mentioned in the datasheet-A is the continuous 105% output with the rated steam pressure corresponding to VWO condition shall be 660 MW + 5%, i.e. 693 MW. Please confirm that Bidder's understanding is correct and amend the specification accordingly.	105% output required from turbine as continuous rating.

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Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
118	1	Datasheet-A, 1.6	Operation capability (b) Continuous 100% output under over pressure operation (VWO condition i.e. TGMCR + 5%).	As per clause no. 11.2 and datasheet-A, clause no. 5.2.1, Generator rating is 660MW continuous with 0.85 p.f. lagging. Bidder requests Owner to clarify the Generator Continuous Rating to meet Operating Capability as specified in clause no. 1.6(b) i.e. TGMCR + 5%. In Bidder's opinion the Continuous Rating of Generator shall be 660 MW + 5%, i.e. 693 MW to meet the above Clause. Please confirm.	1). Overpressure requirement shall be as per IEC 45. 2). Generator over load rating shall be 660 MW +5% i.e, 693MW for testing the turbine VWO capability.
119	1	Datasheet-A 1.6	(b) Continuous 100% output under over pressure operation (VWO condition i.e. TGMCR + 5%)	We understand that VWO condition as defined by tender is, when throttle steam flow is 105% of steam flow of TMCR condition and not 105% TMCR load. Please clarify.	1). Overpressure requirement shall be as per IEC 45. 2). Generator rating shall be 660 MW with capability to overload for testing the turbine VWO capability.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
120	1	DATA SHEET- A 1.6(b)	Operation capability Continuous 100% output under over pressure operation (VWO condition i.e. TGMCR + 5%).	"Continuous <u>105%</u> ~~100%~~ output ~~of~~ <u>100%TMCR (i.e.693MW) operation</u> under ~~over pressure operation rated steam conditions and at design condenser pressure with 1% make-up~~ (VWO condition ~~i.e. TGMCR + 5%~~)." Reason: HTC understand 100%TMCR and VWO definitions are as follows; 100%TMCR: 660MW output operation under rated steam conditions and at design condenser pressure with zero make-up. VWO: 105% output of 100%TMCR (i.e.693MW) operation under rated steam conditions and at design condenser pressure with 1% make-up. Please note that HTC have indicated 1% make-up as per Vol.II Section-8 clause 1.4.16(a)	1). Overpressure requirement shall be as per IEC 45. 2). Generator rating shall be 660 MW with capability to overload for testing the turbine VWO capability.

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PRE - BID QUERIES

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
121	1	Datasheet-A, 1.7	1.7 Steam Parameters at HP Turbine Stop Valve: Pressure: ~247 kg/cm ² (a) Temperature: 565 Deg. C (minimum)	As per the requirement specified, different bidders are free to offer different steam parameters. We request to fix the steam parameters especially MS and HRH temperature in line with the proven practice in India where MS and HRH is usually fixed at 565 deg C and 593 deg C respectively. Bidder is of the opinion that in absence of the fixed steam parameters for STG, it could be difficult to bring all bidders at par in case different bidders offer different steam parameters.	The steam temperature shall be as follows: Main Steam at HP turbine inlet : 565 deg C Hot Reheat Temperature at IP turbine inlet : 593 deg C. Main steam pressure shall be 247 kg/ cm ² (g)
				Reference of projects being constructed, having above steam parameters, for supercritical power plant of similar capacity by various utilities (NTPC/ State Electricity Boards and others) in India are as follows: 1. Koradi TPS Expansion Project 3 x 660MW (MAHAGENCO) 2. Lara Super Thermal Power Project 2 x 800MW (NTPC) 3. Darlipali Super Thermal Power Project 2 x 800MW (NTPC) 4. Gajmara Super Thermal Power Project 2 x 800MW (NTPC) 5. Kudgi Super Thermal Power Project 3 x 800MW (NTPC)	

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
				6. Barh - II 2 x 660MW (NTPC) 7. Tanda Thermal Power Station 1 x 660MW (NTPC) 8. Mouda Super Thermal Power Project 2 x 660MW (NTPC) 9. Solapur Super Thermal Power Project 2 x 660MW (NTPC) 10. Nabinagar Super Thermal Power Project 3 x 660MW (NTPC) 11. Meja Super Thermal Power Project 2 x 660MW (NTPC) 12. Krishnapatnam Thermal Power Station 2 x 800MW (APGENCO) 13. Mundra UMPP 5 x 800MW (TATA) 14. Salaya - II (ESSAR) 15. Prayagraj Power Generation Company Ltd 3 x 660MW (Jaypee) 16. Bina Power Supply Company Ltd. 2 x 660MW (Jaypee) 17. Nabha Thermal Power Station 3 x 700MW (L&T)	
122	1	Datasheet-A, 1.10	Steam turbine insulation - Ceramic mattress type	Please consider to keep additional option for other type of proven insulation i.e spray insulation. Bidder's standard practice is spray type insulation on HP & IP cylinders and valve chests. Removable Blanket type insulation is provided on all pipings. Parts requiring frequent access shall also be provided with removable insulation.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
123	1	Datasheet-A, 1.11.1	Condenser Exhaust Pressure: Normal: 77 mmHg(a)	As per Vol. I, Sec. 1, Cl. No. 19.1 for Loading of Bid Price and Vol. I, Sec. 3, Cl. No. 6.3 for LD, back pressure (condenser pressure) is specified as 76 mmHg. However as per cl. 3.4 and datasheet-A, cl. no. 1.11.1 rated condenser pressure is specified as 77 mmHg. We understand that this is a discrepancy and presume that the condenser pressure to be considered for design and guarantee as 77 mmHg	Design condenser pressure shall be 76 mm Hg (a)
124	1	DATA SHEET- A 1.11.1	CONDENSER EXHAUST PRESSURE Normal 77 mm Hg(a)	"Normal ~~76~~ 77 mm Hg(a)" Reason: According to Vol.I Section-1 19.1 Sr. No.4 and Vol.I Section-3 6.3 Sr. No.1, HTC understand normal condenser pressure is 76 mmHg(a). Please confirm if the heat balance calculation condition currently indicated as "77mmHg(a)" in the specification shall be revised to "76mmHg(a)".	Design condenser pressure shall be 76 mm Hg (a)
125	1	DATA SHEET- A 1.13	Quantity of demineralized water make- up to cycle A maximum of 1% of throttle flow, introduced at surface condenser hot well	According to this specification, HTC understand maximum make-up is 1%. Please confirm if the heat balance calculation condition currently indicated as "3% make-up" shall be revised to "1% make-up".	It is clarified that the Design make up to steam-water cycle is 1 %

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
126	1	Datasheet-A 1.13	Quantity of demineralized water make-up to cycle - A maximum of 1% of throttle flow introduced at surface condenser hotwell	Please clarify the design make-up quantity. it is 1% or 3% ?	
127	1	Datasheet-A 1.19	Final feed water temperature at HP heater outlet is 290 - 300 deg C	The final HP heater outlet temperature will be as per optimized heat balance cycle. Owner may kindly accept.	Bid Specification shall prevail
128	Annexure A	2.1.12.2	(w) Measurement of - ve phase sequence impedence.	Bidder's request to elaborate the Requirement. Please clarify. Please specify the standard as per test to be performed.	As per IEC 60034 - 4 Measurement of - ve phase sequence reactance shall be carried out.
129	Annexure A	2.1.12.3	(d) Impulse withstand voltage test on the terminal bushings.	Please specify the standard as per test to be performed.	As per relevant IS, IEC.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
130	2	2.2 & 2.1	Required numbers of shell & tube type High Pressure Feed Water Heaters with all fittings, gauges, instruments etc.	Please note that Bidder intends to offer either twin stream i.e. 2 x 50% HP feed water heaters with medium operated 3-way bypass valves at upstream and downstream of each train of heater (the bypass line of each train shall be 50% feed water flow capacity) or single stream i.e. 1 x 100% HP feed water heaters with medium operated 3-way bypass valve at upstream and downstream of each heater (the bypass line of train shall be 100% feed water flow capacity). These media operated 3-way valves ensures quick bypassing of HP heaters in case of tube leakages. In this case, motorized isolation valves at upstream and downstream of HP heaters and in bypass line are not required. LPH-3 & LPH-4 shall have individual motorised bypass, but LPH-1 & LPH-2 being duplex type individual bypass is not possible. Bidder confirms that there are many Alstom built plants worldwide which are in successful operation with same philosophy. Please confirm that bidder's proposal is inline with specification.	2x 50% heater trains are acceptable; Rest to be taken up during bid evaluation after receipt of detailed scheme by bidder.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
131	2	2.2	Required number of shell & tube type high pressure closed feedwater heater	Although the tender P&I D(PE-189-PF-204) shows single train of HP feedwater heater, We understand that bidder has an option to provide either single train or two train of HP feedwater heater based on design optimization. Please clarify.	2x 50% heater trains are acceptable.
132	2	3.3	The maximum oxygen content of the feed water discharge from the Deaerator without chemical dosing shall not exceed 0.005 cc/litre at all loads upto and including the rated capacity.	Kindly note that the maximum oxygen content shall not exceed 0.005 cc/litre from 40% - 100% load conditon as a standard & proven practice of manufacturer. Kindly confirm.	Bid Specification shall prevail
133	2	3.5	Minimum acceptable H.P. Heater outlet temperature during Turbine low load operation shall be finalised as per Steam Generator requirement.	We understand that during start-up conditons only the deaerator pegging shall be done 1.5 ata for cold start-up and at 3.5 ata for Hot and Warm start-up. Kindly confirm. For other low load opearting conditions the final feed water temperature shall be per the optimized cycle.	Will be evaluated after recepit of detailed scheme by bidder.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
134	2	3.7	Equipment offered shall have an operating noise level as per ISO -- 85. However, noise level should not exceed 85 dB at 1 m distance.	We assume that this mentioned ISO --85 requirement about equipment noise level relates to the noise rating curve NR85. But this type of noise rating curve is actually no longer used by the noise measurement standards to characterize the noise emissions of industrial machines, or the occupational noise exposure level of the Employees. As per clarification about Section 4 - Clause 17.2.1 of the Master Specifications (Vol. II) regarding Noise Level Requirement, the relevant standard for determination of near field noise levels shall be ISO 3746:2010.	For all continuous operating equipment, 85 dBA shall be maintained; for the rest, it will be evaluated after detailed data from bidder
135	2	4.3	Design temperature Shell& tube side -As per HEI standard rounded off to next higher 10°C	As per HEI standard it is rounded off to next higher 10°F. Please check and confirm.	Agreed.
136	2	5.1.2	The lowest pressure heater may be located in the Condenser neck in case that is the standard arrangement of the manufacturer. In such a case, a separate external drain cooler may be provided instead of being integral to the heater.	Please note that low pressure heaters 1 & 2 are duplex type and located in condenser neck as per standard and proven practice of the Bidder. Since the heat balance cycle is optimised without drain cooling zone as bidder's standard practice, separate external drain cooler is not required for this LP heater in condenser neck.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
137	2	5.1.3	Bidder shall select the temperature terminal difference and the drain cooler approach of the feed heaters keeping in mind overall economy.	As per Datasheet-A cl. no. 1.6.1 & 1.6.2, limits for TTD and DCA values are furnished for Heaters. Bidder would like to clarify that TTD & DCA for heaters shall be decided by the bidder as per optimised water steam cycle and respecting requirements mentioned in HEL. Accordingly, TTD for the LP Heaters shall be upto 4 Deg.C and DCA for the heaters shall be upto 8 Deg.C. Kindly accept.	Bid Specification shall prevail
138	2	5.1.3 (a)	H.P. Heaters shall be provided with Desuperheating and drain cooling zones in addition to the condensing zone.	Bidder would like to clarify that external desuperheater may also be provided for HP heaters as per Bidder's standard and proven practice.	Specification is self-explanatory
139	2	5.1.3 (b)	L.P. Heaters shall be provided with drain cooling zone in addition to the condensing zone.	Please note that the heat balance cycle is optimised without drain cooling zone as bidder's standard practice, the drain cooling zone shall not be provided for duplex LP heater 1 & 2 and LP heater 3.	Bid Specification shall prevail
140	2	5.1.3 (c)	Heat transfer area shall be calculated considering 10% of the tubes plugged.	Please note that as a standard & proven practice of the Bidder, the heaters shall be designed for 100% TMCR with 0% MU condition without considering any tube plugging margin. Kindly accept and confirm.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
141	2	5.1.4	The H.P. Heaters shall be designed for the shut-off pressure of the Boiler Feed Pumps (at maximum speed of operation) on the tube side.	We would like to clarify following : 1) As per Tender PFD (PE-189-PF-203), Isolation valve at economiser inlet is shown and same is not required as per Bidder's standard & proven practice. 2) As per Tender PFD (PE-189-PF-203), feed control station along with necessary isolation valve at economiser inlet (downstream HP heaters) is shown which shall be located upstream of the HP Heaters (after BFPs) as per Bidder's standard & proven practice.	1). HP heater shall be designed for shut off pressure of boiler feed pumps. 2). Economiser isolation valve may be deleted. Rest will be evaluated after receipt of detailed scheme from bidder.
				3) As per IBR amendment dated March 12, 2007 to regulation 520, feed water discharge piping for feed water system without economizer inlet isolating valve can be designed based on boiler design pressure with provision of mechanical relief device, to prevent Boiler Feed Pump (BFP) shut off pressure being communicated to the piping system. 4) This will substantially reduce design pressure of the feed water piping and HP heaters and same are not required to be designed with BFP shut off head. Hence, HP heaters on tube side and feed water piping downstream feed control station shall be designed corresponding boiler economiser design pressure. Kindly accept.	

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
142	2	5.1.4	The H.P. Heaters shall be designed for the shut-off pressure of the Boiler Feed Pumps (at maximum speed of operation) on the tube side.	We would like to clarify following : 1) As per Tender PFD (PE-189-PF-203), Isolation valve at economiser inlet is shown and same is not required as per Bidder's standard & proven practice. 2) As per Tender PFD (PE-189-PF-203), feed control station along with necessary isolation valve at economiser inlet (downstream HP heaters) is shown which shall be located upstream of the HP Heaters (after BFPs) as per Bidder's standard & proven practice. 3) As per IBR amendment dated March 12, 2007 to regulation 520, feed water discharge piping for feed water system without economizer inlet isolating valve can be designed based on boiler design pressure with provision of mechanical relief device, to prevent Boiler Feed Pump (BFP) shut off pressure being communicated to the piping system. 4) This will substantially reduce design pressure of the feed water piping and HP heaters and same are not required to be designed with BFP shut off head. Hence, HP heaters on tube side and feed water	
143	2	5.1.4 & 5.1.6&3.2	HP Heaters shall be designed for the shut off pressure of the boiler feed pumps..	For similar supercritical power plants in the country and elsewhere in the world, the HP heater tube side is not designed for the shut off pressure of BFP, but 110% of the maximum discharge pressure at rated flow.	

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
144	Sec-2	5.1.4	HP Heaters to be designed on the tube side for BFP shut-off head	Feed Control Station shall be provided on the upstream side of HP heaters and there shall be no isolation valve on feed water discharge header to boiler. HP heater tubes shall be designed for the maximum pressure expected from SG side. This is in line with IBR requirement. please confirm.	
145	2	Volume-III B/ 5.1.4	The H.P. Heaters shall be designed for the shut-off pressure of the Boiler Feed Pumps (at maximum speed of operation) on the tube side.	Tube side design pressure for high pressure feed water heater shall be the maximum sustained pressure which is the sum of the maximum pressure at economiser inlet NRV (boiler terminal point), static head from the economiser inlet to the lowest elevation in piping segment, friction losses in the system. Since in supercritical plants the feed water control station is located before the HP heaters, hence complete system including HP heaters, downstream of feed control station will be designed based on maximum sustained pressure. Please confirm	

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
146	2	5.1.6	Each of the L.P. and H.P. Feed Heaters shall have individual motorised bypass arrangements with isolation to enable it to be taken out of service without necessitating the shut down of the Turbine Generator set.	Please note that Bidder intends to offer either twin stream i.e. 2 x 50% HP feed water heaters with medium operated 3-way bypass valves at upstream and downstream of each train of heater (the bypass line of each train shall be 50% feed water flow capacity) or single stream i.e. 1 x 100% HP feed water heaters with medium operated 3-way bypass valve at upstream and downstream of each heater (the bypass line of train shall be 100% feed water flow capacity). These media operated 3-way valves ensures quick bypassing of HP heaters in case of tube leakages. In this case, motorized isolation valves at upstream and downstream of HP heaters and in bypass line are not required. LPH-3 & LPH-4 shall have individual motorised bypass, but LPH-1 & LPH-2 being duplex type individual bypass is not possible. Bidder confirms that there are many Alstom built plants worldwide which are in successful operation with same philosophy. Please confirm that bidder's proposal is inline with specification.	2X 50% Heater trains acceptable; rest to be taken up during bid evaluation

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
147	2	Volume-III B/ 5.1.6	Each of the L.P. and H.P. Feed Heaters shall have individual motorized bypass arrangements with isolation to enable it to be taken out of service without necessitating the shut down of the Turbine Generator set.	In the Power Cycle Scheme, as an option HP heaters of 2 x 50% configuration can be provided with 3Way valve as a group bypass. In this scheme, HP heaters need not be isolated individually. Further, LP Heaters #1 & 2 shall have common bypass line as both of them are condenser neck mounted. Please confirm acceptance.	2X 50% Heater trains acceptable; rest to be taken up during bid evaluation
148	2	5.2.1	The waterbox for the high pressure heaters shall be of forged construction.	Bidder would provide Water box of formed construction (formed from the plate). Please accept.	Bid Specification shall prevail
149	2	Volume-III B/ 5.2.1	The water box for the high pressure heaters shall be of forged construction and welded to the shell.	Please consider water box constructed from boiler quality plates, welded to forged nozzle and manway.	Bid Specification shall prevail
150	2	5.2.2	The LP heater tubes shall be roller expanded into the tube plates provided with at least two grooves.	Bidder would like to clarify that grooves in the tubesheet is not required as per our design.	Bid Specification shall prevail
151	2	Volume-III B/ 5.2.3 Datasheet -A SR. No. 5.3	Seamless or welded type stainless steel (SS-304L) tubes shall be provided. Stainless steel as per SA 213 grade TP 304L for seamless (For HP Heaters) and SA 688 grade TP 304L for welded tubes (For LP Heaters).	Each HP heater shall have SA688 TP304N welded tubes. LP heaters shall have SA688 TP304 welded tubes. The 304N tubes have higher strength compared with its rivals. This reduces overall size and the weight of the equipment. This is in line with all supercritical power plant HP tubes recommendation.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
152	Vol: III-B, Sec-2	6.1	HP heater drain system - to next lower pressure heater, to deaerator and condenser.	HP heater drains shall be led to the next lower pressure heater only, while the drain from the lowest pressure HP heater shall be led to deaerator. Alternate drain from all heaters shall be led to condenser. This is in line with standard practice .please confirm.	Specification is self-explanatory
153	2	7.1.2	A horizontal, direct contact, spray-cum-tray type single de-aerating vessel mounted on a horizontal storage tank shall be provided.	Bidder proposes to provide alternatively an option of vertical type deaerator (Multiple Tower) inline with Bidder's proven design. We request customer to accept vertical deaerator and also accordingly modify provenness criteria allowing vertical deaerator.	Bid Specification shall prevail
154	2	7.1.4	The De-aerator shall be capable of de-aerating all the incoming condensate, H.P. heater drips and emergency make up water at a rate adequate to provide boiler feed to match the Steam Generator MCR requirements continuously.	No emergency make-up water is envisaged at Deaerator as it is provided at condenser hotwell. Hence please delete this requirement from this clause.	Will be evaluated after receipt of detailed scheme by bidder.
155	2	7.1.4	The deaerator shall be capable of de-aerating all the incoming condensate, HP heater drips and emergency make-up water....	As per tender document make-up is only done at Condenser hotwell and no make up is envisaged at the Deaerator. Also as per tender P&ID: PE-189-PF-203 (feedwater system), does not show any emergency make-up line to Deaerator Please clarify.	Will be evaluated after receipt of detailed scheme by bidder.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
156	2	7.1.5	The dissolved oxygen content at the discharge from Deaerator without chemical dosing shall not be more than 0.005 cc/litre in boiler feed water at all loads up to and including the rated capacity.	Kindly note that the maximum oxygen content shall not exceed 0.005 cc/litre from 40% - 100% load condition as a standard & proven practice of manufacturer. Kindly confirm.	Bid Specification shall prevail
157	2	7.1.9 (i)	Sufficient number of inspection openings/man-holes (of minimum 600 mm diameter) with suitable covers for easy cleaning, inspection and maintenance. Covers for these openings/man-holes shall be hinged type.	Bidder would like to clarify that in case of Vertical Deaerator (multiple tower) no manhole will be provided on Deaerator dome. Deaerator dome can be approachable from feed water tank itself for cleaning, inspection and maintenance.	Bid Specification shall prevail
158	2	7.2	Material of construction (c) Trays : 304 stainless steel (d) Tray supports : Stainless steel (e) Internal bolting : Stainless steel	Bidder propose MOC as follows : (c) Trays : 304 stainless steel / Carbon Steel (d) Tray supports : Stainless steel / Carbon Steel (e) Internal bolting : Stainless steel / Carbon Steel	Bid Specification shall prevail
159	2	Datasheet-A, 1.10	Terminal Temperature Difference °C - Less than 0.3°C	As per datasheet-A, cl. No 7.1.2, TTD shall be zero at all load conditions. The requirement specified for TTD is not matching with cl. no. 1.10. We understand that that the TTD for the deaerator shall be zero Deg.C at all load conditions.	Will be evaluated after receipt of detailed scheme by bidder.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
160	2	Datasheet-A, 2.1	Design Data : LP Heater Flow : 105% of design condensate flow from condensate extraction pumps without undue vibration and deleterious effects.	We understand that heaters shall be designed for 100% TMCR with 0% MU condition and this design data is a check case for heaters for operating with 105% of design condensate flow from CEP without undue vibration and deleterious effects. Please confirm.	Specification is self-explanatory
161	2	Datasheet-A, 2.2	Design Data : HP Heater Flow : 105% of the design feed water flow from BFP without undue vibration and deleterious effects	We understand that heaters shall be designed for 100% TMCR with 0% MU condition and this design data is a check case for heaters for operating with 105% of design feed water flow from BFP without undue vibration and deleterious effects. Please confirm.	Bid Specification shall prevails.
162	2	Datasheet-A, 4.3	Design temperature (shell and tube side) - As per HEI Standards rounded-off to next higher 10°C	Owner to note that the design temperature shall be as per HEI rounded-off to next higher 10 Deg. F. This is inline with the HEI guidelines. Kindly accept.	Bidder's understanding is correct; The clause is amended.
163	2	Datasheet-A, 4.4	Maximum tube side velocity : Not to exceed 2.5 m/sec.	Max tube velocity shall be as per HEI. Please confirm.	Agreed
164	2	Datasheet-A, 5.3	Tubes - Stainless steel as per SA 213 grade TP 304L for seamless (For HP Heaters) and SA 688 grade TP 304L for welded tubes (For LP Heaters).	Owner to note that the selection of tube whether seamless / welded for the HP Heaters shall be as per standard and proven practice of the Bidder. Kindly accept.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
165	2	Datasheet-A, 5.4.1	TUBE SHEET LP heaters - Carbon steel as per SA 516 grade 70 or equivalent	Bidder requests Owner to provide an option of MOC for tubesheet from SA 516 Gr 70 , SA 266 grade II & SA 350 grade LF2.	Bid Specification shall prevail
166	2	Volume- IIIB/ Datasheet -A SR. No. 5.4.1 - Tube sheet Material for LP Heater	Carbon steel as per SA 516 grade 70 or equivalent	We propose Tube Sheet Material for LP heater will be Carbon steel as per SA 350 Grade LF2 or equivalent as an alternative. Kindly give the acceptance for the same.	Specification is self-explanatory
167	2	Datasheet-A, 5.4.2	TUBE SHEET HP heaters - Carbon steel as per SA 350 grade LF2 or equivalent with stainless steel cladding	Bidder requests Owner to provide an option of MOC for tubesheet from SA 516 Gr 70 , SA 266 grade II & SA 350 grade LF2.	Specification is self-explanatory
168	2	Datasheet-A, 5.6	Nozzles except HP heaters channel side - Carbon steel as per SA 106 Gr. B or equivalent for temperature less than 400°C. Suitable material for above 400°C	Bidder requests Owner to provide an option of forgings such as SA 266 grade II & SA 350 grade LF2 apart from seamless pipe SA 106 Gr B.	Specification is self-explanatory
169	2	Volume- IIIB/ Feed water Heater Datasheet -A SR. No. 5.11.2	HP Heater Bolt material - SA 193 B16 or equivalent	Bolt material of SA 193 B7 or equivalent may also be accepted as an alternative.	Bid Specification shall prevail

BHUSAWAL THERMAL POWER STATION 1 x 660 MW UNIT - 6 PROJECT**PRE - BID QUERIES****Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-B**

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
170	2	Volume- IIIB/ Deaerator Datasheet -B SR. No. 1.4	Design pressure of de-aerator and feed water storage tank- 125% of maximum extraction steam pressure rounded off to next higher 0.5 kg/cm ² and full vacuum	As per OEM standard practice, design pressure of Stork type deaerator may please be accepted at 110% of the maximum extraction steam pressure obtained from various operating conditions.	Bid Specification shall prevail
171	2	Volume- IIIB/ General	Not specified	Since it is not specified, we presume that heaters are to be designed for Performance guarantee condition at 100%TMCR/0%MU.	Heaters shall be guaranteed for TMCR condition with all specified margins; hence requisite correction curves shall be applicable during demonstration test
172	3	1.1.1	2 x 50% TDBFP and 2 x 30% MDBFP	As an optional case, we propose 2 x 50% TDBFP and 1 x 50% MDBFP for better flexibility on duty point and tools and spares consideration.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
173	3	1.1.4	The pumps shall be designed for efficient and reliable operation and shall be of proven design with at least five years of satisfactory operating experience.	Owner to note that as clause no. 2.2.3, Section - 3, Volume 1 it is mentioned that the for the respective equipments mentioned under that clause, the equipment of desired capacity (as defined under the clause) should have been succesful operation an atleast One (1) plant for a period of not less than one (1) year from the date of opening of bid. However as per the caluse 1.1.4 of volume IIIB it is mentioned that the pumps shall be been in service for atleast 5 years. Bidder understands that the criteria as defined in clause 2.2.3 of volume - 1 shall remain applicable. Kindly ammend the clause of volume IIIB.	Confirmed
174	3	1.2.3	The pumps shall be designed to withstand transient condition due to load swing of the unit from full load to no load. Adequate design margins shall be provided in the pumps for turbine bypass operation.	Sizing CEPs considering turbine bypass operation will oversize the CEPs and in turn will give deteriorated performance at normal TMCR operation. Bidder requests Owner to allow three (3) pumps operation of CEP during turbine bypass operation if two pumps can not cater the spray requirement. Kindly confirm	Bid Specification shall prevail
175	3	1.4	Design capacity per pump=1.05x flow at VWO+spary...)	Please clarify the term 'spray' refers to.	Specification is self-explanatory
176	3	1.8 & 1.7	Total head at rated capacity - 10% margin on..TGVWO ,1% make up and design CWT	Please clarify the make up flow indicated as 1%	Specification is self-explanatory

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
177	3	S. No. 1.10 - CEP datasheet	NPSH required at 3% head break - Shall not be greater than 50% of NPSH available over the entire range of operation from minimum flow to pump run out flow	We propose to limit the maximum value of NPSH required as 80% of NPSH available for entire flow range. Please confirm	Bid Specification shall prevail
178	3	1.11	Design speed -6000 rpm/1500 rpm	BP speed indicated is on lower side for the TDBFP set. Please review.	Bid Specification shall prevail
179	3	S. No. 1.13 - CEP datasheet	Maximum allowable vibration at all operating condition - As per ISO 10816-1 Cl III Zone A/B	Please note that, ISO 10816-7 specifically gives instructions for the evaluation of vibration on rotodynamic pumps for industrial applications with nominal power above 1 kW. Request Owner to provide acceptance for evaluation of vibration per ISO 10816-7.	Will be evaluated after receipt of detailed scheme by bidder.
180	3	2.1.1 (l), 2.1.2(a), 5.1 4.1	Pump warm-up orifice (s) for boiler feed pump.	As per section -3, clause no 5.14.1, pump should be designed to start working without internal or external warm up arrangement. We wish to clarify in reference to the tender requirement that the Warm-up arrangement, if required, shall be provided as per pump manufacturer standard practice.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
181	3	2.1.2 (c)	Temperature sensing type seal control system for the Boiler Feed Pump complete with temperature controller, sensing elements, control valves, filters, air filter regulators, complete piping from the condensate source and suitable seal system as required by the design of the Booster Pump shaft seals.	Employer to note that complete cooling system for the mechanical seals shall not have any control valves and the fixed flow system shall be installed to ensure that the temp of the mechanical seals is well within the normal acceptable range. Also temperature controller will not be required as the colling water flow shall be decided considering the worst operating condition. Kindly accept.	Bid specification prevails
182	3	2.1.1 c / 5.9	Supply of disconnect coupling, if required for the turbine drive main feed pumps.	Flexible coupling between BFP drive Turbine and BFP may be accepted as dry flexible membrane couplings since these are simple in design and lot of accessories required for Disconnect couplings (like hydraulic pumping unit, hydraulic actuators etc.) are not applicable. Dis-engagement is by simple dismantling of spacer bolts.	Bid Specification shall prevail
183	3	2.1.1 (d)	Sole plates, pin and key blocks or other support structure and a common base plate (with foundation anchor bolts/inserts, drip lip and drain) for booster pump and gearbox, motor drive.	Employer to note that the base plates for the complete train shall be as per the standard supply of the Bidder and necessary adjustments shall be done at site during erection. Kindly accept.	Bid Specification shall prevail
184	3	2.1.1 i / 2.1.2 j / 3.1.20	Duplex type basket strainer for installation ahead of the booster pump suction	Simplex strainer or duplex strainer as per the manufacturer's standard practice.	Bid Specification shall prevail
185	3	2.1.2 (k)	Modulating type Recirculation control valves and pressure break down orifices, as necessary to pass the minimum flow required for the pump.	Bidder propoes to provide either hydraulic or pneumatic actuator for BFO recirculation control vlaves. Kindly accept.	Specification is self-explanatory

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
186	3	2.1.1.1	Pump warm up orifice...	It will be provided as applicable to the BFP supplier.	Bid Specification shall prevail
187	Sec-3	2.1.3 (a)	Steam sources for BFP drive turbine	Only two sources have been specified, i.e. from turbine extraction (normal) and CRH (alternative), while the PID PE-189-PR-204 shows an additional alternate source from auxiliary steam. please clarify the requirement.	Clause 2.1.3(a) Section 3 shall prevail. Additional alternative source from aux steam as indicated in P& ID PE-189-PR -204 is not required.
188	3	2.1.3 a	Steam admission pipes from the following sources to the auxiliary turbine along with individual steam admission valves	Sources of steam will be from IP extraction or cold reheat as per system requirement. Steam admission shall be as per manufacturer's standard practice.	Bid Specification shall prevail
189	3	2.1.3 (c)	Gland sealing steam supply piping from main turbine gland sealing system and return piping to gland steam cooler for main steam turbine complete with all fittings, valves, necessary instrumentation and control hardwares to make the system complete in all respects.	Employer to note that the option for taking the gland seal system from upstream of drive turbine steam header shall also be allowed instead of taking the gland steam from the main turbine gland steam header as this is standard practice of the the drive turbine suppliers. Kindly accept.	Bid Specification shall prevail
190	3	3.1.3	Shut-off head shall not, however, be less than 120% and shall not be more than 130% of the head developed at pump design speed.	BFP will be selected based on hot shut-off and Shut-off head shall not be less than 120%, upper limit may be taken care by bidder as per the manufacturer's standard.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
191	3	3.1.5	The pumps shall be capable of accepting...including dry run	The pumps will be capable of accepting complete loss of water for very short duration due to incidents such as inadvertent complete closure of suction valve and brought down to rest in controlled manner from design condition with simultaneous closure of suction valve. However, Dry running shall be avoided due to possible pump damage. Closing of the suction valve during pump operation shall be avoided by interlocking logic in the plant controls.	Bid Specification shall prevail
192	3	3.1.6	Suction specific speed for BFP and booster pump must not exceed 9500 US units.	As per HIS, suction specific speed upto 11000 US units is acceptable. Please confirm acceptance.	Bid Specification shall prevail
193	3	3.1.7	The pumps shall be capable of withstanding reverse rotation...	Reverse rotation detection will be provided in the pump system.	Specification is self-explanatory
194	3	3.1.10	Pump and drive assembly shall run smooth, free from undesirable vibration, noise and leaks. Acceptable peak-to-peak vibration limits of the Hydraulic Institute Standards, USA will be applicable.	Employer to note that the vibration limits for the pump shall be as per ISO 10816-7 Zone A for preferred operating range. Kindly accept the same.	Will be evaluated after receipt of detailed scheme by bidder.
195	3	3.1.16	The pumps shall be capable of safer, proper and continuous operation at speeds upto 10% above rated speed...	Continuous operation at 110% speed is not allowable for the pump operation. Pump will trip at this speed. Also refer the specification clause 5.18.5 which calls for auxiliary turbine trip at 10% above the rated speed. Please clarify.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
196	3	3.1.17	The drive motor margin...BP-5% and BFP-10%.	Please note that the pump itself is provided with lot of margin with respect to the operating point. So we suggest for the BFP drive motor a 5% margin is adequate.	Bidder to note that there is no difference between the specification and the query bidder has posed.
197	3	3.1.18	The critical speed of the rotor assembly, in dry as well as water filled conditions shall be beyond the maximum possible running speed by at least 30%, even after considering power supply to pump drive motor at 51.5 Hz.	To be discussed. NTPC specification is asking such condition for only wet operation and also frequency variation is not asked.	Will be evaluated after receipt of detailed scheme by bidder.
198	3	3.1.18 / 5.3.2	The critical speed of the rotor assembly, in dry as well as water filled conditions shall be beyond the maximum possible running speed by at least 30%, even after considering power supply to pump drive motor at 51.5 Hz.	The critical speed of the pump rotor (only) in water filled conditions will be 30% above the pump maximum running speed. Since dry running is not expected in Super critical technology, critical speed of rotor assembly during dry condition shall be as per manufacturer's standard design.	Will be evaluated after receipt of detailed scheme by bidder.
199	3	3.1.20 5.17.3	Duplex type basket strainers shall be provided on the booster pump suction to protect the fine clearances of the pump. The screening area of the strainer shall be 4-5 times the cross-sectional area of the inlet pipe. Each pump shall be furnished with a flanged suction strainer (the duplex strainer as already specified for the Boiler Feed Pump) complete with other accessories as per requirement.	Employer to note that the Bidder shall be allowed to offer strainers of appropriate mesh size at both booster pump suction and main pump suction so as to maximize the advantage of NPSH available. Kindly accept the bidder's proposal.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
200	3	3.1.21	All the design parameters are to be met during under frequency of 47.5 Hz at grid.	As per Section-3, Datasheet-A, Cl. No. 1.8, Normally working pump(s) would be capable of meeting the 100% TG MCR requirement during an under frequency operation of 47.5 Hz. Please clarify.	Specification is self-explanatory
201	3	3.1.21	All the design parameters are to be met during under frequency condition of 47.5 hz.	The requirement is not clear .Please clarify the term 'all the design parameters'.	Specification is self-explanatory
202	Sec-3	3.1.21	Regarding BFP - 'all design parameters to be met during under frequency conditions of 47.5 Hz'	Data Sheet-A, Sr. no. 1.8 at pg 150/308 of the same section indicates the pumps to be capable of meeting 100% TGMCR during under frequency conditions of 47.5 Hz.MahaGenco to please clarify the requirement. As per normal practice followed, under frequency operation of BFPs is to be checked only for 100% MCR condition.	Specification is self-explanatory
203	3	3.1.21	All the design parameters are to be met during under frequency condition of 47.5 Hz at grid.	The boiler feed pump set shall be designed for 50Hz. However, pumps shall be suitable to meet the normal operating parameters at 47.5 Hz also.	Bid Specification shall prevail
204	3	Datasheet-A 1.6 / 3.1.23	Total combined flow of normally working two pumps shall be 105% of the total feed water flow at TG VWO, 3% MU and design condenser inlet cooling water temperature.	For supercritical applications, 1% MU is adequate and hence, we request acceptance of the same.	Bidder's understanding is correct; The clause is being amended.
205	3	3.1.23	The Boiler Feed Pump set shall be capable of continuous safe, and trouble free operation under other than normal condition, like under and over frequency (47.5 to 51.5 Hz), abnormal pressure decay in De-aerator, VWO with 3% make-up	Please clarify the design make-up quantity. it is 1% or 3% ?	

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
206	3	3.1.24	Motor shall be able to accelerate the pumps from standby conditions to rated pumping conditions in less than 15 seconds after receipt of starting signal while operating either singly or in parallel with other operating pump.	Starting time of motor shall be as per manufacturer standard. Exact starting time shall be finalized during detail engineering.	Bid Specification shall prevail
207	3	3.1.25	The bidder shall demonstrate this capability by a suitable dry running test at his works and shall furnish details of this proposed test including its duration etc. in the bid.	Feed pumps for supercritical boilers are required to generate high pressures and therefore require high numbers of stages (usually 5 or 6). Such pumps are designed to accept vapour locking to the extent it would be expected to occur at site. In practice, such incidents result in the pumps being filled with a mixture of water and vapour (although the risk of such incidents is greatly reduced by modern control systems). The incidents are difficult to simulate in a controlled manner in the small closed loop of a test bed; during a works test, there would be a risk of the pump running completely dry - which would be an unrealistic situation. BFP is not designed for full dry running condition or operation under full vapour locked condition for 15 minutes. However, the offered BFP is capable of safe coasting down to rest, upon any inadvertent closure of suction valve. Adequate protections & interlocks would be built into the system to prevent dry running of the pump for extended length of	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
				time."	
208	3	3.1.25 a.&b.	Dry running test...	The pumps will be capable of accepting complete loss of water for very short duration due to incidents such as inadvertent complete closure of suction valve and brought down to rest in controlled manner from design condition with simultaneous closure of suction valve. However, Dry running shall be avoided due to possible pump damage. Closing of the suction valve during pump operation shall be avoided by interlocking logic in the plant controls.	
209	3	3.1.25 (c)	The Feed Pump shall be capable of operating under full vapour locked condition for 15 minutes (i.e. following an inadvertent closure of suction valve) and rundown to rest from this vapour locked condition without endangering the pump rotor or subsequent detrimental effect in pump overall performance. To establish above criterion, the Bidder shall necessarily submit the full backup calculation, rotor response characteristics, various internal clearances and other features, test reports for similar pumps meeting the above design condition. In order to demonstrate the above capabilities at shop, the Bidder shall furnish complete testing procedure along with the bid.	Boiler Feed Pumps are not suitable for dry running for the duration specified in the specification and hence request to remove such condition. However, dry running test in controlled manner as specified in the Vol IIIB, Annexure A "Minimum Testing Requirement" shall be conducted to demonstrate the dry running capability.	

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
210	3	3.1.25 (c)	The Feed Pump shall be capable of operating under full vapour locked condition for 15 minutes (i.e. following an inadvertent closure of suction valve) and rundown to rest from this vapour locked condition without endangering the pump rotor or subsequent detrimental effect in pump overall performance.	Employer to note that under the full vapour locked condition / dry running condition the pump shall be capable of operating for only 5 min as indicated by various pump manufacturers being the safe operating practice. Kindly accept.	
211	3	3.1.25 (c)	In order to demonstrate the above capabilities at shop, the Bidder shall furnish complete testing procedure along with the bid.	Shall be submitted during the execution engineering stage only. Kindly accept.	Agreed.
212	3	3.1.25 (c)	Bidder must ensure that feed pumps operation at flow beyond its maximum flow handling capability due to low system resistances shall be smooth and without any abnormal noise and vibration and without any necessity of reducing the plant load.	Kindly ammend "Bidder must ensure that feed pumps operation at flow beyond its maximum flow handling capability due to low system resistances (if envisaged by the Bidder) shall be smooth and without any abnormal noise and vibration and without any necessity of reducing the plant load."	Bid Specification shall prevail
213	3	3.1.28	In no case ,the mismatch of feed water flow through the pumps in parallel operation shall exceed 1% of average.	The minimum 5% of difference in flow will be allowed.Please refer the specification dats sheet clause 1.15,It is mentioend as 5%. Please clarify.	Bid Specification shall prevail
214	3	3.1.28	In no case, the mismatch of feed water flow through the feed pumps in parallel operation shall exceed 1% of the average.	The allowable mismatch in flows between two running pumps can go upto 5% , as per various manufacturer's feedback. Kindly allow mismatch upto 5%.	

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
215	3	3.2.2	There has to be two independent source of steam supply under normal and also low load operation. Both sets of steam admission valves (for normal supply and high pressure supply) shall be controlled by the Turbine governing system in a coordinated manner, to ensure a smooth change over from one source to another. Cold reheat steam will be the alternate high-pressure source of supply for these turbines.	Employer to note that all the steam sources for the BFP drive turbine shall form a common header and a control valve finally controlling the steam supply to the drive turbine shall be installed on the common header. Such control valve only is controlled by the turbine governing system. Kindly accept.	Bid specification prevails
216	3	3.3.7 & Volume-IVA/ Section-10/4.1.6	Volume-IIIB/ Section-3 Cl no 3.3.7 - "Rating of the motor shall be selected with at least 5% margin for HT motor & 10% for LT motor over the maximum power required within the range of operation." Volume-IVA/ Section-10 Cl no 4.1.6 - "Motor Name plate rating shall have at least 10% Margin over the input power requirement of the HT Driven equipment and 15% for HT Driven equipment at rated Duty Point"	As noted, there is discrepancy in the criteria for motor selection as stated in electrical section and individual equipment specifications. We propose 5% margin for HT motor and 10% margin on LT motor at design point OR run out power whichever is higher, for all equipment . Please confirm.	Bidder should follow as per Volume-IVA/ Section-10 Cl no 4.1.6 - "Motor Name plate rating shall have at least 10% Margin over the input power requirement of the HT Driven equipment and 15% for LT Driven equipment at rated Duty Point" Refer corrigendum(II).
217	3	3.3.9	The pump rotor assembly ..dry running conditions	The CEP dry running operation is not envisaged.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
218	3	5.4	The seals should be designed to have a minimum life of not less than 25,000 hours between overhauls.	Employer to note that as per clause 3.1.25 (b) of Vol III B section - 3, it is mentioned that the mechanical seal face material shall be capable of operating for atleast 20000 running hours however as per the clause 5.4 it is mentioned that the seals shall be designed to The seals should be designed to have a minimum life of not less than 25,000 hours between overhauls. We understand that the of clause 3.1.25 (b) shall prevail as a standard industry practice. Kindly confirm.	Shall be 25000 hours
219	3	5.7	The common base plate shall also accommodate the drive motor, the Booster Pump, the fluid coupling and the step up gear box as necessary.	Employer to note that the base plates for the complete train shall be as per the standard supply of the Bidder and necessary adjustments shall be done at site during erection. Kindly accept.	Bid Specification shall prevail
220	3	5.13.4	For reducing the bypass pressure to a value suitable for returning to the Deaerator, each pump shall be provided with suitable multiple stellited orifice plates of 11-13% chrome steel with companion flanges for installation in the recirculation piping and adequately designed for prolonged continuous service. Each recirculation line shall be routed independently to deaerator storage tank. An orifice, with a small pressure drop, shall be fitted in each line near the deaerator to prevent any flashing in the pipeline	Employer to note that requirement of multiple orifice plates in the recirculation line shall be decided based on the control range of the recirculation control valve. If the control range is sufficient to meet the deaerator pressure requirement then there is no need to provide such orifice. Additionally anto flash orifices with suitable pressure drop shall be provided at inlet to deaerator. Kindly accept.	Will be evaluated after recepit of detailed scheme by bidder.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
221	3	5.16.2	It shall be complete with stainless impellers, heavy duty roller up to 5 microns.	Coupling impeller MOC will be as per the standard design of manufacturer subject to approval of Owner.	Bid Specification shall prevail
222	3	5.18.3 (a)	Guarded steel oil pressure piping furnished in areas external to the reservoir in vicinity of hot turbine parts.	The oil pressure piping shall be as per standard and proven practice of the Bidder. Kindly accept.	Bid Specification shall prevail
223	3	5.18.3 (h)	Connection on oil coolers, for oil exit temperature sensor for the Owner's sensing line for automatic control of the cooling water flow.	Employer to note that necessary oil temperature control is provided on the lube oil circuit of the cooler and no control is provided on the water side of the oil cooler. Fixed flow cooling water (pre-engineered) is envisaged for the complete range of temperature control of the lube oil. Kindly accept.	Bid Specification shall prevail
224	3	5.18.3 (k)	Hand-adjustable, oil pressure reducing valves for auxiliary steam turbine and Boiler Feed-Booster Pump unit lubrication systems.	Employer to note that control valve for the lube oil header pressure control is provided however manual pressure control for the individual consumer is not envisaged as it is not a standard practice of the Bidder. Kindly accept.	Bid Specification shall prevail
225	3	5.18.4 (a)	Manual speed control shall be provided for both local and remote operation	Employer to note that manual speed control for local operation is not envisaged. Kindly accept.	Bid Specification shall prevail
226	3	5.18.5 (a)	Overspeed governor shall be independent of speed governor and shall include means for intentional tripping at speeds lower than maximum rated.	We understand that the overspeed governor shall trip the turbine at speed higher than the rated speed. Kindly confirm.	Specification is self-explanatory

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
227	3	5.18.5.f.g.h.i	Auxilairy turbine instrumentation and control..	Auxiliary turbine instrumentation and control system will be provided as per the supplier standard practise and the proven technology.	Bid Specification shall prevail
228	3	S. No. 5.18.5 BFP Protective Devices.	Bolt type over speed governor set to trip at.....	An independent dedicated Electronic Over Speed Protection Device with dedicated speed probes and with 2 out of 3 voting logic will be provided, in addition to over speed trip provided in Electronic Governor. Mechanical over speed trip device is not provided. This is in line with the standard design philosophy being followed for steam turbines of this type, size and rating.	Bid Specification shall prevail
229	3	5.19.1	The exhaust duct shall be complete with transition pieces, drain connection, relief device to open in event of vacuum failure, 500 mm square manhole, turning vanes to minimise turbulence and friction losses in the ducts and other fittings as required for safe and smooth operation of the plant.	The exhaust duct for the auxiliary drive turbine shall be as per standard supply of the equipment supplier. Internal such as turning vanes are not required as per standard supply. Kindly accept.	Bid Specification shall prevail
230	3	5.19.5 (c)	Exhaust Duct: Round exhaust ducts shall be fabricated in accordance with ASTM A-155 Grade KC-60, Class-2 or approved equal.	Employer to note that instead of providing duct works for the BFP Drive turbine exhaust, piping conforming to the requirements of ASTM A 672 Gr B 60 shall be provideed as per prevailing industry practice. Kindly accept.	ASTM A 672 shall be employed.
231	3	5.19.5 c	Round exhaust duct shall be fabricated in accordance with ASTM A 155 Gr KC-60, Class-2.	IS 2062 grade B material can also be used as an option. Please confirm	

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
232	3	5.19.5 (c)	Round exhaust duct shall be fabricated in accordance with ASTM A-155 grade KC-60, class -2 or approved equal.	Please note that ASTM A-155 is withdrawn and is replaced by A-671. And bidder's recommendation for exhaust duct is A-672. Please clarify.	
233	3	5.19.5f. g., 5.19.6 g & i & 5.20.2	f. Exhaust duct shall be designed, fabricated, inspected and tested in accordance with ANSI B 31.1 g. All Welding procedure qualifications shall confirm to the requirements of ASME Boiler and pressure vessel code Section IX	The code indicated is not applicable for Low pressure exhaust duct, butterfly valve and expansion joints.	Will be evaluated after receipt of detailed scheme by bidder.
234	3	6.6	MOC of Bowl – Cast Iron	We propose to use MOC of Bowl as Carbon steel.	Bid Specification shall prevail
235	3	6.8	The Condensate Extraction Pump shaft and can length shall be based on the pump NPSH required and the Condenser Hot-Well minimum level; the later being determined based on the fluidized Condenser size, Condenser neck angle of divergence permitted, air system requirement as well as various power cycle system drainage requirement	Employer to note that the Condenser Hot-well minimum level shall be decided as per standard and proven practice of the Bidder ensuring that the NPSH _r of the condensate extraction pump and other condenser internal design requirements are full-filled. Kindly accept.	Bid Specification shall prevail
236	3	Datasheet-A, 1.4	Design capacity per pump, shall be as per the following rounded off to nearest higher 5 m ³ /hr: [1.05 x (flow at turbine vwo + sprays + sealing water) x 0.5	Please elaborate the flow related with sprays.	Specification is self-explanatory
237	3	Datasheet-A, 1.4	Design pressure of Deaerator & Feed water tank : 125 % of the maximum extraction steam pressure rounded off to next 0.5 kg/cm ² and full vacuum	Design pressure of Deaerator & Feed water tank shall be 120 % of the maximum extraction steam pressure rounded off to next 0.5 kg/cm ² and full vacuum.	Bid Specification shall prevail

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PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
238	3	Datasheet-A, 1.6	Rated capacity of pump - Total combined flow of normally working two pump(s) shall be 105% of the total feed water flow at TG VWO, 3% Make-up and design condenser inlet cooling water temperature.....	As per Datasheet-A, clause 1.8, Total head at rated capacity - Shall include 10% margin on equipment and piping pressure drops for TGVWO, 1% Make-up and design CWT. In the referred clauses, Different make up quantities are specified for flow and head in the tender. In line with the tender stipulation, we are considering 1% make up for pump design. Please confirm.	Design Make up shall be 1 %
239	3	Datasheet-A 1.6	Total combined flow of normally working two pump(s) shall be 105% of the total feedwater flow at TG VWO, 3% Make-up .	Please clarify the design make-up quantity. it is 1% or 3% ?	
240	3	Datasheet-A, 1.7	Total dynamic Head at design capacity - (a) 125 % of deaerating feed water heater operating pressure at TG VWO (1 % makeup and design CWT)	Bidder experience indicates that 10% margin on piping pressure drop is sufficient to calculate total dynamic head of CEP. Additional margin i.e. 125% on deaerating feed water heater operating pressure is not required, as it will lead to deteriorated performance at TMCR operation and leads to adverse effect on the auxiliary power consumption. Please also note that pumps are capable to meet head & flow requirement @ 47.5 Hz frequency operation.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
241	3	Condensate Extraction Pump Datasheet - A SR. No. 1.7	Total dynamic head (TDH) at design capacity - (a) 125% of de-aerating feed water heater operating pressure at TG VWO (1% Make-up and design CWT) (b) 10% margin on equipment and piping pressure drops at TG VWO	For optimized CEP TDH calculation at design Point following may kindly be accepted : a) Deaerator pressure as 110% of operating pressure at VWO (with 1% MU, CWT 33 deg C) or maximum deaerator pressure in any operating condition, whichever is higher. b) 10% Margin on piping pressure drop at VWO. Margin on Equipment pressure drop shall not be considered.	Bid Specification shall prevail
242	3	Data Sheet - A 1.9	Shall not be less than three hundred percent NPSH required at 3% head break by booster pump	Employer to note that as per the prevailing industry practice NPSHA shall be 250 % more than the NPSHR. Kindly accept.	Bid Specification shall prevail
243	3	Datasheet-A, 1.9	NPSH available at booster pump centre line (min), Normal operation : Shall not be less than three hundred percent NPSH required at 3% head break by booster pump	Bidder proposes "NPSH available at booster pump centre line (min), Normal operation : Shall not be less than two hundred and fifty percent NPSH required at 3% head break by booster pump"	Bid Specification shall prevail
244	3	Datasheet-A 1.9	Shall not be less than three hundred percent NPSH required at 3% head break by booster pump.	NPSH available higher than 1.8 times NPSH required, during normal operation is sufficient. Please confirm.	Bid Specification shall prevail
245	3	Datasheet-A, 1.10	NPSH available at booster pump centre line (min), Transient operation : Shall not be less than one hundred and twenty five percent the NPSH required at 3% head break by booster pump	Bidder proposes "NPSH available at booster pump centre line (min), Transient operation : Shall be higher than the NPSH required at 3% head break by booster pump"	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
246	3	Datasheet-A, 1.10	NPSH required at 3% head break : Shall not be greater than 50% of NPSH available over the entire range of operation from minimum flow to pump run out.	NPSH required at 3% head break shall not be greater than 80% of NPSH available at pump design point. Further, it will be insured that NPSH available will be higher than NPSH required over the entire range of operation from minimum flow to pump run out.	Bid Specification shall prevail
247	3	Data Sheet - A 1.13	As per ISO 10816-1 Cl II Zone A/B	Employer to note that for the Condensate Extraction Pump the vibration levels shall be as 2.8 mm/ses for the preferred operating range and 4.5 mm/ses for out of preferred operating range inline with the requirements of ISO 10816 - 1 Class IV Zone A. Kindly confirm.	Bid Specification shall prevail
248	3	Datasheet-A, 1.14	Shut-off head - Combined shut-off head of BFP shall be not less than 120% and not greater than 130% of pump	Shut-off pressure shall be between 115% and 130% of pump design total dynamic head as per manufacturer's standard.	Bid Specification shall prevail
249	3	Datasheet-A, 1.15	Condensate pH : 8.6 to 9.2 during normal operation and 11 to 12 during flushing	For combined AVT(O) and OT treatment PH is maintained at 8 to 8.5 as per EPRI guidelines. Please confirm.	Will be evaluated after receipt of detailed scheme by bidder.
250	3	Data Sheet - A 1.19	VDI 2056 group G degree 'Good'	Employer to note that the vibration limits for the pump shall be as per ISO 10816-7 Zone A for preferred operating range. Kindly accept the same.	ISO 10816 agreed as basic standard; Zone to be decided during bid evaluation

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
251	3	Data Sheet - A 1.19	CEP suction piping and strainer shall be above ground level to avoid any trench in the ground floor of steam turbine building.	Employer to note that the location of the CEP suction stariner and the associated piping shall be as per the NPSH requirement of the CEP and as per the standard layout of the Bidder. Kindly accept.	Bid Specification shall prevail
252	3	Datasheet-A, 1.19	Maximum Vibration level at all operating conditions: VDI 2056 Group G Degree Good	VDI 2056 standard has been withdrawn, bidder proposes ISO 10816.	Agreed.
253	4	2.0 - Codes and Standards	 HEI standards or equivalent shall be followed for thermal design and IS-2825 for strength design of condenser.	Please note that strength calculation of Condenser components shall be as per HEI & ASME sec-VIII Div-1 (as referred in HEI). We have not considered IS-2825 standard for strength calculation.	Bidder's understanding is correct.
254	4	2.1	HEI standards or equivalent shall be followed for thermal design and IS-2825 for strength design of condenser.	Kindly note that the strength design of the condenser shall be as per proven and standard practice / guidelines of the manufacturer. Kindly confirm.	In place of IS 2825, ASME Section VIII may also be employed.
255	4	3.1.2	Air Extraction System: both the vacuum pumps will be operated during start up to create initial vacuum within 25 Minutes.	As per HEI, initial vacuum will be obtained within 30 minutes. Please confirm.	Bid Specification shall prevail
256	4	3.1.5	Sponge rubber ball type COLTCS with ball recirculation pump, strainer, automatic ball sorter etc.	Use of Automatic ball sorter is redundant and not required. Please note balls wear and tear is uniform. Also ball monitoring system is provided to	Confirm

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
257	4	5.4	COLTCS- A continuously operating..... Automatic ball sorter, ball collecting strainer.....	provide alarm for addition of new charge of balls when more than 10% balls have worn out. Hence automatic ball sorter is not required nor it is a general practice to provide the same. However we may provide Bucket with sieve type sorter for manual sorting of undersize balls as per general practice. Pl.confirm	Confirm
258	4	4.1	The Condenser shall be designed such that steam received from the Turbine exhaust during Turbine VWO operation with 3% make-up, all heaters in service, and Auxiliary Turbine Drive of Boiler Feed Pump engaged, can be condensed along with other heat rejections like all heater drains & vents diverted to the Condenser etc. maintaining the Condenser pressure of 77 mm of Hg (A) or lower with cooling water temperature of 33 °C with 5% of tube plugged and having a tube cleanliness factor of 90%. The cooling water temperature differential across the Condenser shall remain within 9.5 °C (during maximum thermal load).	Datasheet-A, clause no. 3.0, Design margin on heat load at TG VWO, 1% make-up and design CWT of 33 °C. = 5 % We would like to clarify following points in continuation with the reference clauses: 1) Make-up water to cycle requirement is considered as 1% in line with tender stipulation - Data sheet A. 2) The cooling water temperature differential shall be within 10°C or as optimised by bidder.	Design Make up shall be 1 %; For the rest, Bid Specification shall prevail.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
				3) As the condenser is already designed at VWO condition with 1% make-up & 90% tube cleanliness factor which is an indirect margin on TMCR operation, we do not envisage any additional margin requirement on heat load or tube plugging. This will unnecessarily increase the cost of equipment without any considerable benefit in plant performance. 4) Only LP heater drains to the condenser to be considered for condenser sizing. Bidder confirms that the above design criteria is inline with best engineering & design practices followed in India & worldwide and request you to amend the design criteria accordingly..	
259	4	4.1	Cooling water temperature of 33 degC...	It will be optimised by the bidder for the better performance. Please confirm as this is EPC contract	Cooling water temperaure shall be optimised by bidder based on the ambient data and vacuum specified.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
260	4	4.1- General Performance Requirements	The Condenser shall be designed such that steam received from the Turbine exhaust during Turbine VWO operation with 3% make-up, all heaters in service, and Auxiliary Turbine Drive of Boiler Feed Pump engaged....	Thermal design of the Condenser (surface area) shall be worked out based on process parameters at guarantee Condition i.e. 100% TMCR/ 0% MU. However Condenser design will meet the operating condition of VWO 1% MU while keeping temperature rise limited to 9.5 DegC. Kindly provide the acceptance for the same.	Design Make up shall be 1 %; For the rest, Bid Specification shall prevail.
261	4	4.1	The condenser shall be designed such that steam received from the turbine exhaust during turbine VWO Operation with 3% make-up	Please clarify the design make-up quantity. it is 1% or 3% ?	1%
262	4	4.4	The oxygen content of the condensate leaving the condenser shall not exceed 0.015 cc/litre over the entire load range.	The maximum oxygen content of the condensate leaving the condenser shall be between 40 % - 100 % load range. Kindly confirm.	Bid Specification shall prevail
263	4	4.4- General Performance Requirements	The oxygen content of the condensate leaving the condenser shall not exceed 0.015 cc/litre over the entire load range.	Condensate Outlet Oxygen content will be as defined in HEI clause 4.3	Specification is self-explanatory
264	4	5.1.1	The condenser shall be of two pass..... The cooling water inlet connections shall be at the bottom and outlet connection at the top.	The offered condenser shall be of single pass type. Accordingly, the cooling water will enter at the centre from one side and exit from other side of the condenser water box. Hence, we request you to specify single pass condenser as well in the specification.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
265	4	5.1.1	Corrosion allowance of minimum 0.8 mm on each welded side for the shell side and 3.2 mm for water boxes and tube plates shall be applied to the design thickness of each component. No corrosion allowance shall be provided on tubes.	As per 4, Datasheet-A, Corrosion allowance on ferrous parts - 3.2 mm. We understand that the corrosion allowance shall be as per clause 5.1.1 of the technical specification. Kindly confirm.	Agreed
266	4	5.1.1 - Condenser Type & Duty	The Condenser hot well should have a minimum available Volume, sufficient to contain between its "normal" and "low" levels the condensate that may be produced in the Condenser in a period of three (3) minutes under condition of maximum steam load.	The Condenser hot well should have a minimum available Volume, sufficient to contain between its "normal" and "low" levels the condensate that may be produced in the Condenser in a period of three (3) minutes at 100% TMCR/ 0% MU condition.	Specification is self-explanatory
267	4	5.1.1 - Condenser Type & Duty	C.W. butterfly valves with actuators shall be designed as per AWWA-C-504-70 or Owner approved equivalent standards. Valve material shall be suitable for duty intended.	Butterfly valves shall conform to AWWA C-504 or BS: EN: 593 or equivalent Standard of required class/rating.	Bid Specification shall prevail
268	4	5.1.2	The shell side shall be designed shall be designed from full vacuum to a minimum internal pressure of 1.08 kg/cm ² g. The shell side design temperature shall be 120 Deg C.	As per Datasheet-A, Cl. No. 9, Shell side design pressure - Turbine pressure relief self closing type disc release pressure & FV We understand that the shell side design pressure shall be corresponding to LP Turbine exhaust relief valve set pressure and the design temp shall be the saturation temperature corresponding to such set pressure.	Bid Specification shall prevail
269	4	5.1.3	The tubes shall be SS304, seamless, solid drawn type, manufactured and tested in accordance with the approved standard.	Bidder would like to clarify that the condenser tubes would be welded type of material A249 TP 304.	Clause 5.1.3 is being amended

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
270	4	5.1.3	The Condenser tube plates shall be of carbon steel conforming to ASTM A285 Gr. C. The tube plate shall preferably be welded to the shell. Tube sheets Carbon steel as per SA 516 Gr. 70.	As per Datasheet-A, cl. No. 22.4, Tube sheet shall be SA 516 Gr. 70. Kindly clarify the discrepancy in the two statements. We understand that the tube sheet shall be of SA 516 Gr 70 material.	Bidder's understanding is correct;
271	4	5.1.2	Condenser Shell And Fittings The design shall be as per ASME pressure vessel code.	Bidder clarifies that ASME pressure vessel code is not applicable for condenser. Condenser mechanical design shall be as per proven and standard practice / guidelines of the manufacturer.	Bid Specification shall prevail
272	4	5.1.5 (e)	The outer surface shall be painted with suitable paint after the surface is cleaned and degreased. Cathodic protection of water boxes and tube sheets shall be provided.	Kindly note that the cathodic protection of the tube sheet shall be as required based on the material selection of the tube sheet. Kindly confirm.	Bid Specification shall prevail
273	4	5.1.5 (i)	Adequate arrangement shall be made for removal of water box cover for tube replacement without disturbing C.W. piping. Necessary monorail, hoist block etc. shall be included.	Kindly note that incase of hinged type of water box no separate monorail and hoist block is required. Kindly confirm.	Agreed
274	4	5.2.1	AIR EVACUATION SYSTEM - VACUUM PUMPS : The design capacity of each pump shall be selected to meet both the above requirement with margin of 10%.	Design capacity of vacuum pump shall be as per HEL.	Bid Specification shall prevail

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Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
275	4	5.2.1&2.1	Vacuum pump with design margin of 10%...	Margin over design requirement as per HEI for evacuation equipment is not recommended,as it is detrimental to turbine blades and also higher auxiliary power consumption. Also in the data sheet -A the margin is not specified. Please review.	Bid Specification shall prevail
276	4	5.2.1	It is possible to create within 25 minutes sufficient vacuum in the condenser suitable for raising the steam turbine to its full load.	The starting/rapid evacuation capacity of the vacuum pumps shall be as per HEI for Steam Surface Condenser, Cl. 6.6. Kindly confirm.	Bid Specification shall prevail
277	4	5.2.1	The design capacity of each pump shall be selected to meet both the above requirements with a margin of 10%	The capacity of the vacuum pumps shall be selected as per HEI standard.	Bid Specification shall prevail
278	4	5.2.1	Besides, the pump capacity shall also be such that at starting, with both pumps working in parallel, it is possible to create within 25 minutes sufficient vacuum in the condenser suitable for raising the steam turbine to its full speed	Since the vacuum pump capacity calculation is as per HEI (refer clarification Cl.No. 21 below), therefore the hogging capacity of pump shall also be considered as per HEI. We understand that both vacuum pumps operating in parallel shall be able to create condenser pressure upto 0.35 kg/cm2(a) in 30 minutes, inline with HEI.	Bid Specification shall prevail
279	4	5.2.1	The design capacity of each pump shall be selected to meet both the above requirements with a margin of 10%...	We understand that Vacuum Pumps capacity calculation shall be as per HEI. Please confirm	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
280	4	5.2.3	Suitable compression ratio shall be selected so that the pumps operate effectively at all conditions of operation with cooling water temperatures mentioned above.	Cooling water temperature for vacuum pump design shall be taken as 33 deg C.	Specification is self-explanatory
281	4	5.2.8	The heat exchanger shall be arranged to permit the access to tubes without disturbing the piping connection.	As per OEM's standard design vacuum Pump skid is supplied with PHE. Owner is requested to consider the same.	Agreed
282	4	Datasheet-A 2.1	Capacity of pump- As per HEI standards	We understand that Vacuum Pumps capacity calculation shall be as per HEI. Please confirm	Specification is self-explanatory
283	4	Datasheet-A 2.2	Capacity of pump during hogging- Shall be able to maintain vacuum up to 0.35 kg/cm2(a) within 25 minutes with both the vacuum pumps in operation	Since the vacuum pump capacity calculation is as per HEI (refer clarification Cl.No. 21 below), therefore the hogging capacity of pump shall also be considered as per HEI. We understand that both vacuum pumps operating in parallel shall be able to create condenser pressure upto 0.35 kg/cm2(a) in 30 minutes, inline with HEI.	Bid Specification shall prevail
284	4	Datasheet-A, 11.0	Tube gauge in air cooling zone and top two rows (steam impingement areas) - 18 BWG	Bidder would like to clarify that top two rows (impingement tubes) would be of higher thickness i.e. 21 BWG and air cooling zone would be of same thickness as condensing zone tubes i.e. 22 BWG.	Bid Specification shall prevail
285	4	Datasheet A21	Corrosion allowance on ferrous parts- 3.2 mm.	Corrosion allowance will be considered as per HEI standard.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
286	4 Pg No. 179 OF 308	Datasheet-A Cl. 2.2	Shall be able to maintain vacuum up to 0.35 kg/cm2(a) within 25 minutes with both the vacuum pumps in operation	The starting/rapid evacuation capacity of the vacuum pumps shall be as per HEI for Steam Surface Condenser, Cl. 6.6. Kindly confirm.	Bid Specification shall prevail
287	4 Pg No. 179 OF 308	Datasheet-A Cl. 6.0	As per ISO10816-1 CL II zone A/B	Shall be as per ISO10816-7 Kindly confirm the acceptance on same.	ISO 10816 agreed as basic standard; Zone to be decided during bid evaluation.
288	Sec-5	1.0	Regarding quantity of Lube Oil Purifiers	2 nos. unit purifiers and 2 nos. central lube oil purifiers have been specified. Normally, 1 no. unit lube oil purifier and 1 no. central lube oil purifier are sufficient. MahaGenco to review and clarify/confirm.	Bid Specification shall prevail
289	5	1.1.1	The unit lube oil system shall have two (2) oil purification units with all interconnecting piping, valves, fittings, supports, necessary instruments & control hardware to make the system complete in all respect	We understand that only one no. of Central Oil Purification system to be provided for the plant which consists of two (2) purifiers. Please confirm.	Bid Specification shall prevail
290	5	3.2	The capacity of each compartment of storage tank or one storage tank shall be sufficient to hold total oil in the unit oil system or 30 m3 whichever is higher.	Please note: 1.The capacity of clean & dirty oil tanks mentioned in cl.3.6 in section-5 is 150% of unit oil requirement 2. It is mentioned as 120% of unit oil requirement in datasheet-A on page 191 of 308.	Clause 3.6 shall prevail.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
291	Sec-5 Pg 193/308	Cl. 4.3,	Regarding capacity of Central Lube Oil Purifier	The capacity specified under this clause differs from cl. No. 1.1.2 of pg 185/308 of this section. The capacity of Central Lube Oil Purifier should be identical to unit lube oil purifiers, as per cl. No. 1.1.2 of pg 185/308 of this section. MahaGenco to please clarify.	Oil purifiers (2 nos unit purifiers and 2 nos central purifiers)shall be of identical and capacity as per Data sheet A, SI No. 4.3
292	Sec-5 Pg 192/308	Datasheet 2.4	Regarding capacity of clean oil transfer pump	Capacity of clean oil transfer pump specified is different from dirty oil transfer pump. Capacity of Clean Oil Transfer Pump should be equal to Central Lube Oil Purifier Capacity, i.e same as Dirty Oil Transfer Pump, for better interchangeability/redundancy, as Clean & Dirty Oil Pumps shall be interconnected at suction and discharge. please confirm.	Capacity shall be identical and adequate to transfer the entire oil from clean oil tank to main oil tank in 2 hours.
293	6	1.2	CP system shall comprise 3 x 50% condensate polisher mixed beds and one external regeneration system.	CP system we envisaged for 3 x 33.33% condensate polisher mixed beds and one external regeneration system.	Bid Specification shall prevail
294	6 Page no. 199 of 308	Clause No. 1.2,	3x50% Condensate Polisher	As an option, we propose 4x33% configuration for CPU enabling better reliability in terms of proven design, proven vessel sizing, etc. This may kindly be reviewed.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
295	6 Page no. 199 of 308 Page no. 201-3 of 309	Clause No. 1.3, Clause No. 2.13.6/7/8/10/11/13/20/21/22/23/	Regen. Vessel , meas. Tank and pumps shall be located near TG hall ...	Please clarify if the same can also be placed near DM plant. We propose combined bulk chemical storage tanks and transfer pumps, hose stations, metering tank for Neut. facilities, N-pit and Neutr. waste transfer pumps for CPU regeneration facilities and DM plant. Please confirm acceptance.	Bid Specification shall prevail
296	6	1.4	The regeneration facilities comprising of Regeneration Vessels, Measuring Tanks and Pumps shall be located in a separate place near and outside the TG building. The resins will be transferred to the Regeneration Area from the Condensate Polisher Mixed Beds and vice versa through a pipeline	We propose to locate External Regeneration facility in DM Plant area. Please clarify and confirm.	Bid Specification shall prevail
297	6	2.8	Two number recirculation pumps.....	Rinse water shall be led to the Hotwell of the condenser. In view of this the recirculation pumps will not be required. Pl. confirm.	Bid Specification shall prevail
298	6 Page no. 201, 207 of 310	Clause No. 2.13, 3.14	Based on specific regeneration technology, the Bidder may adopt deviations with reference to regeneration vessels...	Based on indicated statement, specific design criteria given in the CPU specification shall be used for guidance only. The CPU design shall be based on proven technology of OEM. Please confirm	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
299	6	2.13	External Regeneration Vessels	For optimization, we propose to use the DM Plant regeneration facilities (wherever applicable) like Acid, Alkali system, Neutralization Pit etc. for CPU regeneration also. Please clarify and confirm.	Bid Specification shall prevail
300	6	2.13.8,2.13.13	One number Hydrochloric Acid storage.....one number Alkali Storage	The acid and alkali storage facility along with N-pit can be common for CPU and DM plant. Pl.confirm.	Bid Specification shall prevail
301	6 Page no. 204 of 310	Clause No. 3.1,	The system shall be designed for 100% condensate polishing corresponding to Max. mass flow rate established with VWO condition of turbine with suitable bypass arrangement plus max. heat cycle make-up.	We understand design of CPU will not be for HP LP bypass operation where the flows/temperature are high for short transient period. Please confirm.	Bid Specification shall prevail
302	6	3.13	Vendor should offer proven technology..... Minimum 2 years in supercritical power plant	The provenness criteria shall be as per volume-1. Please confirm that for any equipment, the provenness / qualification criteria mentioned anywhere in the tender specification, other than Volume-1, is not to be considered.	Criteria as per Vol -I shall prevail
303	6	3.14	The free board in various vessels shall be Mixed Bed Polisher 100 %	Please note that CPU suppliers provide service vessels of either cylindrical type or spherical type as their standard practice. Please note that free board shall not be applicable in case spherical vessels are supplied. However, the same shall be provided if cylindrical vessels are provided. Pl.confirm.	Yes, confirmed

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
304	6	3.16	Under normal condition.....will be transferred hydraulically	Transfer of resins from exhausted vessel to regeneration area or vise versa shall be done hydraulically or hydro-pneumatically. Pl.confirm.	Bid Specification shall prevail
305	6	3.16	For regeneration, resin from the exhausted Condensate Polisher Mixed Bed will be transferred hydraulically	Please confirm if hydro-pneumatic transfer of resin is also acceptable.	Bid Specification shall prevail
306	6 Page no. 201, 207 of 310	Clause No. 2.13, 3.14	Based on specific regeneration technology, the Bidder may adopt deviations with reference to regeneration vessels...	Based on indicated statement, specific design criteria given in the CPU specification shall be used for guidance only. The CPU design shall be based on proven technology of OEM. Please confirm	Bid Specification shall prevail
307	6 Page no. 205 of 312 &	Clause No. 3.6,	Analysis of treated condensate	Total copper, Silica and chloride shall be max. 2 ppb, 10 ppb and 5 ppb respectively complying to SG & STG manufacturer's recommendation may please be allowed.	Bid Specification shall prevail
308	6 Page no. 205 of 312	Clause No. 3.7,	Under condenser tube leakage condition, the CP system....in addition to the influent contaminants under normal condition as stated above.	We could not locate influent contaminant levels in the specification. Please furnish.	Silica < 15 ppm as SiO ₂
309	6 Page no. 206 of 312	Clause No. 3.11,	The resin should be of CPU grade with uniform coeff. Less than 1.1.	Uniformity co-efficient of less than 1.1 is not available in any of CPU grade resin from Resin supplier suggested in the tender commercially. The same shall be as per resin supplier's standard.	U.C. < 1.2
310	6 Page no. 210 of 313	Clause No. 4.0,	draining the condensate polisher mixed bed to condenser hot well	We understand drain to hot well is not required since the rinse recirculation pumps are provided. Please confirm.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
311	7	1.1.4	One (1) debris filter in CW lines	CW system for this project is not a once thru system. This is a closed cycle with cooling tower. So there should not be any requirement of debris filter. Please clarify.	Bid Specification shall prevail
312	7	3.2.1a)	The cleanliness.....	The purpose of COLTCS is to minimize the fouling in condenser tubes. Maintenance of condenser vaccumm depends on number of other factors like Cooling water temp., Cooling water flow, quality of water etc. Maintaining of condenser vaccumm by only COLTCS is not correct. So this clause is not applicable for COLTCS package. Please review and confirm.	Will be evaluated after receipt of detailed scheme by bidder.
313	7	3.2.1 (b)	The pressure drop across the ball separator screens and debris filter screens during normal cleaning operation shall be minimum (it should not be more than 30 millibar).	The individual pressure drop across separator screen and debris filter screen shall not be more than 30 milibar, OR the combined pressure drop (separator screen + debris filter) shall not be more than 30 milibar. Please clarify.	Bid Specification shall prevail
314	7	3.2.1c)	In the automatic system.....	Before cleaning or washing mode, balls are collected during collection mode to avoid loss during cleaning or washing mode, however there are chances that some %age of balls (approx. 10%) may be lost in condenser water box/tubes and pipe. Please confirm that this is acceptable to MahaGenco	Will be evaluated after receipt of detailed scheme by bidder.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
315	7	3.2.1d)	The on line Condenser.....	Purpose of COLTCS is to prevent fouling and scaling. If any scale is already formed in condenser the same can't be removed by COLTCS. Maintenance of condenser back pressure/overall heat transfer co-efficient depends on number of other factors like Cooling water temp., Cooling water flow, quality of water etc. Maintaining of condenser back pressure/overall heat transfer co-efficient by only COLTCS is not correct. So this clause is not considered applicable for COLTCS package. ~~Please review and confirm~~	Will be evaluated after receipt of detailed scheme by bidder.
316	7	3.2.1e)	The quantity of cleaning.....	Ball loss shall be kept below 10%. Pl.review and confirm.	Bid Specification shall prevail
317	7	3.2.1f)	Bidder shall prove the guaranteed.....	Following three parameters shall be guaranteed for performance testing of COLTCS inline with acceptable practice followed for number of projects: 1) Ball recovery not less than 90% 2) Ball Life - Three weeks 3) Pressure drop across Ball separator - not greater than 30 millibar. Performance testing shall be done immediately after commissioning and trial run and not after twelve months of initial trial. Please review and confirm.	Bid Specification shall prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
318	7	3.2.1h)	The temprature difference.....	The temprature difference between condensate and CW outlet over a period of one year depends on number of factors other than COLTCS. So this clause is not considered applicable for COLTCS package. The perf parameters as indicated above shall only be complied for COLTCS package. Please review and confirm.	Will be evaluated after receipt of detailed scheme by bidder.
319	7	3.2.1i), 3.2.1 j) & 3.2.1 k)	The owner shall conduct.....	The perf parameters as indicated above only shall be complied for COLTCS package. Please review and confirm.	Will be evaluated after receipt of detailed scheme by bidder.
320	7	3.2.2 a) & 3.2.2 b)	During the trial operation the temprature.....	The temprature difference between condensate and CW outlet over a period of one year depends on number of factors other than COLTCS. So this clause is not considered applicable for COLTCS package. The perf parameters as indicated above only shall be complied for COLTCS package. Please review and confirm.	Will be evaluated after receipt of detailed scheme by bidder.
321	7	3.2.2 c)	The performance guarantee test shall.....	The perf parameters as indicated above only shall be complied for COLTCS package. Please review and confirm.	Will be evaluated after receipt of detailed scheme by bidder.
322	Annexure-A /QAP	1	Performance test ...shut off head to 125% of rated capacity of the pump.	Performance test will be done only for the operating point. The other conditions will be extrapolated accordingly. Please confirm.	All Test/ inspection related points shall be reviewed and finalised during detailed engineering.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
323	Annexure-A	2.1.1(b)	Casting suppliers should have established practices to ensure requirements of creep and rupture, in order to establish the adequacy of material to meet the duty requirements of long exposure to high temperatures and pressures. This data will be furnished for Owner's approval.	Bidder shall submit the available stress rupture data for customer approval.	
324	Annexure-A	2.1.1(e)	Cast enclosure shall be subjected to a hydraulic pressure test based on established practice of manufacturer unless there is a geometrical constraint for doing hydro test. Bidder to furnish their practice in this regard for Owner's approval, if feasible.	Bidder carry out hydraulic pressure tests on HP & IP Outer Casings only.	
325	Annexure-A	2.1.1(f)	Castings Hardness survey shall be carried out on the repaired area.	Bidder carry out hardness checks at random on entire casting to review the homogeneity after heat treatment since the complete casting is heat treated in furnace after weld repair. The hardness survey on representative samples of weld repairs is possible.	
326	Annexure-A	2.1.1(g)	Where stub pipes and transition pieces are welded to the main body of an enclosure the following shall be carried out: Hardness test on weld joint, HAZ and parent material	Bidder carries out a controlled stress relieving treatment for valves with transition stubs, by furnace or by local heat treatment. A hardness survey can be accepted in addition as requested.	
327	Annexure-A	2.1.1(h)	HP & IP Outer Casings Wall thickness measurement by ultrasonic for critical and highly stressed zones of the casting shall be carried out	Bidder carries out wall thickness measurement at random 20 spots for HP & IP Inner Casings only.	

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
328	Annexure-A	2.1.1(h)	Color matching of casting by putting two halves together or feeler gauge tightness check from outside to ensure required contact area and joint tightness shall be carried out.	Bidder carries out a color matching test for HP and IP outer casings only. Color matching or feeler gauge tightness check is technically not feasible for HP and IP Inner Casings.	
329	Annexure-A	2.1.2 (b)	Low pressure enclosure Bidder to furnish their practice regarding stress relieving of the fabricated enclosures for Owner's approval.	Bidder does not carry out any stress relieving treatment on fabricated LP-enclosures. The material is unalloyed.	
330	Annexure-A	2.1.2(c)	Bidder to furnish their standard practice regarding NDT on welds for Owner's approval, however following are minimum NDT requirements :	Can MPE/DP test be also acceptable for Butt Welds? Bidder carries out NDT on weld seams of LP-enclosures as per applicable European standard. Acceptance and test criteria will be made available to employer for information only.	
331	Annexure-A	2.1.2 (d)	Low pressure enclosure :- Bidder to furnish his proven practice for hydraulic pressure tests. If it is not their practice, the justification for not carrying out hydraulic test shall be furnished for Owner's approval.	In line with PED (Pressure Equipment directive), bidder does not carry out hydraulic pressure test on LP-enclosure.	

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
332	Annexure-A	2.1.3.1 (a)	Rotor forgings Fully representative tangential or radial test pieces shall be provided at each end of the body, at each shaft end and radial test piece from the trepanned core (when a core is trepanned) to determine mechanical properties including impact, brinell hardness etc. and tests for notch toughness i.e. FATT (both transition temperature and room temperature impact values)	Bidder carries out tensile and impact test on each shaft part and on each shaft end taken from a ring in tangential direction only. Radial test pieces from trepanned core and Notch toughness test (FATT) for estimation of transition temperature are carried out as type tests for initial product qualification stage only. Bidder is using material with long time experience.	
333	Annexure-A	2.1.3.1(b)	Forging suppliers should have established practices to ensure requirements of creep and rupture in order to establish the adequacy of material to meet the duty requirements of long exposure to high temperatures and pressures. This data shall be furnished for Owner's approval.	Bidder shall submit the available stress rupture data for customer approval.	
334	Annexure-A	2.1.3.1©	Heat treatment should be carried out in such a way so as to ensure minimum residual stress in the rotor. Residual stress measurement shall be carried out.	Residual stress measurement will be reasonable only for monoblock rotors. Turbine rotors are welded from single discs. Each disc will be heat treated including controlled cooling with low cooling gradient. In addition to that the welded rotor will be subjected to a heat treatment in furnace.	
335	Annexure-A	2.1.3.(d)	Rotor forgings Supplier should furnish the UT proposal, scanning plan and probe angles for clients approval	Bidder will submit the scanning plan, acceptance criteria and information about the probes and frequency for information only.	

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
336	Annexure-A	2.1.3.1(g)	Rotor Forgings: Thermal stability tests shall be carried out on HP and IP rotor forging to ensure the thermal stability of the rotors in service and at overspeed.	As per bidder's practice, Heat stability test is not carried for welded rotors. Heat stability tests are only done on monoblock rotors which exceed a delivery weight of 32 tons when quenched in vertical position and on 5 tons when quenched in horizontal position. Rotors are made of high alloy raw material (Cr Mo W V Nb N steel) supplied by experienced suppliers, poured by ESR to reduce segregation in the forgings	
337	Annexure-A	2.1.3.1(h), iv	Rotor forging welds Hardness survey on the welds	Required test can be performed randomly for information only.	
338	Annexure-A	2.13.2 (a)	Complete rotor Axial & radial run-outs and surface finish checks shall be carried out before and after blading and after overspeed tests. Run out examination will be carried out at blade shrouds also.	Bidder carries out axial & radial run-outs before blading and after overspeed test only. Bidder will not perform run out test on shrouds.	
339	Annexure-A	2.13.2 (b)	Complete rotor Check of clearance of rotor groove and blade at the root.	This test is not applicable to bidder's design due to the use of pretwisted blades.	
340	Annexure-A	2.1.3.2(d)	An overspeed test shall be carried out during which the rotor shall withstand an overspeed of 120% for five continuous minutes. If bidder's practice is different from as stated above, then same shall be furnished to Owner's approval. During this test, vibration measurement and analysis shall be carried out.	Bidder's practice is to do the test at 120% speed for 3 minute as per ISO Specification.	

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
341	Annexure-A	2.1.3.2 (e)	After blading and again after over speed testing, rotor stages with blades over 225 mm of active length are to be given standing vibration tests to determine natural frequencies in various vibration modes to ensure that the ranges are outside operating frequencies. The modes to be tested are: Bucket group tangential, wheel axial and group axial.	This is not applicable to bidder's design. All moving blades exception of the LP- last stage moving blade are designed with integral shrouds and pretwisted. Natural frequencies will be measured only on freestanding LP blades before installation on rotor.	
342	Annexure-A	2.1.3.2 (g)	Lock blade lift after the overspeed shall be checked and record for same shall be maintained.	This is not applicable because bidder's design does not use lock blade.	
343	Annexure-A	2.1.4.3	Stator and rotor blades When erosion shielded, the erosion shield and blade joint shall be radiographed	Erosion shields are not applicable to bidder's design. Bidder protects LP last stage moving blades against erosion by high frequency hardening at the inlet edges.	
344	Annexure-A	2.1.4.7	Stator and rotor blades: Natural frequencies of the LP Turbine blades shall be determined before mounting on rotors to ensure that the same are outside operating frequency range	Bidder carries out critical frequencies of blades applicable only for free standing blades without shrouds	
345	Annexure-A	2.1.4.8	Stator and rotor blades Shroud bands after punching and after rivet-ting shall be subjected to 100% DPT to ensure freedom from harmful surface defects	This is not applicable for bidder's design as shrouds are integral with blades and there are no shroud bands provided	
346	Annexure-A	2.1.4.9 (b)	Stator and rotor blades (in case of cast blades):- Rough machined and finished machined cast blades shall be subjected to MPI test	Bidder carry out MPI test on blade foil and transition zone only.	
347	Annexure-A	2.1.4.9 ©	Stator and rotor blades (in case of cast blades):- RT on blades	Bidder practice to do UT on cast blades.	

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
348	Annexure-A	2.1.4.9 d (I)	Stator and rotor blades (in case of cast blades):- Before starting mass productions, following technological tests shall be carried out on the first lot of 10 to 15 blades:-(i) 100% radiography and 100% MPI on blades	Bidder carries out UT & MT on all blades as per the proven inspection & test programma and same shall be submitted to customer for approval.	
349	Annexure-A	2.1.6 (a)	Casting suppliers should have established practices to ensure requirements of creep and rupture, in order to establish the adequacy of material to meet the duty requirements of long exposure to high temperatures and pressures.	Bidder shall submit the available stress rupture data for customer approval.	
350	Annexure-A	2.1.6 (d)	Stop, cotrol and bypass valve valve seat bore shall be checked for size and concentricity	Valve seat will be checked for size dimension only.	
351	Annexure-A	2.1.6 (e)	Stop, control and bypass valve: Bar stock for valve stem shall be subjected to ultrasonic examination and finish machined stem shall be subjected to magnetic particle/Dye penetrant examination.	Forged valve spindles are subjected to an US test but the MPI test on finish machined spindles is not Bidder standard. Bidder carry out a surface crack dtetection test /dye pentration test on speciaal areas on valve spindles. E.g. spray coating- or hard facing areas.	
352	Annexure-A	2.1.6 (f)	Each valve body and bonnet will be hydraulic tested at minimum 1.5 times the maximum working pressure after applying temp. Correction.	Bidder carry out hydraulic pressure tests on valve body only. Suitable NDT (like UT & MPI) is performed on bonnet as per bidder's standard practice.	
353	Annexure-A	2.1.7	Cast and Forged steel components such as LP Casing, in case of cast design, inlet and extraction/exhaust connection, shaft seal covers and rings, servo motor etc.....	All parts listed under 2.1.7 will be tested as per bidder's Standards which are based on European standards.	

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
354	Annexure-A	2.1.8 ©	Bar stock greater than or equal to 50mm in diameter for bolts shall be subjected to US-examination	US test on bars as required in applicable EN standard.	
355	Annexure-A	2.1.8 (b)	Finished machined bolts shall be subjected to MPI examination / DPT for surface defect examination	This is not the bidder's standard. Inadmissible defects will be found by US-test on raw material, because tests will be carried out with high test sensitivity as specified in applicable acceptance level in EN-standard, Therefore bidder do not carry out a surface crack detection test on finished bolts.	
356	Annexure-A	2.1.9	Governing and protection system equipment such as electro-hydraulic controller, hydraulic amplifier, hydraulic controller, electro hydraulic convertors, hydraulic convertors, hydraulic speed governor, trip devices etc.....	Electro-hydraulic controller, hydraulic amplifier, hydraulic controller, hydraulic convertors, hydraulic speed governor not applicable per Bidder design. Bidder uses electronic controller in place of electro hydraulic controller	
357	Annexure-A	2.1.9	Inspection of complete turbine ..prepare a checklist and submit the same for Owner's approval..	Document will be submitted for information only.	
358	Annexure-A	2.1.11(a)	Inspection of complete turbine .. His practise to carry out no load test works running tests on the steam turbine a) part of a no-load test under steam	Bidder's practice is to assemble HP & IP at the manufacturer work shop	

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
359	Annexure-A	2.1.12	Generator Tests: The tests listed below shall be carried out on the generator to be supplied against this specification. If possible running trials shall be conducted for the generator,excitator and automatic voltage regulator equipment combined as a unit, on the test bed, and the bidder shall clarify indicate in his bid whether he is able to meet these requirements. (Included Clauses : 2.1.12.1,.....,2.1.12.17)	During generator manufacturing, the tests in Bidder's Standard Shop Inspection and Test Program will be conducted. It is not envisaged to conduct type tests / shop running tests since over 50 similar units are under operation which amply prove the generator design.	
360	Annexure-A	2.2.2 (a)	Cross around pipes Weld edge preparations of shop and site welds shall be checked by MPI test	For HP-loop pipes accepted but not applicable to fabricated LP-cross over pipe.	
361	Annexure-A	2.2.2 (b)	Cross around pipes butt welds shall be subjected to 100% radiographic test	For HP-loop pipes accepted, but for fabricated LP-cross over pipe, bidder's practice is to carry RT for 50% of butt welds.	
362	Annexure-A	2.2.2 ©	Cross around pipes butt welds shall be subjected to 100% magnetic particle test	Bidder's practice is to carry MPI test on 50% butt welds, 25% Fillet welds and 100% nozzle welds.	
363	Annexure-A	2.2.3 (I)	Lubricating oil pumps Main oil pump shaft shall be subjected to US-examination	No RT/UT on weld seams applicable because casing is made from cast iron.	
364	Annexure-A	2.2.3 (ii)	Lubricating oil pumps Impeller of main oil pumps shall be subjected to an overspeed test for 5 min.	Main oil is a gear type pump without impeller. Overspeed test is not applicable.	
365	Annexure-A	2.2.3 (iii)	Lubricating oil pumps pump casing should be subjected to a hydraulic pressure test at 2 times the working pressure	Oil pumps will be subjected to hydraulic pressure test with 1.5 times working pressure.	

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
366	Annexure-A	2.2.3 (iii)	Lubricating oil pumps All pumps shall be performance tested including vibration and noise level test.	Performance test will be performed at sub suppliers work shop. Noise and vibration are type tests.	
367	Annexure-A	2.3.2	Metallic Expansion Joint: Life cycle test, meridional yield rupture test and squirm test to be carried out on a prototype/expansion bellow as per Sec. D clause 3.2 of standards of Expansion joint Manufacturer Association (EJMA). Test reports may be furnished by manufacturer for consideration and approval of Owner.	These tests shall be not done for the offered product. Instead, test reports available with the manufacturer for the same product shall be submitted for approval.	
368	Annexure-A	2.3.3	Rubber Expansion Joint: Life cycle test and burst test shall be carried out on bellows of each type, design and size. Test certificate for the same may be furnished for approval of Owner.	These tests shall be not done for the offered product. Instead, test reports available with the manufacturer for the same product shall be submitted for approval.	
369	Annexure-A	2.8	BFP + Booster Pump (In Process Tests): DPT & MPI shall be carried out on Gear, Pinion, Shaft & Wheel	Bidder request that either of DPT or MPI will suffice the inspection requirement. Hence either of DPT or MPI will be carried out on these items.	
370	Annexure-A	2.8	BFP: Other test (Final Test for BFP & Booster Pump)	Please clarify, what is other test.	

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
371	Annexure-A	2.8	BFP: Thermal Shock Test shall be carried out on one Boiler Feed Pump, Metal Temperature resulting from thermal gradients and Strain Gauge Measurement shall be taken on all critical areas such as Barrel, Discharge Branch, Casing Cover, Casing Cover Stud etc. Temperature range of the test shall vary from 20 degree C to maximum operating temperature.	Thermal shock test is not a manufacturer's standard practice, hence we request Owner to withdraw this testing requirement.	
372	Annexure-A	2.8	BFP: Visual Cavitations Test on one first stage production impeller of Boiler Feed Pump shall be carried out to demonstrate absence of Cavitations at Design Speed in Cold Water. The test will establish the cavitations characteristic of one production first stage impeller to confirm that the cavity length under dynamically scaled site conditions corresponding to design point will not exceed an agreed size. This test shall be carried out at 25%, 50%, 65%, 80%, 100% and 125% of Design Flow.	Test on one first stage production impeller of Boiler Feed Pump will be carried out to demonstrate absence of Cavitations at Test Speed in Cold Water. The test will establish the cavitations characteristic of one production first stage impeller to confirm that the cavity length under dynamically scaled site conditions corresponding to design point will not exceed an agreed size. This test shall be carried out at 25%, 50%, 65%, 80%, 100% and 125% of Design Flow.	

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
373	Annexure-A	2.8	BFP: Complete Strip Down of Boiler Feed Pump which under goes Performance Test, NPSH Test, Dry Run Test, Thermal Shock Test etc. shall be done in order to check problems like Internal Rubbing Damage, Excessive Wear etc. One Booster Pump shall be dismantled for visual inspection after completion of performance test and NPSH Test. For other Pumps strip down test shall be conducted only in case abnormal performance such as Excessive Vibration, High noise, high bearing temperature etc. is observed during performance test. In the lieu of testing, bidder may submit the test report of type test earlier carried out, if the type test report are not found satisfactory to the owner, then the specified tests shall be conducted per the approved performance test procedure we. In any case bidder to carry out NPSHR test on one BFP and booster pump. The above criteria are applicable to CEP as well.	It is the understanding of Bidder that if pump supplier produces the type test report of Complete Strip Down of BFP of similar model as offered for this project, then the requirement of carrying out Strip Down Test separately for this project shall be removed. Similar criteria are applicable to CEP as well.	
374	Annexure-A	2.8.3	CEP: Complete CEP Final Test	Final Test as mentioned in table on CEP Assy. is not clear. Please clarify.	
375	Annexure-A	2.8.3	CEP: DPT & MPI shall be carried out on Shaft	Bidder request that either of DPT or MPI will suffice the inspection requirement. Hence either of DPT or MPI will be carried out on these items.	

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
376	Annexure-A /QAP	4	Dry running test...(optional)	Please clarify that the dry run test cost to be included in the bid as it is indicated as optional test. This testing requirements may be withdrawn .	
377	Annexure-A /QAP	9	Drive turbine shall be tested as per ASME PTC-6	Separate test for the drive turbine as per PTC-6 will not be done as it is not the part of guarantee under LD.	

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

RESPONSE TO PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1

VOLUME - III C

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project
Pre - Bid Queries
Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-C

S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
1		1.1	Approval from Zonal Railways/RDSO	We request that the approval from RDSO/Zonal Railways be arranged by Owner. The Contractor will provide all the required technical information and also participate in the meetings with the authorities.	Bid specification Prevail.
2		1.1	Railway siding	Please let us know if the proposed railway siding arrangement is in line with the Zonal Railways requirement. Please let us know the remedy in case the Zonal Railways/RDSO require major modifications/changes/revision to the railway siding arrangement including but not limited to number of lines, length of lines, arrangement of lines, alignment of lines.	Minimum requirement of railway siding are given however bidder shall consider provision as per Railway norms
3		1.1	Bidder shall be responsible for obtaining approval from RDSO/Zonal railway/RITES.....	We presume our scope is limited to ensure tippler structure to conform to the latest applicable Indian / British / DIN Standards (specifically to IS 10095) and requirements of RDSO	Bid specification Prevail.
4	Page 11 of 245	2.1.12	For blending operation, imported coal shall be reclaimed by conveyor 8 with the help of necessary hopper & pay loader.	The capacity of reclaim conveyor (from the ground hopper) is considered as 30 % of CHP system capacity. Please confirm Also specify the capacity of ground hopper. Additional belt weighed is required for conveyor - 8. Please confirm.	Rated Capacity of Conv.8 shall be 450 TPH. Design Capacity of Conv.8 shall be 500 TPH. Capacity of Ground hopper shall be 150 Tonnes. Belt weigher shall be provided.
5		2..1.13	Reclaimed imported coal shall be blended with indigeneous coal on conveyor 3A or 3B	Please furnish blending ratio of indigeneous coal & imported coal has to be considered to blend imported coal with indigeneous coal on Conveyor 3A/B	Bid specification Prevail.

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6	Page 11 of 245 Page 12 of 245	2.1.15 ; 2.1.16 ; 2.1.17	Conveyor 4A & 4B shall be provided with fixed tripper FTR-1 and FTR-2 to convey coal either to conveyor 5A & 5B through chute 7 flap gates in TP-4 or to conveyor 6A & 6B through chutes & Flap gates in TP-5. Conveyor 5A & 5B shall convey coal to the bunkers 1,2,3,4,5. Each conveyor shall be provided with a moving tripper which travel from 1st bunker to the last bunker. The travelling tripper (TTR-1 & TTR-2) shall have one way discharge chutes as per design to discharge coal to the required bunkers.	For front mill arrangement conveyor 4A & 4B will be equipped with one no. travelling tripper on each conveyor. Please confirm acceptance.	Bid specification Prevail.
7	Page 63 of 247	2.1.22 Sr. No. 42	Auxiliary equipment shall be provided as per normal practice. In-line magnetic separator shall be provided over discharge pulley of each of conveyors 2A & 2B, 3A & 3B and yard conveyor 7. In line conveyor scale/belt weigher shall be provided on each of conveyors 2A & 2B, 4A & 4B and boom conveyors. Metal detectors shall be provided on each conveyors 4A & 4B. Quantity of separator: Two (2) for each stream + One (1) on conveyor 7	a) Please note that in-line magnetic separator for conveyor 7 may not be required as the ongoing conveyor 3A & 3B also have inline magnetic separators. b) Belt weigher are considered for conv. 2A & 2B, Conv.4A & 4B, CC-8 and boom conveyors only. c) Metal detector are considered for conveyors 2A & 2B and 3A & 3B. Please confirm above	a) Bid specification prevails. b) Belt Weigher shall be provided for conv.8 c) Bid specification Prevail.

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
8		2.2	Coal storage	Three stockpiles, two(2) for indigenous & one (1) for imported coal shall be provided as per specifications and drawings but the dimensions of imported crushed coal stock piles are not given in the plotplan however crushed coal stockpile dimensions were given as 270 X 50X 11 m ³ (2 Nos). Please furnish the imported coal stockpile dimensions.	In the crushed coal stock pile dimensions shown in the plot plan i.e (270x50x11(2nos.)), Imported coal shall be stacked in some area of one of the two stock piles i.e(100 X 50x 11) m ³ as shown in the drawing
9		2.2 ; Data sheet A : Stacker cum reclaimer Sr.1.7 GA of Coal Handling Plant dwg no.PE-189- GA-120	The height of the stockpile shall be about 11m. The cross section of the stockpile shall be trapezoidal. To suit layout and requirement, 300 meters minimum As per dwg.PE-189-GA-120 the length of stockpile indicated around 270 meters. Please clarify.	We will follow layout drawing PE-189-GA-120 for stockpile length, please confirm.	Dimensions of the stockpiles shall be 270mx50mx11m.
10		2.3,	Conveyors capacity	Rated capacity of conveyors has been specified as 1500 TPH in the system description. This is very much on the higher side for 1 no 660 MW plant. Please review the requirement, otherwise the system will be oversized for the requirement and may not be economical.	Bid specification Prevail.

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
11		2.3 2.1.1	Two streams of conveyors and equipment (2x100%) with rated capacity of 1500 TPH shall be provided for coal handling system. Indigenous Coal of (-) 300 mm size and Imported Coal of (-) 50 mm size shall be received at Bhusawal T.P.S. site by box-N type wagons and shall be unloaded in any one of the two (2) Wagon Tippler Hoppers by means of Wagon Tiplers and side arm chargers.	We understand that rated capacity of coal handling system is decided based on minimum tipping rate (25 Tips/hr) of wagon tippler and BOX-N type of wagons each carrying 60T of coal. Please confirm. However, if transportation of coal shall be done by newly introduced wagons like DFC Type wagon (Net Weight of coal 108T), BOXNHL type wagon (net weight of coal 71T), BOX 25 type wagon (net weight of coal 77T), then downstream system capacity shall not be adequate and capacity shall not match with tipping rate. Please check and confirm. Also as per list of condition mentioned in RDSO norms G-33, Rev. 1 (Cl. No. 8.2) : If the client desires lesser numbers of tips, concurrence of the concerned railway authorities shall be obtained. Please refer enclosed "Annexure 1 G-33 (Rev.1) Cl. 8.2" for ready reference.	Bid specification Prevail.
12	-	2.3	SYSTEM CAPACITY Two streams of conveyors and equipment (2x100%) with rated capacity of 1500 TPH shall be provided for Coal Handling System	Based upon specified 1500 TPH Bunker Feeding Conveyor Capacity system is capable of feeding the 24 hr coal requirement within 7.5 hr only. As per latest CEA Guidelines, operating hour for Coal Handling Plant is about 14 hr per day. So, our understanding is that 2 x 800 tph streams shall be adequate meeting the CEA guidelines.	Bid specification Prevail.
13	Page 14 of 245	3.1.1	Rota Side Wagon Tippler....	Wagon Tippler in line with RDSO's G-33 Rev-1, May 2010, as approved by RDSO shall be offered. Please confirm that old design Rota Side Wagon tippler shall not be acceptable as RDSO will not accept the same.	Bid specification Prevail.
14		3.1.2	Siding	We understand that the siding Owner mentioned here refers to Mahagenco. Kindly confirm.	Confirmed

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
15		3.1.2	Wagon Retarders	Please furnish the specifications for the wagon retarders if it is required to be considered in our offer.	Bid specification Prevail.
16	Page 14 of 245	3.1.3	The height of roof shall be decided...	HT wire above Tippler is not recommended as it will interfere with WT clamps when raised. RDSO's G-33 Rev. 1, page 4 of 13 clause 3.6 also specifies the same. Please refer "Annexure 2 G-33 (Rev.1) Cl. 3.6" for ready reference.	As per RDSO
17		3.1.6	Steel Grating (heavy duty) of 250 mm square openings over wagon tippler hoppers. The gratings shall be suitable to pass coal of size 300 mm and below	Please Confirm the Steel Grating openings shall be 350mm for coal size of 300mm.	300mm square openings shall be provided
18	Page 14 of 245	3.1.6	Grating opening of 250 sq.mm to pass coal of size 300 mm and below.	250 sq mm opening of grating will not allow 300 sq mm lump size of coal. Please check and confirm.	
19	Page 15 of 245 Page 56 of 247	3.1.14 Corrigendum-I/Sr.No.5	One portable oil filtration machine in each of the following areas to filter oil of two (2) microns... One Potable oil filtration machine to filter oil of two (2) microns and minimum eight (8) lpm capacity shall be provided.	10 (ten) microns filtration level of hydraulic oil is the standard practice for such applications, which shall be maintained by portable oil filtering machine. Please confirm Also please provide the detailed specification of the oil filtration machine.	During Detailed Engineering
20	Page 16 of 245	3.2	One monorail mounted Electric hoist and one portable manual hoist shall be provided for handling of Take up pulley/Counter weight.	Hoist schedule given at page no 165 of 245, does not specify requirement of electric hoist at take up area. Kindly clarify.	

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
21	page 16-17 of 245	3.2,	One motorised winch shall be provided ... almost all location of gravity take up tower for....four reversible belt feeder at sl no (i) and BF at sl no (j)	Kindly note that only screw take up is applicable for Reversible belt feeders and belt feeder. Hence, winch is not considered.	Bid specification Prevail.
22	(Page-171	3.5.4; Data Sheet of Belt Vulcaniser Sr. No.1.0)	One (1) potable hydraulic press type belt vulcanising machine complete..... Quantity Two (2) Nos. for belt vulcaniser	Please confirm the quantity of belt vulcaniser.	Refer corrigendum.
23		General	Wobbler feeder	Please confirm whether vibrating grizzly feeder is acceptable in place of wobbler feeder.	Bid specification Prevail.
24		3.9.4	Crusher house elevator	Please confirm that rack and pinion elevator is acceptable for the crusher house.	Confirmed
25		3.9.6	GHP Capacity	Please furnish hopper capacity to be considered for our estimation since same is not mentioned in the specification.	Capacity of GHP shall be 150 Tonnes.
26		3.9.6	Vibro feeder & conveyor 8 capacity	Please furnish the specifications for the vibro feeder to be considered also specify the capacity of conveyor which is taking feed from the GHP I.E Conveyor 8	Vibrofeeder capacity-450 TPH GHP Capacity -150 Tonnes
27		3.9.7	Pay loaders	Please provide the quantity of pay loaders required to be included in scope. Specification for pay loader if available may also be provided.	Minimum 8 payloaders of 3T(minimum) operating capacity. Specification shall be as per manufacturers standard.
28		3.9.7	Pay loader	Please furnish the specifications for payloader to be considered in our offer along with quantity.	Please refer reply to sr.no 27
29	Page 19 of 245	3.9.7	Scope of work : Necessary Pay loaders	Please specify the capacity of the pay loader & provide the specifications.	Please refer reply to sr.no 27

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
30	Page 20 of 245	3.9.8	Bidder shall provided necessary arrangement for ground unloading of coal for emergency application	Kindly specify the location and requirement details for ground unloading of coal.	As shown in plot plan PE-189-GA-101 (P4).
31		5.1.2	Capacity	The ratio of design capacity to rated capacity indicated is quite high. We request you to please consider 10 to 15%.	Bid specification Prevail.
32		5.1.2	Design capacity shall be 25% more than the rated capacity	The criteria for arriving design capacity as 25% more than rated capacity as specified in tender specifications seems to be very high. Normal practice we will consider maximum design capacity as 20% more than rated capacity. Please review the same & confirm us.	Bid specification Prevail.
33		5.1.2	The rated capacity.....1500TPH	Contextually the rated capacity shall be based on governing input parameter and boiler design and efficiency . Hence we reserve right to alter the parameter after assessing the factor that have decisive impact and shall still meeting the desired performance i.e. (Operational hour).	Rated Capacity - 1200 TPH Design Capacity - 1500 TPH
34		5.1.2	The rated capacity of coal handling system shall be 1500 TPH. For design of structural selection of belt etc. the design capacity shall be minimum 25 % more than rated capacity.	Design capacity of coal handling system shall be considered same as Rated / Guaranteed capacity 1500 TPH. Please confirm.	The design capacity of coal handling system shall be 1500 TPH. For design of structural selection of belt etc. the design capacity shall be minimum 10 % more than design capacity.

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
35		5.1.4	Bulk density of coal, 800 kg/m ³ for Volume and 1200 kg/m ³ for design of structural and drive selection.	However, for structural design, we are considering bulk density of coal 1200 kg/m³. Please confirm. Accordingly, please specify the rated and design capacity of all equipment e.g., conveyors, Wobbler feeder, Crusher, S/R, Tripper, ILMS, Metal Detector, Belt Scale, Apron feeder, Dribble conv., Vibro feeder. Drive selection shall be based on Design Capacity of coal handling system considering the Volumetric bulk density 800 kg/m³. We are considering 10% Drive margin on actual consumed horse power. Please confirm.	Bid specification prevail. Equipment capacities will be ammended
36		5.1.2, page 23 of 245, sl no 3.0 in data sheet for apron feeder at page 193 of 245	Conveyor system rated capacity 1500 TPH. Apron feeder capacity as 1500 TPH rated.	If down stream system has to cater for future DFC wagon as per RDSO's G-33 rev 1 guideline, system capacity is not adequate. Kindly check & confirm.	Bid specification Prevail. Conveyor rated capacity - 1200 TPH Conveyor design capacity - 1500 TPH Apron Feeder rated capacity - 1200 TPH Apron Feeder design capacity - 1500 TPH
37	-	5.1.2	...the design capacity shall be min. 25% more than the rated capacity.	As per latest CEA guidelines and latest coming projects design margin on Coal handling Capacity is 10% only. Kindly confirm the same.	Please refer reply to Sr.no 34
38	-	5.1.3	Maximum moisture content during rainy season shall be considered for design of equipment as 20 % including surface moisture.	Kindly confirm moisture content to be considered for system design.	Bid specification and corrigendum prevail.
39	Page 24 of 245	5.1.6(b)	Belting shall be of synthetic fiber such as N/N	In case steel cord belt is required the factor of safety of 7 is considered as per belt manufacturer's recommendation. Please confirm acceptance	Bid specification Prevail.
40	Page 25 of 245	5.1.6(p),	Number of ply shall be as per IS:11592	Number of ply shall be as per belt manufacturer's catalogue based on tensile strength requirement derived from tension calculation	Bid specification Prevail.

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
41	Page 25 of 245	5.1.6(p)	Coupling and pulleys for conveyors shall be standardised and min.no of types shall be limited to min. possible	Please confirm number of types of pulley and drive to be considered. Also specify the qty if belt rating is also to be standardized.	Bid specification Prevail.
42	Page 25 of 245	5.1.6(q),	Breaker ply shall be provided for belt handling ROM coal	We are considering Breaker ply for Conv 1A/B,2A/B & RBF1/2 only. Please confirm.	Corrigendum Prevail
43	Page 25 of 245	5.1.7(b)	All Troughing idler shall be 3 roll type having angle 35 deg troughing angle	We propose to consider troughing angle for carrying & impact idlers for belt feeders shall be 20 deg	Bid specification Prevail.
44	Page 26 of 245	5.1.7 (d),(e),	Calculation as per CEMA method, friction factor value should be selected suitably as per CEMA standard.....Value of friction factor taken for calculation shall not be less than 0.02	If Power calculation is done as per CEMA method, separate friction factor 0.02 is not required. However, Artificial co-efficient factor may be taken as 0.025 for doing power calculation as per IS:11592.Kindly specify which standard to be followed for power/tension calculation.	CEMA
45		5.1.8	(n) Minimum 3 no. Idler pulleys per conveyor shall be provided where return belt changes direction near head and tail snub idlers	One no. each Idler pulleys required at head end and tail end on return side of the belt conveyor(total 2 Nos). Please Confirm.	Bid specification Prevail.
46	Page 26 of 245	5.1.8(g) ,	Return idler shall be two roll 10 deg troughing angle	Flat return idler shall be provided for belt feeder for placement of internal scraper. Also troughing idlers for belt feeder is 20 deg. Please confirm.	Bid specification Prevail.
47	Page 27 of 245	5.1.8(m) ,	Idlers below magnetic separator shall be non magnetic type	Effective area of magnetic field of ILMS is at the top of drive pulley & upto top of conveyor belt and hence we are not considering non magnetic idler at head end where ILMS is installed. Please confirm.	Bid specification Prevail.
48	Page 27 of 245	5.1.9(b) ,	Pulleys shall be welded construction	Pulleys of 500 mm dia & below may be made from seamless carbon steel pipes of required thickness as per calculation.	Bid specification Prevail.

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
49		5.1.10	Conveyor Drive : Hydraulic drive shall be offered for all coal conveyors	Please confirm whether conventional drive can be acceptable for coal conveyors in place of hydraulic drives.	Bid specification Prevail.
50	Page 28,29 of 245 page 59 of 247	5.1.10(a)-(d), Sr. no 28,	Conveyor drive-Hydraulic drive shall be offered for all coal conveyors Annunciation- Hydraulic motor driven conveyor.	As per clause no 5.1.11,5.1.12,5.1.12 of pages from 29-35 of 245,conveyor drive is conventional type with gear box, input & output coupling. We recommend electromechanical drive for all conveyors. Please review and confirm.	Except Belt feeders and reversible belt feeders all conveyor drives shall be hydraulic.
51	Page 29 of 245	5.1.11(b),	Gearboxes shall be of same handling and completely interchangeable for all twin conveyors	Gearboxes may be interchangeable for twin conveyors by changing the internals. Please confirm acceptance.	Except Belt feeders and reversible belt feeders all conveyor drives shall be hydraulic.
52	Page 33 of 245	5.1.12(c),	Fluid coupling shall be Traction type in general. However,for highest rating scoop type can be provided, if required. As per fluid Coupling Data sheet at page no 125 of 245 at sl no 5:Scoop coupling for crusher motor.	As we understand, scoop type coupling is to be provided for crusher motor only and for all other areas fluid coupling of traction type shall be provided. Please confirm acceptance.	Bid specification Prevail.
53	Page 35 of 245	5.1.14,	All conveyor and belt feeders shall be provided with brakes	We propose to provide brakes only to the belt conveyors where the same is required to adjust difference in costing down time with its preceding and succeeding conveyors. Please confirm acceptance.	Bid specification Prevail.
54	Page 36 of 245	5.1.15,	Take up arrangement	Take up travel is considered as 2.5% of Horizontal cross section of Conv length.	As per CEMA
55		5.1.15, (f)	Takeup weight material	please confirm whether take up weight madeup of RCC is acceptable in place of cast iron or not.	Bid specification Prevail.

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56	Page 36 of 245	5.1.16(b),	Internal belt cleaner shall be V plough type, made of mild steel and hard strips with necessary chutes shall be furnished for cleaning internal surface of belt.	Requirement of chute is not clear for the application. Please specify requirement.	Bid specification Prevail.
57		5.1.17	Beltsway switch	We will consider belt sway switches in pairs at periodic intervals of 50m instead of 30m as specified in tender specifications for all conveyors. Please confirm your acceptance	Bid specification Prevail.
58	Page 40 of 245	5.2.2,	Belt speed for belt feeder as 3.0 m/s	We understand that belt speed upto 3 m/s is applicable only for belt feeders. Please confirm.	Bid specification Prevail.
59	Page 41 of 245	5.3.1(c),	Requirement of stair case	Kindly clarify if all external staircases to be covered from FGL upto roof or only working floors are to be covered for all tall TPs near boiler bunker area upto roof.	Upto Roof
60	-	5.4.2	The Machine should be rated for continuous duty and should be able to unload all standard open broad gauge wagons (including future high sided wagons) of Indian Railways. It shall be capable of unloading either One eight-wheeler wagon or Two four Wheeler wagons at a time.	As per RSDO Guidelines G-33_Rev.-1,Wagon Payload Capacity for 1. DFC- 25 is about 82 T & unloading capacity- 2050 T/hr 2. DFC-32.5 is about 108 T unloading capacity-2700 T/hr based upon the 25 tips/hr So, we understand that coal unloading streams starting from apron feeder, conveyor upto coal stock pile shall be 2 x 3000 tph streams. Please clarify.	Bid specification Prevail.
61		5.8.4	Type of Crusher	Please confirm whether ring granulator type crusher is acceptable in place of Impactor hammer reversible type as specified in tender specifications since output size of crusher required is (-) 20 mm as per tender specifications.	Corrigendum Prevail.
62		5.8.10	All hammers shall be toothed hammer weighing maximum 30 Kg	we request customer to review hammer weight , max30 kg as specified by customer since capacity of crusher is not specified in tender specifications to check the possibility of the same.	Bid specification Prevail.

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
63	Page 55 of 245	Stacker Reclaimer 5.9.4	The carriage, capable of moving both....	The carriage shall be provided with squirrel cage motors with VVVF control. This is a much better solution compared to the older slip ring drives which required high maintenance.	Swuirrel cage motor with VVVF drive is acceptable
64	Page 60 of 245 page 138 of 245	5.11.1, data sheet for flap gate sl no 2.6 ,	Min.thrust given as 750 kg in data sheet whereas actuator rating is specified as min 2500 kg in cl no 5.11.1	Kindly specify min. thrust requirement.	During Detailed Engineering
65		5.15.1	Travelling belt tripper shall be motorized (independent) travelling type on rails fitted with One way chutes, belt cleaner and associated accessories.	For Travelling Tripper Motorized Two way discharge chute is required instead of one way. Please Confirm.	Bid specification Prevail.
66	Page 66 of 245	5.15.12,	Rating of drive motor for tripper bogie should be at least 120% of the design power...	We will consider tripper travel speed as 15 m/min for doing travel drive motor power calculation. Please confirm.	Bid specification Prevail.
67	Page 77 of 245	5.24.1.1	CHP office cum maintenance building	Please mention the requirement of CHP office cum maintenance building. Also, please provide the drawing.	For maintainance of CHP equipments. Drawing dimensions are given in plot plan
68	Page 77 of 245 Page 77 of 245	5.24.1.2 5.24.1.2	Service air required for all DE units (filter cleaning, etc.), fog type DS system, shall be arranged by Bidder at required pressure by providing 2 x 100% compressors. Air Compressor shall be provided to cater to the requirement of compressed air of the "Dry Fog" System and other service air requirement.	There is no service air requirement for TP floor cleaning in CHP area because service water is used to clean the floors. We understand that the scope of service air is only for DE & DS system. No service air is required for other area of CHP. Please confirm.	Bid specification Prevail.

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
69	Page 77 of 245	5.24.12	Service air required for all DE units (filter cleaning, etc.), fog type DS system, shall be arranged by Bidder at required pressure by providing 2 x 100% compressors.	Compressor capacity will be based on single stream operation. During double stream operation, both the compressor will run with no stand by. Please confirm.	Confirmed
70	Page 77 of 245	5.24.12	Service air required for all DE units (filter cleaning, etc.), fog type DS system, shall be arranged by Bidder at required pressure by providing 2 x 100% compressors.	Compressed air requirement for DE system shall be tapped from DFDS compressors. Please confirm.	Confirmed
71	Pg 77 of 245 Pg 201 of 245	DE, DS & Ventilation system 5.24.1.1 & Data Sheet A List of Split AC Units	Suitable ventilation for ...CHP control rooms, WT control rooms....and bunker house. Control Room 2 nos 2.0 TR AC, Wagon Tippler control room 4 no's 2.0 TR AC system.	We will consider Air conditioning system for CHP control room and Wagon Tippler control room. We are not considering ventilation system any where, if AC system is envisaged. Please confirm acceptance.	Confirmed
72	Pg 78 of 245	DE, DS & Ventilation system 5.24.1.6 (a)	Dry cyclone type bag filter...coal bunker and transfer points as indicated in flow diagram	We shall consider DE system at crusher house and bunker as per flow diagram. Please confirm.	Confirmed
73	Pg 78 of 245	DE, DS & Ventilation system 5.24.1.4	Plain water DS system for discharge of coal in coal pile area shall be considered.	We shall consider stock pile DS nozzles which can perform stacker and reclaimers discharge DS also. Please confirm.	Bid specification Prevail.
74	Page 80 of 245	5.24.2.2	Compressed air supply system shall be supplied complete with 2 x 100% capacity air compressor (1W + 1S), pipe & pipe fittings, Air receiver, Air drier, Oil cooler, solenoid valves, timers, etc. for all Dust Extraction units.	DE system capacity for crusher house will be based on single stream operation. During double stream operation, DE system will run with no stand by. Please confirm.	Confirmed

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75	Pg 84 of 245	DE, DS & Ventilation system 5.24.3.1 (a) (VIII)	The bags shall be manufactured of suitable material fire proof with antistatic properties	We understand fire proof antistatic bag filter means fire retardant, non-woven antistatic material. Please Confirm.	Bid specification Prevail.
76	Pg 91 of 245	DE, DS & Ventilation system 5.24.3.3 ©	Roof extractors shall be provided for bunker house ventilation.	We are considering DE system for bunker hoppers. For bunker building excluding hopper Volume we are considering roof extractors capacity of 10 air change/hr. Please confirm.	For bunker building excluding hopper Volume roof extractors of capacity 15 air change/hr shall be considered.
77	Pg 110	8.1.9 (d)	Wagon Tippler- 25 tips /hour (designed Capacity)	As per RSDO Guidelines G-33_Rev.-1,Wagon Payload Capacity for 1. DFC- 25 is about 82 T & unloading capacity- 2050 T/hr 2. DFC-32.5 is about 108 T unloading capacity-2700 T/hr based upon the 25 tips/hr So, we understand that coal unloading streams starting from apron feeder, conveyor upto coal stock pile shall be 2 x 3000 tph streams. Please clarify.	Bid specification Prevail.
78	Pg 110	8.1.9 (e)	Apron Feeder- 1500 TPH guaranteed capacity	As per RSDO Guidelines G-33_Rev.-1,Wagon Payload Capacity for 1. DFC- 25 is about 82 T & unloading capacity- 2050 T/hr 2. DFC-32.5 is about 108 T unloading capacity-2700 T/hr based upon the 25 tips/hr So, we understand that coal unloading streams starting from apron feeder, conveyor upto coal stock pile shall be 2 x 3000 tph streams. Please clarify.	Bid specification Prevail.
79	Page 115 of 245	DATA SHEET - A Sr.no 10	Belt Width :- Before crusher 1400mm, After crusher 1200 mm Reversible Belt Feeder 2000 mm, Belt feeder 2000 mm	For Reversible belt feeder 1600 mm and belt feeder 1400 mm are adequate for the specified rated capacity of 1500tph & design capacity of 1875tph. Please confirm.	Before crusher -1400 mm After crusher -1200mm Reversible Belt Feeder -1600mm Belt Feeder -1600mm

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
80	page 116 of 245	Data sheet for Conveyor belt :sl no 13,	M24 as minimum grade of belt	As per sl no 14,page 116 of 245, cover grade FR is also mentioned. Please clarify.	Bid specification Prevail.
81	page 119 of 245	Data sheet for Pulley :sl no 1,	Tail snub pulley for conveyor	Snub pulley will be provided only at drive pulley of belt conveyors. Please confirm acceptance.	Confirmed except for reversible belt feeder(For reversible belt feeder 2 snub pulleys shall be provided.One at each drive end)
82	page 119 of 245	Data sheet for Pulley :sl no 1,	Snub & Tail snub pulley for Belt feeders	Belt feeders shall be provided with 180 Deg wrap angle with no snub pulley. Please confirm acceptance.	Bid specification Prevail.
83	page 119 of 245	Data sheet for Pulley :sl no 12,	Shell thickness:min 16 mm	Min shell thickness of 16 mm is applicable only for drive pulley or all types of pulleys. Please clarify.	Bid specification Prevail.
84	page 123 of 245	Data sheet for gear box :sl no 3 at	Gear boxes shall be unidirectional	Gear boxes shall be bi-directional for reversible belt feeders. Please confirm.	Bid specification Prevail.
85	Page 131 of 245	DATA SHEET - A Sr.no.4.0	For return idler spacing 2400mm (1500 mm in the region of convex curve)	Its is 3000 mm spacing's (1500 mm in the convex curve). Please Confirm.	Bid specification Prevail.
86	Page 133 OF 245	DATA SHEET - A Sr. no 1.5	Belt Width :- 1800mm / 2000 mm	Please Confirm the belt width	Corrigendum Prevail
87	Page 133 OF 245	DATA SHEET - A Sr. no 2.1	Material: Electric /Sail hard Minimum (on sliding & adjacent side)	Please Clear the material mentioned.	Corrigendum Prevail
88	page 133 of 245	Data sheet for Hopper chute & skirt :sl no 2.0 at	Hopper & chute material	Thickness of material is not specified for sliding & adjacent side. Please specify chute material for crushed & uncrushed coal.	Corrigendum Prevail

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
89	Page 133 OF 245	Data Sheet-A 1.6	Maximum Moisture Content- 15 %	Kindly confirm moisture content to be considered for system design.	Corrigendum Prevail
90	page 134 of 245	Data sheet for Hopper chute & skirt :	Hood	Please specify the hood plate thickness and material.	MS and Minimum 4 mm
91	Page 137 OF 245	Data Sheet-A 1.10	Moisture Content- 15%	Kindly confirm moisture content to be considered for system design.	Corrigendum Prevail
92	Page 141 OF 245	DATA SHEET - A Sr. no 1.3	Belt Width & speed :- 1800mm; 3.0 M/sec.	Please Confirm the belt width	Corrigendum Prevail
93	page 141 of 245 page 149 of 245	Data sheet for ILMS : Data sheet for Fixed Tripper :s.n.1.4	Belt thickness as 20 mm Belt thickness as 20 mm	We suggest that, this to be decided during detail engineering. Please confirm.	Bid specification Prevail.
94	Page 145 OF 245	DATA SHEET - A Sr. no 1.9	Belt details:- Belt width shall be as maximum as possible but not less than 2000 mm.	Required maximum belt is 1600 mm only. Please Confirmed.	Please refer reply to sr.no:79
95	page 145 of 245	Data sheet for Belt feeders :sl no 1.10	Helical gear box at belt feeders drive	As per Data sheet for gear box :sl no 8.0 at page 123 of 245, worm gear box can be used for belt feeder. Please clarify.	Gear box shall be Helical
96	Page 151 of 245	DATA SHEET - A Sr. no. 1.6 & 1.7	Belt width 1800 mm & Capacity 1200 TPH	Please Confirm Belt width & Capacity (this shall be 1500tph & belt width 1200mm)	Corrigendum Prevail
97	page 152 of 245	Data sheet for Mobile Tripper :s.n.3.3	lagging thickness as 12mm	It shall be 16 mm. Please confirm.	Confirmed
98	Page 153 of 245	DATA SHEET - A Sr. no. 5.13	Flap gate:- Double flap motorised.	Pl clarify whether a two way chute or three way chute is required.	Bid specification Prevail.

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
99	page 154 of 245	Data sheet for Mobile Tripper :s.n.2 under note	Bidder shall explore possibility of providing 2 way chute for fixed & travelling tripper	There is only 1 way flap gate chute as per flow diagram and NIT drawings. Please clarify requirement.	Bid specification Prevail.
100	PAGE 166 OF 245	Data Sheet-A	Selection of electric Hoists	Please clarify the contradiction in selection of electric hoist since it is mentioned differently in the datasheet of manula & electric hoist (as above 3T & above 2 T).	Hoists above 1 Tonne shall be electric
101	page 167 of 245	Data sheet for Metal Detector :s.n.12	Min size of metal to be detected:10 mm dia steel ball ,250 mm(min)aluminium sphere	We presume that it should be 25mm(min)aluminium sphere and not 250mm. Please confirm.	Confirmed
102	page 171 of 245	Data sheet for Belt Vulcanizer :s.n.4.0	Belt width: 2000 mm or max.width of the belt used in the plant whichever is higher	Please specify the max.belt width to be considered.	Corrigendum Prevail Max. Belt Width +200mm
103	page 173 of 245	Data sheet for Wobbler feeder : s.n.5.0	Max lump size(input coal):- 300 mm	Please furnish coal sieve analysis.	Bid specification Prevail.
104	page 173 of 245	Data sheet for Wobbler feeder :s.n.11.1 & 11.2	Material for wobbler bar and elliptical disc bar: Manganese steel to IS 276	MOC shall be as per reputed manufacturer's standard satisfying design parameter.	Bid specification Prevail.
105	page 176 of 245	Data sheet for Crusher :s.n.3	MOC of shaft, frame, breaker plate, internal part and side liner	MOC shall be as per reputed manufacturer's standard satisfying design requirement.	Bid specification Prevail.
106	Page 179 of 245	DATA SHEET - A Sr. no.1.7	Stock pile length : To suit layout & requirement, 300 meters minimum and 270 M shown in the drawing PE-189-Ga-120.	300m is not feasible.Please confirm the stocke pile length required is 270m.	Length of the stockpile shall be 270 m.
107	Page 181 of 245	DATA SHEET - A Sr. no. 4.5.1	Belt width :- 1800 mm	For the capacity 1500tph specified, 1200mm width is sufficient.Please confirm.	Corrigendum Prevail
108	PAGE 191 OF 245	Data Sheet-A	Wagon tippler quantity: 2Nos. (1 W+1S)	Please confirm the number of wagon tipplers in working condition in view of considering conveyor capacity, 1500 TPH as specified in tender specifications.	Bid specification Prevail.

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
109	page 195 of 245	Data sheet for Dribble Conv :s.n.12	Type of belt :EP/FR	Type of belt: NN/FR can also be used. Please clarify.	Bid specification Prevail.
110	PAGE 199 OF 245	Data Sheet-A	Bunker sealing arrangement	Please furnish slot width for us to estimate bunker sealing belt width required to be considered.	During Detailed Engineering
111	PAGE 201 OF 245	Data Sheet-A	List of split AC units	Please furnish the dimensions of buildings specified in the data sheet since same is required for our estimation.	Bid specification Prevail.
112	page 205 of 245	Data sheet for Coal Sampling unit :21.1	Vezin/Moving hopper type secondary sampler	Please provide the source of Vezin/Moving hopper type secondary sampler. Or it shall be as per reputed manufacturer's recommendation.	Bid specification Prevail.
113	Pg 211 of 245	Data Sheet A Schedule of dust extraction system	Function/ Location: Crusher house: To extract dust from discharge pulley of conveyor 2A/B, Feed point WF and crusher, Feed discharge point of RBF 1,2,3,4,5,&6 and feed & discharge point of conv. 7.	Providing of any dust control system near ILMS is technically not suggested. So we are excluding DE/DS system at discharge pulley of conv 2A/B and discharge point of conv 7. We are providing DE at receipt and discharge points of RBF-1,2,3 & 4, WF, Crusher only. Remaining places like receipt and discharge of BF, discharge of conveyor 8, receipt of conveyor 3A/B we are considering Dry Fog dust suppression system. Please confirm.	Bid specification Prevail.

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
114	Pg 217 of 245	Data Sheet A Schedule of Ventilation system Sl. No 2.0	Function/ Location: Exhaust air from under ground portion of WT-1 & WT-2 & tunnel part of Conv 1A/B in TP-1 up to TP-2	Under ground portion of conveyor 1A/B ends at pent house. So we are considering supply and exhaust ventilation system for under ground portion up to pent house only. Not up to TP-2. Please confirm.	Confirmed
115	PAGE 227 OF 245	Data Sheet-A	Elevators	Please confirm whether rack & pinion type elevator is acceptable or not since type of elevator is not specified in tender specifications	Confirmed
116		Data Sheet-A	Equipments capacity	Capacities of some of the equipments like crusher, wobbler feeder, vibro feeder are specified in data sheet-A and some are not specified. Please confirm whether equipments capacity shall be considered as per specification or system requirement. If it is to be considered as per specifications, please furnish capacities of all the equipments.	Please refer corrigendum-III
117		Data Sheet-A	Belt Width	Please clarify the contradiction in the belt width to be considered since it has been specified different values (1200mm, 1400mm and 1800mm) in Data Sheet- A of conveyor belt data, coal sampling unit, inline magnetic separators and travelling tripper	Corrigendum Prevail
118		Data Sheet-A	CHP office cum maintenance building	We will provide CHP office cum maintenance building having dimension 25 X 40 m ² (as specified in the plot plan for CHP maintenance building dimensions) with single ground floor. Please confirm your acceptance.	Building shall be double storied
119		2.3, Conveyor belt Data sheet-A	Conveyors capacity	Rated capacity of conveyors has been specified as 1500 TPH in the system description. Whereas in data sheet it has been specified as "bidder has to be derive based on the requirement in the Conveyor belt data sheet". Please clarify the contradiction.	Rated capacity - 1200 TPH Design Capacity - 1500 TPH

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
120		2.3, Conveyor belt Data sheet-A	Hours of operation of the plant /day	Please indicate the number of hours of operation of coal handling plant for normal operation for calculation of conveyor capacity.	Bid specification Prevail.
121		5.1.18 & DATASHEET- A Hopper chutes & skirt board	Chutes & Hopper shall be made up of structural steel plate	Please indicate the main plate thickness for chutes and we understand that liner is to be provided on all the sides.	Bid specification Prevail.
122			AUTOCAD copy of plot plan	Please furnish the AUTO CAD copy of plot plan to measure the exact lengths of various conveyors, stock pile dimensions etc.	Already Furnished
123	General			Kindly furnish the coal analysis	Bid specification Prevail.
124		V:IV-A, Section-1/1.7 (ff) page 17 of 440	Loco shed	Please provide the detail drawing of loco shed. Also in tender plot plan drg. No. PE-189-GA-101, P2 is not showing any loco shed. Also please mention the requirement of rail siding for loco shed in plot plan.	Loco shed is Excluded.
125		General		Coal Bunker shall be designed for 12 hours storage. Please confirm.	Bid specification Prevail.
126	-	-	Bulldozer	Since ground hopper is specified hence the requirement of Bulldozer to be clarified because the same is not specified. Kindly confirm.	Minimum 8 nos.payloaders.
127	-	-	Locomotive	Locomotive is not EPC bidder scope. Kindly Confirm.	Confirmed
128	Page 55 of 247;	Corrigendum-I/Sr.3,	Coal from W.T hopper-1 & 2 shall be - apron feeder and rack & pinion gates fitted below respective W.T hopper	In TP1, Flap Gates are provided so that coal can be fed either to conv 1A or 1B through Apron Feeder AF1 / AF2. Request to clarify the requirement of Rack & Pinion Gates at this location.	For Two stream operation with one wagon tippler working

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
129	Page 55 of 247	Corrigendum-I/Sr.4	Conveyor 1A & 1 B through chutes and rack & pinion gates	Request to clarify the requirement of Rack & Pinion Gates in place of Flap Gates since conv 1A and 1B has to feed either to conv 2A or 2B	Bid specification Prevail.
130	Page 56 of 247; Page 58 of 247 Page 58 of 247	Corrigendum-I/Sr.9, Corrigendum-I/Sr. 19 Corrigendum-I/Sr. 46,	Facility of toilet block, drinking water along with water cooler, UV Purifier and sound proof cabin for operator. Facility of toilet block drinking along with water cooler , UV purifier and soundproof cabin for operator. Facility of toilet block drinking along with water cooler , UV purifier and soundproof cabin for operator.	Please furnish the size and other facilities required in toilet block.	Bid specification Prevail.
131	Page 58 of 247 Page 62 of 247 Page 63 of 247	Corrigendum-I/Sr.15 Corrigendum-I/Sr. 36 Corrigendum-I/Sr. 45	All roller of similar type of idler shall be complete with heavy duty antifriction split case type bearing,...etc. Type of bearing : Split case. Bearing : Split case type.	Split type bearing in case of idler roller is not applicable. Please check and confirm.	Confirmed.
132	Page 59 of 247	Corrigendum-I/Sr. 23	Steel grating shall be provided over the wagon tippler hopper, sump pump pits.....boiler bunkers. The grating over grizzly/reclaim hopper shall be designed for movement of three (3) pay loaders. All the grating ---civil constructions.	Confirmed, However, in wagon tippler hopper, pay loader cannot go fully over grizzly due to machine configuration.	Corrigendum Prevail

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
133	Page 63 of 247	Corrigendum-I/Sr. 44	Lump Size : 300 mm (indicative)	Belt feeder RBF-3, RBF-4 & BF-1 shall carry material of (-) 20mm crushed coal. Hence lump size as 300 mm for all belt feeders not applicable. Please confirm.	Confirmed
134	Page 64 of 247 Page 66 of 247	Corrigendum-I/Sr. 49 Corrigendum-I/Sr. 64	Belt width : 1200 mm Belt width : 1200 mm	1200 mm belt width shall not be adequate at 3 m/s speed, 800 Kg/M3 bulk density, 90% filling as per IS:11592. Please confirm.. Please check and confirm.	Bid specification Prevail.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

RESPONSE TO PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1

VOLUME - III D

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-D

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
1	Pg. 132 of 175 Pg. 133 of 175 Pg. 134 of 175 Pg. 135 of 175	2.7.1 2.7.2 2.7.3 2.7.4 3.3.1 3.3.2 3.3.3 4.10.2 4.10.3 4.10.6	Bottom Ash Water Impounded Hopper Discharge Gates: Gates – Cast Iron IS:210, Gr. FG-260 Gate wear liners – 6mm thk SS:316/410 Gate spindle – SS Housing wear plates – 25mm Alloy CI 400 BHN min Jet Pumps: Inlet section, throat, and discharge/tail piece – Alloy CI as per IS:4771... Nozzle Inlet – CI Grade FG-260 as per IS 210 Nozzle Tip – Ceramic lined stainless steel / tungsten carbide. Min 500 BHN. Clinker Grinder/Ash Crusher: Wear Plates – 12-14% Mn. Austenitic steel plates to IS:276. 10mm thick or 20mm thick Alloy CI with min 450 BHN Grinder Rolls & teeth – Manganese steel (ASTM A128, 12-14% Mn) Clinker outlet chute – 10mm thick MS (IS: 2062)	OEM standard metallurgy and construction for discharge gates, gate liners, spindles, jet pumps, clinker grinders/ash crushers, etc. may kindly be accepted which are based on long experience and provenness over the years which would meet the guarantee parameters and operational requirements. Owner may kindly accept.	Bid Specification Prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
2	Pg No. 10 of 175	3.0,3.3.1 Dwg No. PE-189-PF-236,P1 and PE-189-PI-239, P1	For Fly Ash system, bidder shall provide pressurised pneumatic conveying system from ESP Hoppers to HCSD Silos and directly to dry fly ash remote silo.	There is a Contradiction between two flow diagrams of fly ash handling system (Dwg No. PE-189-PF-236,P1 and PE-189-PI-239, P1). Please confirm which flow diagram shall be followed for fly ash system design and supply.	PE-189-PI-239, P3 shall be followed
3		3.0, 5.1.2 (c), 5.4.1(b), 5.4.2 (a) datasheet-A S no. 17.5,	B.A. hopper shall be cleared in about 1 hour 30 minutes....	With the Jet pump capacity of 90 TPH, slurry velocity for BA slurry pipe upto ash slurry sump will be in the tune of 2.78 m/sec for 8" NB pipe. Please confirm the velocity is acceptable.	Bid Specification Prevail
4		3.1.2	BA evacuation time	The duration of 1.5 hrs including flushing time, is quite low. We request that this be made as 2 hrs 15 minutes which is normally adopted for similar plants. As this is a single unit and also the fly ash is conveyed in HCS and not lean slurry, the duration should be acceptable.	Bid Specification Prevail
5	Pg No. 11,12 of 175	3.1.2, 3.2.3, 5.1.1, 5.2	Bottom ash as 25 % of total ash with worst coal... Economiser ash (5%) and Air Pre Heater Hopper ash (5%)	Ash distribution at various ash collection points and No. of ash collecting hoppers shall be as per our Boiler design Please confirm.	Bid Specification Prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
6	Page 11 of 175	3.2 3.2.1, 8.15.6 and flow diagram No. PE-189-PF-235, P1 and PE-189-PI-238, P1	-	As per this clause, the ECO ash as well as APH hopper ash shall be collected in a tank by feeder ejector and then pump to slurry sump by jet pump. As per the latest best simplified method it is to provide flushing apparatus system below ECO hopper and APH inlet hopper and taken it to bottom ash hopper for onward disposal to slurry sump via bottom ash system jet pump. APH outlet hopper ash, stack hopper ash can be clubbed with ESP ash. This is the best suited scheme as is being adopted in now a day in most of the plant. Owner will save power, water by adopting the same. In view of above bottom ash can not be evacuated within 1 hr 30 minutes as specified in the specification. Bottom ash evacuation time shall be 2 hrs including start , stop and flushing time.	Bid Specification Prevail
7		3.2.1, Datasheet-A S. No. 1.8	-	Coarse ash tank Volume of 100 m3 as specified in the technical specification is not matching with Owner's requirement of evacuating coarse ash tank in 1 hr 10 min for 8 hrs shift. Please confirm the requirement.	Bid Specification Prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
8	PAGE 12 OF 175	3.3.1	FA conveying compressors	We understand there will be total 5 compressors for total conveying air supply (hoppers to HCSD silo and from HCSD silo to remote silo). Out of this 3 will be normally working and 2 will be standby. Please confirm.	Total 6 compressors shall be provided (3X50%(2W+1S) for conveying ash from ESP hoppers to HCSD silo & 3X50% (2W+1S) for conveying ash from HCSD silo to Remote silo)
9		3.3.1, 5.5.3(d) and Datasheet-A 10.1.2 & Flow diagram PE-189-PF-236 & PE-189-PI 239	For conveying ash from HCSD silos to remote silo, One(1) compressor shall be provided. Four (4) (2W+2S) screw type/Centrifugal type conveying compressors.... For conveying ash from HCSD silos to remote silo, One(1) compressor shall be provided.	a) As per Clause No. 3.3.1 of Tender Specification, One conveying air compressor shall be provided for conveying fly ash from HCSD silo to Remote fly ash silo but it is not possible to convey 240 TPH of fly ash with the help of single compressor. Please review and advise the supply & design of fly ash system.	

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
10		3.3.1	-	Please modify as: "As specified in Corrigendum-1, Nos. of Transport Air Compressor 1 W + 1 S for ESP area ash conveying to HCSD Silo @ 240 TPH / Unit (using 1 Nos. TAC) while 1 W + 1 S compressors are for Fly ash transfer from HCSD Silo to Remote silo. Fly ash conveying capacity of one stream of 240 TPH from HCSD silo to remote fly ash silo is not proven system. Please review the capacity and no. of streams for fly ash conveying capacity. We suggest two streams having capacity of 120 TPH from HCSD silo to remote fly ash silo with two numbers of working compressors.	
11	PAGE 13 OF 175	3.3.3	HCSD pump capacity	The specified capacity of the HCSD pump is quite high. Since one standby is provided we consider that the capacity can be around 180 tph. Please review.	Bid Specification Prevail

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Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-D

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
12	Page 14 of 175	3.3.3 & 3.3.4 - &	-	As per this clause, below each HCSD silo a conveying vessel of 300 TPH shall be provided and at the subsequent below stated clause it is specified that ash conveying vessel to capable of operating simultaneously. At the clause no. 4.3.2 Page 28 of 175, the capacity of vessel below HCSD silo has been specified as 240 TPH. So, please clarify the following: a) Final capacity of conveying vessel - 240 TPH or 300 TPH; (b) Compressor to be sized for 2 vessel working simultaneously from both the HCSD silo or one vessel. We presume that it should be one working at a time only. (c) VFD rotary feeder below HCSD silo for feeding to conveying vessel are not required as stated on Page 28 of 175.	a)240 TPH shall considered for conveying ash pneumatically from HCSD silo to Remote silo.The no. of ash conveying vessels shall be two (2) numbers below each HCSD silo and operating simultaneously with two ash conveying lines from each HCSD silo to remote silo b)Each compressor shall be 120TPH//vessel c) For feeding ash to conveying vessel,rotary feeder(120 TPH)shall be provided
13	Pg. 15 of 175	3.4	3 Bottom ash slurry pipes from 3V bottom ash hopper	Bottom Ash Hopper 3V vs 2V configuration may please be left as an option for bidder to decide since this is a complete EPC Proposal. Kindly confirm acceptance.	Bid Specification Prevail
14	Pg 16of 175	3.4.3	The grade level..... at dyke is 60 meter above plant grade level	Grade height 60 meter for lean slurry disposal height seems to be very high . Please review	Bid Specification Prevail

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Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-D

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
15	Pg. No. 16, 36, 47 of 175	3.4.3, 5.6.1, 5.6.2, 3.4.3, 4.21.16 & 6.17.1	Bottom ash: 270 TPH @20-25% by weight for 12 km route length with 60 M static lift.	As per Tender specification we understand that Ash Slurry pump (HCSD and Bottom ash slurry disposal Pump) shall be selected by considering 60 m static lift with respect to plant grade level only. Further dyke rise of 11 m to reach at 281 m as indicated in the clause No. 3.4.3, shall be achieved by future slurry pumps as indicated in the clause No. 5.6.2. These future slurry pumps shall not be in bidder's scope of supply but space for the same shall be kept in the respective building. Please confirm. However, as per clause no. 4.4.3 Final dyke height to be considered as El (+) 281 M. Please clarify and confirm the final dyke height to be considered for Ash slurry Pump sizing."	The final height to be considered for bottom ash and fly aly ash slurry pumps design shall be RL(+) 281m.The plant grade level 208.5(FGL) and dyke height 281 as indicated ar cl..23.5 & 23.6 on pg no. 166 of 175 shall be referred to for B.A & HCSD pump design.The B.A pump house shall be designed considering a space provision for future addition of one more pump in each pump series. The 60 meter static lift appearing in the specification stands deleted.
16	PAGE 16 OF 175	3.5	Location of Ash Disposal Area	Location of the Ash pond and tentative routing for ash conveying pipes from SCSD and Slurry Disposal Sump is not furnished with the tender.	Soft copy furnished

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project**Pre - Bid Queries****Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-D**

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
17		3.5 & 4.3.2, 4.21, 5.7.1, 6.18.7 and Datasheet- A S.No. 23, 24, 25 &29	-	HCSD pump and associated equipments shall be provided as per vendor proven design. Please confirm.	Bid Specification Prevail
18	PAGE 16 OF 175	3.5.1	HCSD concentration	The concentration of slurry will depend on the ash characteristics which can be predicted at detailed engineering stage after the sample of ash is available. For design of HCSD system/pumps the value of 65% will be adopted.	Please refer reply to Sr.no:58 For design of HCSD system pumps the value 70% shall be adopted
19	Page 16 of 175	3.5.1	-	As per this clause, the minimum concentration of fly ash system should be 65% and range of concentration should be 65%-70%. We request you to kindly design the pump at 60% concentration and range of concentration should be 60-67% based on final concentration to be achieved at site based on behaviour of ash and fly ash rheology test, which can not be predicted at this stage.	Bid Specification Prevail

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-D

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
20	Pg. 17 of 175	3.5.3	Actuator control orifice feeder	Rotary vane feeder with VFD to control ash flow rate may please be allowed as an option to actuator control orifice feeder. Please confirm.	Bid Specification Prevail
21	Pg. 17 of 175	3.5.3	Solid flow meter	Solid flow meter is not required since ash flow rate is controlled upstream by rotary vane feeder. This can be decided during detail engineering. Please confirm acceptance.	Bid Specification Prevail
22	PAGE 12 OF 175	3.5.4	Ash disposal line	Pl clarify that 12km specified is inclusive/exclusive of garlanding pipe length. Please indicate the garland pipe length for the BA disposal. We understand garland pipe for the HCSD is not required. Please review and confirm. If such pipe is to be provided, please indicate the length required	corrigendum prevail
23	PAGE 18 OF 175	3.5.4	HCSD piping	These being high pressure piping, and normal temperature service, expansion joint or expansion loops are not normally provided. Please review this requirement. Such expansion loops could cause choking of slurry.	During Detailed Engineering
24	Pg 16 of 175	3.5.4		Please furnish the static height to be considered for HCSD	Please refer reply to sr.no 15

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Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-D

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
25		3.8.1, 5.7.8	In-plant Tube Settler shall receive water from the Bottom Ash Overflow Pump discharge, NDCT Blow Down...	There is a contradiction between following two clauses. As per cl. No. 3.9.1 (d) and flow diagram (PE-189-PI-242, P1) of tender specification NDCT Blow down water shall be routed directly to ash water sump but as per clause no. 5.7.8 tube settler/clarifier shall clarify NDCT blow down water. Please clarify the requirement.	Corrigendum prevails
26	PAGE 20 OF 175	3.9.1	Ash water recovery	Please clarify the terminal point for ash water recovery. Our understanding is that separate treatment for the recovery water is not in Bidder scope.	Please refer corrigendum-I Sr.No.6 Page No.7 of 247 The tap off provided is of 400 NB.As specified the recovered water shall be laid through tube settler and the flow of recovered water to be considered for 660 MW shall be considered as min. 800 m ³ /hr
27	Pg 20of 175	3.9.2	Return from ash dump area will be fed to existing 2X500MW . From this line makeup water shall be tapped	Kindly specify the location of tap up point or distance of tap up point from existing pipe to ash water sump	Please refer corrigendum-I Sr.No.6 Page No.7 of 247

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-D

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
28	PAGE 21 OF 175	3.9.5	HCSD LP Water sump	Separate HCSD LP Water sump is asked for getting feed for HCSD LP water pumps in tender specification whereas Drawing.235 P1 (BOTTOM ASH AND COARSE ASH HANDLING SYSTEM) is showing that HCSD LP Water pumps are getting feed from same ash water sump. Please clarify the contradiction.	Separate compartment shall be made in Ash water for LP HCSD water pumps
29	PAGE 24 OF 175	4.1.4	HCSD LP Water sump Capacity	Please specify the basis of selection of HCSD LP water sump capacity.	Please refer DWG No. PE-189-PI-242 (P3)
30	PAGE 24 OF 175	4.1.12	Ash water recovery	Please clarify if the tube settler is to be designed for the ash water recovery also. If so what is the capacity.	Please refer reply to Sr.no:26
31	PAGE 24 OF 175	4.1.12	Tube settler & Sludge Sump capacity	Please specify the criteria to select the capacity of tube settler & sludge sump .	BA.over flow water + Ash water recovery + NDCT blow down water as per system design
32	PAGE 24 OF 175	4.1.12, 4.5	Tube settler Arrangement	Please confirm whether ash bund recovered water is going to tube settler or existing ash water recovery system since there is a contradiction as per the specified clauses of tender specifications	Please refer reply to serial no.31
33	PAGE 24 OF 175	4.1.13	Lining for sludge sump	For the sludge sump separate liner is not required. Please review	Bid Specification Prevail

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Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-D

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
34	PAGE 25 OF 175	4.2.6	Chimney ash tank and jet pump below the chimney hopper shall be furnished to discharge the chimney ash to the ash slurry sump	In case of Chimney design with steel lining, Chimney ash tank and jet pump below the chimney hopper arrangement is not required. Hope this is acceptable to MahaGenco	Chimney shall be provided with ash collection hopper and ash removal equipment i.e manual and pneumatic valves, feeder ejectors, chimney ash tank with jet pumps as specified. Alternatively dense phase pneumatic ash removal arrangement to transfer ash to silo shall be provided by independent line.
35	PAGE 27 OF 175	4.3.1	Air Receivers	As per specifications, each compressors shall be provided with adequate capacity of air receiver whereas tender drawing, 236 P1 (FLY ASH HANDLING SYSTEM) is shownig 2 Nos common air receivers for 4 nos compressors and 1 No air receiver for One compressor. Please clarify the contradiction with quantity of air receivers to be considered in our offer.	Total 5 air receivers shall be provided. Two common for 3 compressors (ESP to HCSD) of capacity 10m ³ , Two common for three compressors (HCSD to Remote) of capacity 10m ³ and one receiver of capacity 20m ³ near ESP.
36	PAGE 25 OF 175	4.3.1	Transport air compressors: Two compressors shall be dedicated for transfer of ESP ash to HCSD silo and one for transport of ash from HCSD silo to remote silo	Please clarify the number of compressors to be considered for in case of transport of ESP ash directly to remote silo.	Provision of Conveying ash from ESP to remote silo directly shall be deleted

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project**Pre - Bid Queries****Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-D**

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
37	Page 27 of 175	4.3.1	-	Please modify as: "As specified in Corrigendum-1, Nos. of Transport Air Compressor 1 W + 1 S for ESP area ash conveying to HCSD Silo @ 240 TPH / Unit (using 1 Nos. TAC) while 1 W + 1 S compressors are for Fly ash transfer from HCSD Silo to Remote silo. one number to cater the requirement of conveying fly ash upto HCSD silo and one number for conveying from HCSD silo to main silo. In one of the clause of specification it is specified to convey the fly ash upto remote silo also. So, please clarify whether the conveying air compressor shall be sized for conveying upto remote silo or only upto HCSD silo. It may please be noted that the pressure and flow profile for conveying ash from ESP to HCSD silo or to remote silo as the case may be and for HCSD silo to remote silo will vary. So, it is recommended to have compressor capacities as defined below:- Conveying air compressor from ESP to HCSD silo or remote silo - 4 Nos. (2W+2SB); From HCSD silo to remote silo - 2 Nos. (1W+1SB). So, please review and confirm."	Please refer Clause Sr.no 8 and 36
38	Pg. 27 of 175 & Pg. 29 of 175	4.3.1 (h) & 4.3.4 (i)	Heater rating shall be selected according to blower capacity and to raise the temperature of aeration air to 200C.	Heater rating to raise the temperature of air upto 135 Deg C is sufficient. Kindly review and confirm.	Clause 4.3.1 (h) in the tender specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-D

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
39	PAGE30 OF 175	4.4.3	Ash slurry pipes	Inside the plant boundary, where the pipes are in open yards, the slurry pipes can be routed in the sleepers under ash slurry pipe corridors. Please review and confirm.	Bid Specification Prevail Inside plant boundary ash slurry pipes shall be routed on pipe racks only.
40	PAGE30 OF 175	4.4.3	Ash slurry pipes	For rail or road crossing culverts may also be adopted instead of pipe racks, please confirm.	Bid Specification Prevail. Refer Addendum II to Bid specification.
41	PAGE 30 OF 175	4.4.3, 6.15.3	Vertical clearance of over head pipe lines at the rail/road crossings & walk ways	Please clarify the contradiction in vertical clearance to be considered for over head piping above walk ways and road ways/rail ways which is mentioned as 6.2m & 8m in tender specifications.	Corrigendum II prevail
42	-	4.4.3	from ash slurry pump discharge to the ash dump yard, which is about 12 km away from the plant. The grade level elevation at disposal area is about 60 m higher than the main plant grade level.	Please confirm & specify the location of Ash dump yard.	Soft copy furnished
43	PAGE 31 OF 175	4.5	Recovery from ash pond	Pl clarify whether the recovery water from the ash pond is for use of existing 500mw units or for the unit-6. Also pl indicate the expected amount of recovery water from the existing pond.	Please refer reply to Sr.no 26
44	PAGE 31 OF 175	4.5	Raw water pump house location	Please indicate raw water pump house location, ash dyke in the plot plan for our estimation of raw water pipe lines & associated structural works and furnish revised plot plan.	Soft copy furnished

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-D

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
45		4.6 and Flow diagram PE-189-PF-227, P1	-	There is a contradiction between following two clauses. As per flow diagram dwg No. PE-189-PF-227, P1 one raw water make up line to ash water sump shall be provided while as per clause No. 4.6 of Volume-IIID, two raw water Make up pipeline shall be provided for ash water make up in ash water sump. Please clarify.	One Raw water make up pipe line shall be considered.
46	Pg. 134 of 175	4.6	Clinker Grinder Type: Double roll	As an option, please allow Clinker Grinder Type: Single roll.	Bid Specification Prevail
47	PAGE 31 OF 175	4.6.4	Clarified water shall be used as make up to common seal water sump or corresponding seal water pump suction header	Drg. PE-189-PI-242 /P1 (ASH SLURRY DISPOSAL SYSTEM) is showing that HP & LP Seal Water pumps are geeting feed from ash water sump whereas it is mentioned as common seal water sump in tender specifications. Please clarify the contradiction between drawing & specifications also clarify the term " Common seal water sump" if seperate seal water sump has to be considered.	The arrangement shown in the Corrigendum drawing prevail.Bidder to ensure the quality of seal water.
48		4.12	-	Water Pumps have been specified for Silo Floor washing. Please advise Nos. of Pumps and design basis for Pump Capacity.	No separate pumps for silo floor washing shall be provided,however necessary tappings with hose pipe jetting nozzles shall be provided at HCSD and Remote silo from HP/LP water pump headers

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Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-D

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
49		Cl No.4.14	HCSD LP Water shall have separate compartment.	Please clarify why HCSD LP water requires separate storage compartment in ash water pump house.	Bid specification prevail
50	PAGE 32 OF 175	4.15	AHP- cooling water	Our understanding is that the DMCW system of SG can be adopted for ash handling system aux coolers. Alternately bidder can provide independent system. Please confirm.	Bid specification prevails.independent system as specified shall be provided
51	PAGE 32 OF 175	4.15	One plate type heat exchanger with all accessories for ash handling make up water.	Normally we will use boiler DMCW system for ash handling applications also. So it is not required to consider sepearte PHE for ash handling plant applications.	Bid specification prevails.independent system as specified shall be provided
52	PAGE 33 OF 175	4.18	cross country pipe	The Owner shall arrange for approvals from relevant authorities or private parties with respect to the pipe laying including corridor to be adopted, right of way for piping, clearing of trees or plants etc in the corridor, clearance for routing piping crossing roads and railways etc.	Corrigendum II being issued.
53	PAGE 33 OF 175	4.18	Drawings of pipeline routings	Please furnish L-section drawings of pipeline routings to our civil estimation for laying of the cross country ash transport pipilines, culverts & bridges etc. for crossing roads, rail tracks, canals etc.	Soft copy furnished

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project**Pre - Bid Queries****Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-D**

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
54		4.18	-	Please let us have L-Section drawing for disposal line as same has not been received with Tender specification . Please provide the details of corridor for pipe routing, culverts, pipe bridges, etc. as required for present unit of 1X660 MW, Bhusawal.	Soft copy furnished
55	PAGE 34 OF 175	4.20.6	Cranes	For the ash handling system water pump house, BA slurry pump house electrically operated travelling underslung crane can be adopted. Please confirm.	Over head crane shall be provided
56	PAGE 35 OF 175	4.21.10	HCSD- Emergency flushing pump	Since standby HCSD pump is also provided, the same pump could be used for emergency flushing. In such a case separate emergency flushing pumps are not required. Please confirm.	Bid Specification Prevail
57	PAGE 35 OF 175	4.21.12	HCSD piping	Please review and clarify the last sentence related to the piping design consideration.	Pipeline shall be ASTM schedule 80 thickness 15.09 mm
58	PAGE 38 OF 175	4.30	Ash properties	Carrying out rheology test and submission of results during the bid stage is practically difficult due to time required, collection of appropriate sample (coal and ash properties for the proposed plant may be different from the existing plant). So it will be done after contract award. Kindly confirm.	Confirmed

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-D

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
59	PAGE 39 OF 175	5.0 (g)	Design of ash handling plant shall be carried out considering following ash generation rates(% of Total ash) with worst coal at 100% PLF : - BA generation/shift: 25% of total ash -FA generation/Shift : 90% total ash ash & APH ash : 10% total ash	We will consider the following ash generation rates (% of Total ash) with worst coal for the design of ash handling plant in our offer as per general practice: - BA generation/shift: 20% of total ash -FA generation/Shift : 85% total ash -Eco, APH & duct ash : 10% total ash Please confirm your acceptance.	Bid Specification Prevail
60		5.1.3. (b)	Velocities considered in pipe for various duties...	Minimum velocity of HCSD pipeline shall be decided based on the fly ash rheology test. Please confirm.	Bid Specification Prevail
61	Pg No. 42 of 175	5.1.5	capacity Slurry sump (each compartment)	As per Industry practice, we have considered effective storage capacity of ash slurry sump as 5 minute of maximum slurry disposal pumping capacity. Please confirm.	Bid Specification Prevail
62		5.3.5	Lift of Hoists and cranes shall be minimum two times the tallest equipment in the room.	Lift of crane and hoist will be decided based on type of overhauling the component (from top or side) required as per building layout. Please confirm.	Bid Specification Prevail
63	PAGE 34 OF 175	5.4.1 & 5.5.1	System Capacity	Please clarify whether we have to design the capacity of BA & FA streams based on our Boiler & ESP ash generated data and numbers of hours for evacuation. otherwise we have to follow the tender specs which states the capacities of each stream of BA as 90TPH & FA as 40 TPH .	Bid Specification Prevail

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-D

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
64		5.4.1 (b), 5.4.2 (a), 10.4	-	As per technical specification, ash slurry pump shall operate for 2 hr 40 min excluding flushing time. Please advise how to handle other area sludge (ETP area, SSF area and AHP tube settler sludge) coming to ash slurry sump.	Time specified is meant for evacuation of bottom ash per shift(8 hours).
65	Page No. 75 of 175	5.4.3	Capacity of feeder ejector/jet pump is 30 TPH.	As the Ash distribution for APH and economiser hoppers ash vary as per boiler vendor input, please note that capacity of feeder ejector/jet pump shall be selected such that complete coarse ash can be evacuated to coarse ash tank. Hence capacity of the feeder ejector/jet pump shall be selected during detail engineering. Please confirm.	Bid Specification Prevail

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-D

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
66	Page 47 of 175	5.6.2 & 6.17.4 & 5.5.3	-	a) As per this clause, the capacity of HCSD system should be 300 TPH. The fly ash collection rate considering 90% as fly ash comes out to 165 TPH. The HCSD system are recommended to be operated on continuous basis and if run it for intermittent operation then the purpose of HCSD is defeated because it will be operated for 4 to 4.5 hrs. in a shift and line has to be flushed after its operation. So, there is no point of having higher capacity HCSD system and it should be in the range of 180-185 TPH only. So, please review and clarify. b) There is a contradiction between Cl. No. 6.17.4 and HCSD evacuation time with respect to 300 TPH capacity. HCSD pump shall not run continuously as per suggested system design. Please advise.	Bid Specification Prevail
67		5.6.2	-	Total static height has been mentioned as 60 Mtrs for Head calculation of slurry Pumping. We also find that Main plant area is 206.5 Mtrs & HCSD Area is 206.5 Mtr and Ash pond area RL is also mentioned as 281 Mtrs on Page 166 of 177. Please advise static lift to be considered separately for (1) BA Slurry system (2) HCSD System indicating difference in Grade level and Dyke height.	Please refer reply to Sr.no 15

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-D

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
68	Pg. 49 of 175	5.7.3	Two Dosing Screws, one with each independent HCSD system stream ...	Fluidized conveyor may please be allowed as an option to dosing screws. Please confirm.	Bid Specification Prevail
69		5.7.6 & 6.18.7(C & Datasheet-A, Sr. No. 23.4, 24.7	These pumps shall be provided with variable speed drive/mechanism to achieve pumping rate variation of 10% to 100% of full flow.	HCSD pump operating range from 10% to 100% of full flow is not a technically viable feature. Operating range shall be selected based on minimum velocity criteria. Please confirm.	Bid Specification Prevail
70		5.7.8, 4.5, 4.1.12, 3.8.1	-	Ash pond recovery system has been excluded from bidder's scope of work. Request to provide following information for 1X660 MW Unit. Tapping shall be taken from this recovery water line coming to existing plant by bidder and required support structures shall be under scope of bidder as per Cl. No. 4.5 of tender specification. Owner is requested to provide following inputs to us. i) Please confirm the flow rate, terminal pressure and pipe size of recovery water line to be considered from tapping point of recover water line to be considered for tube settler sizing. ii) Recovery booster pumps, sumps and buildings after terminal point of ash recovery water pipe has been excluded from bidder's scope of work. Please confirm.	a) Please refer reply to serial no:26 b)Confirmed

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-D

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
71	PAGE 49 OF 175	5.8.3	Average evaluated sound pressure levels shall be within 85 dB (A) measured at a distance of one (1) m from the equipment concerned as per Noise Rating Curve ISO 85.	We assume that this mentioned ISO --85 requirement about equipment noise level relates to the noise rating curve NR85. But this type of noise rating curve is actually no longer used by the noise measurement standards to characterize the noise emissions of industrial machines, or the occupational noise exposure level of the Employees. As per clarification about Section 4 - Clause 17.2.1 of the Master Specifications (Vol. II) regarding Noise Level Requirement, the relevant standard for determination of near field noise levels shall be ISO 3746:2010.	Shall not exceed 85 dB(A) 1.0 m equipment outline.
72		6.7.3 & 4.3.1 h) & Datasheet-A 12.5	Necessary heating arrangement with a suitable bypass shall be provided...	As per Clause No. 6.7.3 of Tender specification, all fluidising heater shall be provided to raise the fluidising air temperature at 150 °C. Please confirm.	Please refer Clause 4.3.1.(h)
73	PAGE 58 OF 175	6.12.1	Water seperators	Please clarify the requirement of water seperators and specify the quantity and location of water seperators to be considered in our offer	At every air receivers.
74		6.16.1(c)	Specially designed expansion joints shall be provided at an interval of 300M to take care of thermal expansion.	Sleeve coupling shall be provided to take care thermal expansion instead of specially designed expansion joint. Please confirm.	During Detailed Engineering

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-D

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
75		6.18.8 (c)	All the fittings shall be 3D in vertical line and 10D in horizontal lines.	All the fittings shall be provided as per vendor proven design and fly ash rheology instead of considering 10D fittings in horizontal as per cl no. 6.18.8(C of tender specification . Please confirm.	Bid Specification Prevail
76		Data sheet	Material of construction of Valves.	We will provide fly ash line valves, branch line valves, slurry line valves etc. as per the availability in terms of material of construction from atleast three vendors. Please confirm your acceptance.	Bid Specification Prevail
77		(Datasheet- A S NO.15.2, 16.2) & Cl. No. 5.5.2, 5.5.3, 4.3.1 (k), 4.4.3 (b)	-	We have considered Remote dry fly silo and HCSD silo effective storage capacity of 1300 MT as per Datasheet-A Sr.N. 15.2 & 16.2. Please confirm.	Confirmed
78		(Datasheet- A S NO. 26.2) and Cl No.4.14, 3.4.1	-	Ash water sump and ash slurry sump shall be semi over ground type. Please confirm.	Bid Specification Prevail.Net positive suction for pump and required sump draining/cleaning arrangement to ensure.
79		Data sheet- A, 16.7.2 (a), (b)	Main Header portion of each fly ash transport system (i.e. from switch valve/change over valve) to HCSD/remote silo and from HCSD silo to Remote ash silo	Fly ash pipe from ESP Hoppers to silo shall be MS pipe as per IS: 1239 & 3589. Please confirm.	Bid Specification Prevail

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-D

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
80		Data sheet-A, 20.1.2	Knife Gate:SS with stelliting to achieve hardness 600 BHN (minimum)	Knife gate material for Ash slurry line valve shall be SS with minimum 350-400 BHN hardness on wear surfaces for knife edge gate valve or carbon steel to ASTM-A-216 Gr. WCB case hardened to 400-450 (port) and BHN suitably impregnated for low friction.	Bid Specification Prevail
81			General- Ash slurry pipe route	Please provide the contour layout, if available, for the ash pipe line route (slurry pipe to dyke). Please also provide details of the existing railway lines where the ash slurry pipes have to cross.	Soft copy furnished
82		GENERAL	AUTOCAD copy of plot plan	Please furnish AUTOCAD copy of plot plan to measure the exact distance between HCSD silo & remote silo, ESP to HCSD silo etc.	Already furnished
83	General			Please furnish the contour of dyke and plot plan showing dyke area	Soft copy furnished
84		-	-	Ash dyke Drawing has not been indicated with specification. Please furnish the Cross section of the existing ash dyke area.	Soft copy furnished
85		-	Two number silos are envisaged in between ESP hoppers and remote silos.	There is a contradiction in the specification regarding no. of remote fly ash silo. Please confirm the number of remote FA silo.	One (1) no. of remote silo & Two nos. of HCSD silos

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project**Pre - Bid Queries****Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-D**

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
86				There is a contradiction for storage capacity of remote silo and HCSD silo in the technical specification. 1) 2000 m3 as per cl. No. 5.5.2 & 5.5.3 2) 1300 Ton as per DATASHEET-A, sr no. 15.2 & 16.2 3) 8 hour storage as per cl. no. 5.5.2 & 5.5.3, 4.3.1 (k), 4.3.3 (b) Please confirm the storage capacity to be considered for HCSD silo capacity and Remote fly ash storage capacity,	Capacity of silo shall be 1300 Tonnes
87		-	-	Coarse ash tank Volume shall be derived based on fly ash bulk density. Please confirm.	Bid specification prevails
88			-	We have found duplicate flow diagram for ash handling system 1) Bottom ash handling system (No. PE-189-PF-235, P1 and PE-189-PI-242, P1) 2) Fly ash disposal system (No. PE-189-PF-236, P1 and PE-189-PI-239, P1) Please advise which flow diagram to be followed.	P & I diagram shall be referred for detailed scope. Process flow diagram depicts general scheme only
89			-	Please provide the flow diagram and technical specification for ash handling tube settler/clarifier.	Refer annexure of Corrigendum-II
90				We have not received revised ash handling flow diagram for Rev-2 along with Corregendum-1. Please furnish the same.	will be furnished along with Corrigendum-II

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

RESPONSE TO PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1

VOLUME - III E 1

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III E1

S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
1	1	General		Owner may review the DM storage capacity in the plant, considering the nature of technology and requirement of flushing and cycle cleaning during every cold start-up. Recommended storage should be 4000 m3.	Bid specification prevail
2	1	2	A tapping is to be taken and water shall be by gravity	1) Since the proposed water intake is by gravity , please ensure the flowability of water on continues basis. 2) Please specify the location of tap-off point	Ensured & Basic information furnished for Detail information Bidder may visit site
3	1	2.2	Filtered water tank	Based on layout and plant grading elevation difference, we may consider above ground filtered water storage tank. Accordingly, all downstream pumps will be horizontal instead of vertical pumps. Please confirm acceptance	Bid specification prevail
4	Sec-1	2.3	Regarding capacity of DM water storage tanks	The capacity specified under this clause (1000 M ³) differs from Annexure-I of Vol:III-I, Sec-3/D, pg 211/328, where capacity specified is 850 M ³ . MahaGenco to please clarify.	DMWT : 1000 m ³ CST : 850 m ³

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PRE -BID QUERIES from Prospective Bidders

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
5	1	Clause No. 2.5, Page no. 15 of 313 & Process Flow diagram (PE-189-PF-227).	CHP dust suppression & Service water for CHP Equipment Cooling	We may provide water for CHP Dust Suppression & CHP equipment cooling from Clear water storage tank as an option	Till ETP is commissioned Service water shall be drawn from Service water storage tank and after Commissioning of ETP water shall be drawn from clear water storage tank.
6	1	3.1.1 (i)	Dumpers for sludge disposal	It is suggested that dumpers be excluded from bidder's scope. This can be arranged by Owner at operation stage.	Bid specification prevail
7	1	3.5.3, page 19 of 313 and 4.8 para 3 page 232 of 313	Three (3X50%) clear water transfer pumps. These pumps shall supply clear water -----,horticulture / Gardening.	Pl.clarify the location where clear water is required to be terminated for horticulture / Gardening.	To be taken up during detailing
8	1	Clause No. 4.5. Page no. 20 of 313	Raw water storage tank	We noticed that minimum capacity indicated as 48000 is very low as compared to estimated plant water requirement (almost 1.5 times). Hence, we request you to consider plant water requirement of 1 days excluding ash water. We may provide raw water tank above grade. Please furnish pressure and pipe elevation at terminal point.	Bid specification prevail

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
9	1	ADDENDUM-I, PAGE 3 OF 54	The distance for the exiting raw water pump house to the 1 x 660 mw unit is approximately 3 km.	Please furnish 3 KM stretch survey map indicating the pipe corridor, road crossing details - culverts & bridges, etc.	ADDITIONAL WATER SOURCING as per Addendum -I is deleted from the scope , hence not appilcable.
10	1	ADDENDUM-I, PAGE 3 OF 54	Non-operational pump to be replaced by one of new pumps. Further space for installing one additional pump is also available in pump house. Thus 2 nos. of (1W+1SB) can be accommodated in pump house.	Please provide existing pump datasheet. Please provide GA of Pump house for better understanding about available space.	ADDITIONAL WATER SOURCING as per Addendum -I is deleted from the scope , hence not appilcable.
11	2	1	System description: Capacity of DM plant is 2x100cu.m/hr with 1 stream in operation during normal condition. Output between regeneration of SAC, SBA is 20hrs with output of 2000cu.m/day	As indicated above, we suggest RO with EDI system with 3x50% operation and producing a net output of 2000cu.m/day.	Bid specification prevail

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
12	2	Clause No. 1.1 & (Datasheet A, Clause No. 3.2.3), Page no. 27 of 313 and clause 5.4.3	Capacity for DM & Non-DM : Gravity Filters	In Clause No. 1.1 capacity is mentioned as 50 m ³ /hr For DM chain & 2000 m ³ /hr for NON DM Chain & in Datasheet A, Clause No. 3.2.3 capacity is mentioned as 100 m ³ /hr For Dm chain & 1800 m ³ /hr for NON DM Chain. In Guarantee parameter clause 5.4.3, it is indicated as 1800 m ³ /hr and 50 m ³ /hr respectively. Please clarify capacity for DM & Non-DM Chain.	Gravity Filters : 2 x 100% & cap. of 100 m ³ /hr each For DM chain & Gravity Filters : 9 Nos (8 W + 1 S) & cap. Of 250 m ³ /hr each for Non DM
13	2	1.1, para 4	PT plant	We understand solids contact clarifiers are to be provided and not clarifloculator.	Bid specification prevail
14	2 2	19 2.0	Gravity filter Acitvated Carbon filter (ACF)	We suggest Ultra filtration (UF) (submerged) system (2x50%) in place of Gravity filters & ACF for DM water treatment. UF system has the following advantages: 1. Consistent outlet water quality (SDI) 2. Can handle wide variation in feed water TSS. Can operate even when Clarifier system is down. 3. Easy operation with less manual intervention. Owner is requested to review and change the specification accordingly	Bid specification prevail

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
15	2	2.1.1, pg 28 of 313	Two (2) Raw water header pipes of suitable length complete with all accessories.	As per dwg. No. PE-189-PI-249, Rev P0, only one pipe has been indicated. Please clarify.	Two (2) Raw water header pipes of suitable length complete with all accessories.
16	2	Clause No. 2.1.24 & (Datasheet A, Clause No. 20.1), Page no. 30 of 313 & Page no. 45 of 313	Air blower for gravity filter	There is discrepancy in the no. of air blowers (4 Nos. or 2 Nos.) in the mentioned clauses. Please clarify.	it shall be 4 nos i.e. (1 W +1 SB) for DM & (1 W +1 SB) for Non DM
17	2	2.1.27, pg 30 of 313	Two independent flow control station for DM & Non DM at Gravity filter outlet	As water from Gravity filter will flow to FWST by gravity hence flow control station will not be required. Kindly delete the same from scope of supply.	Bid specification prevail
18	2	3.1.9, pg 32 of 313 19.1, pg 64 of 313	Two (2) Gravity filters shall be installed for DM & Non-DM respectively. NUMBER OF UNITS: Nine (Eight as working + one standby) for Non-DM; Two (2 x 100 %) for DM	Please clarify the number of gravity filters that is to be considered for Non-DM.	Gravity Filters : 2 x 100% & cap. of 100 m ³ /hr each For DM chain & Gravity Filters : 9 Nos (8 W + 1 SB) & cap. Of 250 m ³ /hr each for Non DM

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
19	2	19.7, pg 66 of 313	Characteristics of Media: 19.7.4 Effective size, mm: Around 0.45 19.7.5 Uniformity Coefficient: 1.6 - 1.65 19.7.6 Silica % (minimum): 90	Please clarify which clause is to be followed for quality of filter sand.	(b) Effective size shall be 0.45 to 0.7 mm. (c) Uniformity co-efficient shall not be more than 1.7 nor less than 1.3 (f) Silica content shall be not less than 99.8%.
	2	3.1.9, pg 33 of 313	(b) Effective size shall be 0.45 to 0.7 mm. (c) Uniformity co-efficient shall not be more than 1.7 nor less than 1.3 (f) Silica content shall be not less than 99.8%.		
20	2	12.2.1, pg 55 of 313	Type of Pump: Positive displacement and hydraulic diaphragm type with stroke adjustment.	As per the datasheet the alum solution Injection Pumps are positive displacement type whereas they are centrifugal type as per the dwg no. PE-189-PI-249, Rev P0. Please clarify the type of pump to be considered.	Type of Pump: Positive displacement and hydraulic diaphragm type with stroke adjustment.

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
21	2	18.2.1, pg 62 of 313	Type of Pump: Positive displacement and hydraulic diaphragm type with stroke adjustment.	As per the datasheet the Poly electrolyte dosing Pumps are positive displacement type whereas they are centrifugal type as per the dwg no. PE-189-PI-249, Rev P0. Please clarify the type of pump to be considered.	Type of Pump: Positive displacement and hydraulic diaphragm type with stroke adjustment.
22	2	19.6.2, pg 65 of 313	Bed depth of media, mm: Min 750 for sand, Min 450 for Gravel	As per the clause no.3.1.9 (of Volume III E1, Section-2, pg 33 of 313), the depth of gravel in filter bed shall not be less than 50 cm. Please clarify the min. depth of gravel in filter bed to be considered.	Bed depth of media, mm: Min 750 for sand, Min 450 for Gravel
23	2	19.8.4, pg 66 of 313	Backwash system shall be designed for maximum attainable temperature. Velocity shall not be less than 35 m/hr, when air scouring is employed.	As per cl. No. 3.1.9 (of Volume III E1, Section-2, pg 33 of 313), Backwash velocity for filter mentioned is not less than 30m /hr. Please clarify the velocity to be considered for backwash purpose.	35 m/hr
24	2	annexure -1, analysis of raw water, page 41 of 313	TDS - 870 PPM	It is to note that the TDS of the raw water is 870 pp. For such a higher TDS water normally RO based DM plant is recommended. Pl.review and confirm.	Bid specification prevail

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
25	2	annexure -1, analysis of raw water, page 41 of 313	Turbidity (NTU) - 100 ppm during non - monsoon up to 10,000 during monsoon.	It is noted that a very wide variation for turbidity value (100 to 10,000 ppm) has been indicated in the raw water analysis. customer is requested to furnish the design value of suspended solids for designing of clarifier system.	Clariflocculator shall be designed considering TSS : ≤ 2000 ppm Centrifuge & Thickener shall be designed considering TSS : 1000 ppm
26	2	1.1 para 5 and 19.2.1 gravity filters	Gravity filters for DM and non - DM flow rate indicative of 50 m ³ /hr and 2000 m ³ /hr. respectively. Net continuous normal service flow rate, m ³ /hr 1800 and 100 for non-DM and DM.	Net continuous service flow rate for non-DM and DM gravity filters are not matching in the referred clauses. Please clarify.	Gravity Filters : 2 x 100% & cap. of 100 m ³ /hr each For DM chain & Gravity Filters : 9 Nos (8 W + 1 SB) & cap. Of 250 m ³ /hr each for Non DM
27	2	Annexure-1	Not Available	Please furnish the following Raw water parameters currently mentioned as "Not Available": TSS, Carbonates, Boron, Oil&Grease.	Bid specification prevail
28	2	Annexure-1	Analysis of Raw water: Organic matter as KMnO ₄ : 50ppm	Kindly provide us the TOC, BOD & COD values since the organic matter as KMnO ₄ present in Raw water is 50ppm.	Bid specification prevail
29	2	Annexure-1	Analysis of Raw water: Turbidity (NTU): 100 during non-monsoon & 10000 during monsoon	Kindly provide us the Total Suspended solids (TSS) values corresponding to the non-monsoon & monsoon period for requirement / design of clarifier system.	Bid specification prevail

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
30	2	Annexure-1	Water analysis	We note that the TDS of raw water is 870 ppm (Conductivity 1300 microS/cm). For this TDS the ion exchange type DM plant will not be an optimal solution due to high regeneration chemical requirements. It is suggested to provide RO followed by MB unit for this application considering the high TDS. Please review.	Bid specification prevail
31	2	Annexure-1	Water analysis	Please indicate the design turbidity for the clarifier. The value indicated for monsoon is too high and not applied for design.	Bid specification prevail

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
32	2	Annexure-1 2.0	Analysis of Raw water: Raw water TDS: 870ppm Colloidal Silica < 1ppm Scope of supply & services: Conventional PT & DM plant (Gravity filters, ACF, SAC, Degasser, SBA, MB of 2x100% capacity)	1. For the given Raw water TDS and prescence of colloidal silica ~1ppm, Conventional DM plant (as per Tender) will not be an effective functional solution for producing DM make-up water. 2. Removal of colloidal silica requires membrane based (UF system) treatment system. 3. Also resin & chemical consumption will also be high due to high ionic load. 4. We suggest membrane based treatment plant (Reverse Osmosis (RO) with Electro DeIonisation (EDI) system) with 3x50% capacity (2working & 1 standby streams). 5. EDI has the advantage of continuous operation without any regeneration, compact, fully automatic. Also no separate regeneration is required, hence no chemical consumption for regeneration and regeneration waste generation. Owner is requested to review and change the specifiation to membrane based treatment plant (Reverse Osmosis (RO) with Electro DeIonisation (EDI) system), in place of the conventional plant presently specified.	Bid specification prevail

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
33	2	Annexure-1 7.0	TDS = 870 ppm	Cation & Anion mentioned in the Raw water analysis as 585 ppm each, therefore TDS should be around 1170 ppm. Please clarify.	Bid specification prevail
34	2	Ann. I, Clause No. 13.0, Page no. 41 of 313	Analysis of Raw Water - Turbidity	Clarifier and pre-treatment plant equipment will be designed for 100 NTU turbidity. Increased turbidity during monsoon will be considered as off design case only. Further, thickener & centrifuge will be designed based on 500 ppm inlet load at Clarifier. Please confirm.	Please refer reply to sr.no:25
35	2	Datasheet A, Clause No. 4.0 & 5.0, Page no. 46 of 313	Flash Mixer & Clariflocculator	As per clause no. 4.0, detail of Flash mixer is mentioned whereas in Clause no. 5.0 detail of Draft tube is specified. The bidder may also consider HRSCC clarifier for Removal of TSS. HRSCC will be designed for surface flow rate in clarification zone of $2.5 \text{ m}^3/\text{hr}/\text{m}^2$ and maximum residence time in clarification zone as 100 min. Please confirm acceptance.	Flash Mixer & Clariflocculator shall be considered
36	2	Datasheet A, Clause No.12.0, 16.0 & 18.0, Page no. 54, 60, 62 of 313	Dosing Pump for DM & Non-DM Stream	We suggest two (2) Different working dosing pumps for DM & Non-DM Chain for better control of dosing.	agreed, it shall be 2 nos (1 W+1S) for DM & 2 nos (1 W+1S) for Non DM

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
37	2	Datasheet A, Clause No.19.0, Page no. 64 of 313	Gravity Filter	We suggest deletion of Gravity filter for Non-DM Stream. We will supply clarify water for CT Make up and service water. Potable water will be passed through a separate Dual media filter.	Bid specification prevail
38	3	Clause No.1.1, Page no. 75 of 313 Clause No.29.2.4, Page no. 160 of 313	Neutralization Pit, each compartment capable to hold regeneration effluent generated from one (1) complete chains plus 20% margin. ...capacity of each compartment... Suitable to hold effluent generated from two (2) nos.complete chains +20% margin	We shall follow Clause No. 1.1 for effective capacity to be considered for each compartment of DM plant Neutralization pit. Please confirm acceptance.	Agreed
39	3	Clause No.1.2 E, Page no. 75 of 313 As per cl. No.3.3.14	Bed depth of inert resin : 100mm Bed depth of inert resin : 150mm	Please clarify bed depth of inert resin to be considered.	100mm
40	3	Clause no. 5.0, Page no. 78 & 106 of 313	DG Air Blower	As per datasheet, quantity of DG Blower is Two (2) Nos & as per specification, quantity of DG Blower is Three (3) (2 W + 1 S) nos. Please clarify scope of supply for the same.	DG Blowers shall be Two nos. (2) (1 W + 1 S) & scope as per spec

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
41	3	Clause no. 6.0, Page no. 109 of 313	DG water storage tank	As per specification, minimum capacity indicated as 250 m3 seems to be on the higher side for stream capacity of 100 cum/hr. As per industry practice, standby tank is not required. Please review and clarify.	agreed & Tank qty shall be 2 Nos as per spec & tank cap shall be 120 m ³ each.
42	4	1.3.2 (a), pg 199 of 313	SULPHURIC ACID DAY TANKS Type: Vertical cylindrical with <i>dished ends</i> .	As per the P&ID (Dwg n. PE-189-PI-244, SH 2 of 2, Rev P0), Sulphuric Acid day tanks are vertical cylindrical with flat bottom. Please Clarify.	Vertical cylindrical with dished ends.
43	4	1.5.2 (a), pg 203 of 313	SCALE INHIBITOR TANKS Type: Vertical cylindrical with <i>dished bottom</i> .	As per the P&ID (Dwg n. PE-189-PI-244, SH 2 of 2, Rev P0), Scale Inhibitor tanks are vertical cylindrical with flat bottom. Please Clarify.	Vertical cylindrical with dished ends.
44	4	1.7.2 (a), pg 208 of 313	CORROSION INHIBITOR TANKS Type: Vertical cylindrical with <i>dished bottom</i> .	As per the P&ID (Dwg n. PE-189-PI-244, SH 2 of 2, Rev P0), Corrosion Inhibitor tanks are vertical cylindrical with flat bottom. Please Clarify.	Vertical cylindrical with dished ends.
45	4	1.9.2 (a), pg 212 of 313	BIOCIDE STORAGE TANKS Type: Vertical cylindrical with <i>dished bottom</i> .	As per the P&ID (Dwg n. PE-189-PI-244, SH 2 of 2, Rev P0), Biocide Storage tanks are vertical cylindrical with flat bottom. Please Clarify.	Vertical cylindrical with dished ends.

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
46	4	2.1.1, pg 216 of 313	AUTOMATIC VALVELESS GRAVITY FILTERS Number: Eight (8) (Seven working + One standby)	As per this clause only one (1) filter shall be standby where as per the clause no.1.2.9 [of Volume III E1, Section-4, pg 171 of 313], it is stated that minimum two (2) modules shall be standby. Please clarify.	AUTOMATIC VALVELESS GRAVITY FILTERS Number: Eight (8) (Seven working + One standby) each of cap 250 m ³ /hr.
47	4	3.12, pg 183 of 313	The chemical injection pumps shall be positive displacement, simplex, constant speed, variable stroke plunger operated reciprocating type...	As per the P&ID (Dwg n. PE-189-PI-244, SH 2 of 2, Rev P0), all chemical injection pumps are centrifugal. Please clarify the type of chemical injection pumps to be considered.	The chemical injection pumps shall be positive displacement, simplex, constant speed, variable stroke plunger operated reciprocating type.
48	4	Ann. A, Page no. 193 of 313	Cycle of Concentration	Due to high Non-Colloidal Silica (36 ppm), we suggest to consider COC as 4. Please check and confirm COC to be adopted.	Bid specification prevail
49	5	Section -5/1.0	The Bidder shall design and develop the Waste Water management scheme thereof, adopting the philosophy of 100% recycling of treated effluent for a "Zero Discharge" concept of management.	In order to meet zero discharge from ETP, RO plant will be required. As RO plant is not mentioned in specification, we will design the effluent treatment plant re-using water to the maximum possible extent. Please review and confirm.	Bid specification prevail

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
50	5	2	Environmental stipulation	Please note that , to comply effluent to EPA 1986 SECTION VI , post treatment system is also required which is not envisaged in tender . Please review the requirement of this clause.	Bid specification prevail
51	5	3.1.1	(b) Maximum permissible noise level in (i) Control rooms a. back-ground noise level 50 dB (A) b. speech interference level 40 dB (A) (ii) other control areas, where person-to-person or telephonic conversation is required : a. back-ground noise level 65 dB (A) b. speech interference level 55 dB (A)	By background noise level, we understand the one caused by all the permanent noise sources radiating inside the room (i.e. HVAC equipment, ventilation of computers and electrical cabinets, ...), but excluding the intermittent noise emissions due to alarms, conversations, phone rings, printing operations. In this regard, ALSTOM guarantees only the respective limit values of 50 dB(A) and 65 dB(A) for the background noise level in the Main Control Room & the one in Other Control Areas unequipped with machinery, considering that it is sufficient to ensure a good intelligibility of the speech, without the need of additional guarantees in terms of speech interference levels.	Bid specification prevail

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
52	5	3.1.1	(b) Maximum permissible noise level in (iii) other rooms/building where various plant and equipment are housed: 85 dB (A)	For other rooms/buildings where various plant and equipment are housed, the applicable near field noise guarantee is actually the one stated in the clarification about Section 4 - Clause 17.2.1 of the Master Specifications (Vol. II) regarding Noise Level Requirement, namely a maximum surface sound pressure level of 85 dB(A) at 1 m distance from the equipment, when averaged over the measurement surface in accordance with standard ISO 3746-2010, at a distance of 1 m from the equipment outlines, and at a height of 1.5 m above the floor or walkways level.	Bid specification prevail
53	5	Clause 4.3 page 229 of 313	Backwash waste from side stream filtration:- Suspended solids at inlet :- 500 ppm (max.)	As per preliminary estimation, TSS in backwash waste is approximately 1000 ppm.	Tender spec shall prevail

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
54	5	Clause 4.5 (d) page 231 of 313 Clause 5.4.3 (a)-(iii) page no. 312 of 313	Oily waste:- Suspended solids in treated water= 50mg/l. Suspended Solids not to exceed 20 ppm	We shall provide Oily Water separator to maintain suspended solids in treated water as 50 ppm as per Cl. No. 4.5. Please confirm.	Suspended Solids not to exceed 20 ppm
55	5	Clause 4.6 page 232 of 313 & Clause 5.4.3 (b)-(i) page no. 312 of 313 Datasheet A 4.2.2 (C), Page no. 266 of 313	Coal pile run-off water quantity :- 400 m3/hr Effective capacity :- Capacity shall be adequate based on 100 m3/hr inlet flow (rain intensity 1hr peak rainfall shall be considered.)	We have considered 150 m3/hr capacity based on coal pile area of 300 m X 50 m X 2nos. and peak rainfall for 1 day as 0.1122 m (as per climatological table). Please confirm.	Capacity shall be adequate based on 100 m3/hr inlet flow (rain intensity 1hr peak rainfall shall be considered.)
56	5	4.7, pg 232 of 313	 This effluent shall be collected in neutralization pit for DM Plant & CPU and located near DM plant & Boiler area....	Please clarify whether the N-pit shall be common for DM Plant & CPU or separate.	Dedicated N.Pit for DM Plant & CPU

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
57	5	4.8 & Datasheet A 13.0, Page no. 228 of 313	1) Central monitoring basin waste treatment & recycling system:- From Stilling chamber, water shall be directed to one (1) no. Distribution chamber through.... 2). 13.0 Flash mixer	As per description in clause 4.8 and P&ID PE-189-PI-250, distribution chamber is shown but in datasheet A 13.0, Flash mixer data is mentioned. We suggest to use distribution chamber and HRSCC (High rate solid contact clarifier) with draft tube (See 14.2.4). Please confirm acceptance.	agreed but there shall be no distribution chamber & Clariflocculator shall be Solids contact type.
58	5	Datasheet A 4.2.2 (C), Page no. 266 of 313	Coal partical settling basin:- Effective capacity :- Capacity shall be adequate based on 100 m3/hr inlet flow (rain intensity 1hr peak rainfall shall be considered.)	We have considered 150 m3/hr capacity based on 1hr. Peak rainfall as given coal pile area is 300 m X 50 m X 2nos. and peak rainfall for 1 day is 0.1122 m. (as per climatological table).	Capacity shall be adequate based on 100 m3/hr inlet flow (rain intensity 1hr peak rainfall shall be considered.)
59	5	Clause 5.4.3 (a)-(i) page no. 312 of 313 Datasheet A 3.5 (b) Oil water separator :-	Oil water separator :- The unit shall have rated output capacity not less than 100 m3/hr (net). Rated output capacity, m3/hr. :- 50 (Net)	Please clarify the output capacity of oil water separator.	Rated output capacity, m3/hr. :- 50 (Net)

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Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III E1

S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
60	5	Clause 6.0 (c)(xiii), Page no. 241 of 313 & P&ID PE-189-PI-250 (Volume_VII A2)	CPI sludge sump:- One (1) CPI sludge sump (With two compartments) complete with all accessories.	We shall provide single compartment as shown in P&ID PE-189-PI-250. Please confirm.	CPI sludge sump:- One (1) CPI sludge sump (With two compartments) complete with all accessories.
61	5	7.1.11, page 246 of 313	The tubes / plates shall be inclined by 50 to 600 angle to the horizontal--- -	The tube plate shall be inclined by 50 to 60 degree angle to the horizontal. It appears to be a typographical error. Pl.confirm.	Confirmed
62	5	Datasheet A 1.1.1 (C), Page no. 251 of 313	Backwash waste from side stream filtration:- Flow rate at inlet (Indicative) :- 300m3/hr	By considering 10 min backwash time and 30 m/hr velocity flow rate at inlet is 215 m3.Please confirm.	To be taken up during detailing
63	5	Datasheet A 3.8.2 (a), Page no. 263 of 313 P&ID PE-189-PI-250 (Volume_VII A2)	Oily water separator treated effluent transfer pump:- Type :- Screw type Type:-Diaphragm	Please clarify the type of oily effluent transfer pump.	Type :- Screw type

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III E1

S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
64		4.6	Water hammer analysis	Water hammer analysis (transient analysis) is applied only for the CW piping. For other piping this is not applicable. Please confirm.	Bid specification prevail
65		4.6.1 to 4.6.5	Accessories	We understand that this is a general clause and is not applicable for all the systems. Some of the items referred here are not applicable for all the systems; example quick closing power packed check valve is not applicable for any of the system, anti vacuum valve is used in the CW system only. Isolating butterfly valves is not provided for cross country piping. Please review and confirm.	Bid specification prevail

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

RESPONSE TO PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1

VOLUME - III E 2

BHUSAVAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III E2

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
1	1	2.1.11	Two (2) Self-cleaning strainers in ACW discharge header, upstream of Plate Type Heat Exchanger & Recirculation line in ACW system	Recirculation line for these pumps are not required.	Spec prevails
2	1	2.1.2	CW pumps: Concrete volute	Concrete volute is not warranted for the water quality specified. For the specified water in circulation, conventional casing material (CI) with wet pit arrangement can be used. This being EPC contract the Bidder may be allowed to select concrete volute or vertical turbine pump with metal casing.	Spec prevails
3	1	2.1.2	Concrete Volute Casing, Dry Pit Type Condenser Cooling Water Pumps	Vertical turbine pumps are suited for flow ranges between 20,00-50,000 m ³ /hr and the flow for present application falls in this range .Hence, we will be offering Vertical wet well type metallic casing CWP with Bell mouth, impeller and pump casing/diffuser construction. Such pumps have been supplied for numerous projects for 500/660/800 MW projects.Customer is requested to consider vertical wet well type metallic CWP also for this application.	Spec prevails

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III E2

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
4	1	2.1.2	Concrete Volute Casing, Dry Pit Type Condenser Cooling Water Pumps	Vertical turbine pumps are suited for flow ranges between 20,00-50,000 m ³ /hr and the flow for present application falls in this range .Hence we will be offering Vertical wet well type metallic casing CWP with Bell mouth, impeller and pump casing/diffuser construction.Such pumps have been supplied for numerous projects for 500/660/800 MW projects. MahaGenco is requested to consider vertical wet well type metallic CWP also for this application.	Spec prevails
5	1	2.1.4	Independent CW & ACW return lines shall be provided for taking out hot water to NDCT	We propose that ACW return lines will be merged with CW return header and single header will be provided upto the NDCT. Please confirm.	Bid spec prevails
6	1	2.1.4	Independent ACW & CW return lines shall be provided for taking out hot water to NDCT.	Please note that ACW return line shall be connected to CW outlet pipes near condenser as per standard practise. There is no need of separate lines of CW & ACW system upto cooling tower.Pl.confirm.	Bid spec prevails
7	1	3.1.5	The design flow of ACW shall be determined based on heat load of all equipments forming power plant unit loaded up to 15% margin	Please note that design flow with 15% margin is not desired. This will increase in the size, cost and Aux power consumption of ACW pumps without any advantage. Design flow rate shall be actual flow requirement based on heat load of equipment. However margin of 10% shall be provided on the pump capacity. Pl.confirm.	Bid spec prevails

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III E2

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
8	1	3.1.6 (b), pg 16 of 113 3.2.2 (b), pg 19 of 113 3.4.3, pg 21 of 113	Total dynamic head : A minimum of 10% margin on frictional losses assuming C = 120 on Hazen and William's Formula for design purposes based on respective pumping capacity as obtained above. Total dynamic head: A minimum of ten (10) % margin over frictional losses based on pumping capacity as obtained in (a) above. The total dynamic head of each Cycle Make-up pump shall be sized by the Bidder considering a minimum of ten (10) % margin over and above the total frictional losses based on pump capacity as guided above.	10% margin on frictional losses on actual required flow will be taken for selecting pump TDH. Please confirm the same.	Bid spec prevails
9	1	3.1.9	shall be suitably stiffened to withstand soil loads and loads due to heavy vehicles at road crossings.	Thickness of pipe shall be selected based on AWWA M11 guidelines for soil loads. At road/rail crossings pipelines shall be concrete encased to take care of loads due to heavy vehicles.	Specification is self-explanatory.
10	1	3.1.11 (C)	Each individual sump in the CW Pump house shall be designed in accordance with the recommendations specified in Hydraulic Institute/British Hydraulic Research Association/equivalent international standard and its dimensions shall be finally selected after conducting necessary sump model tests by the Bidder.	CW Pump Sump shall be designed based on manufacturer's recommendation. This shall be later verified by sump model and pump model tests as there is no specific HIS for concrete Volute pumps. HIS 9.8 is not applicable for concrete Volute pumps. Concrete volute pumps shall be as per manufacturers design. Please confirm.	Spec prevails

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III E2

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
11	1	3.1.11 (g)	Sump gates shall be accessible from pump house overhead crane.	Screens and stop log gates to be provided at CW/ACW pump bay cannot be accessed by pump house overhead crane. Separate hoists will be provided for accessing the same. Please confirm our understanding.	Agreed.
12	1	3.2.1	Bidder shall ensure that the average temperature rise of DMCW is limited to 5.5 Deg C under all circumstances.	It may not feasible to restrict average temperature rise to 5.5 Deg C because of various coolers in SG and TG circuits of PHE. Hence, the heat exchangers shall be designed with a Terminal Temperature Difference (TTD) of 3 Deg C (max). The outlet temperature of cooling water on the secondary circuit shall in no case exceed the design outlet temperature of C.W. in condenser.	Bid spec prevails
13	1	3.2.1	 A minimum of 20 % margin shall be considered over and above the total required flow and heat load to compute the design DMCW flow and design heat load respectively in the closed circuit.	Margin shall be 20% over the design heat load only.	Agreed.
14	1	3.2.1	The required flow in this system.....A minimum of 20% margin shall be considered over and above the total required flow and heat load to compute design DMCW flow and design heat load respectively.	Please note that design flow with 20% margin on flow and 20% margin on heat load is not desired. This will increase in the size, cost and Aux power consumption of DMCW pumps, piping, PHE's etc. Design flow rate shall be actual flow requirement based on heat load of equipment. However margin of 10% shall be provided on the pump capacity.Pl.confirm.	Margin shall be 20% over the design heat load only.

BHUSAVAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III E2

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
15	1	3.2.1	The required flow in this system.....In computing the design heat load and design DMCW flow in individual system, bidder shall ensure that the average temprature rise of DMCW is limited to 5.5 degC under all circumstances.	Please note that by limiting the temperature rise to 5.5°C, DMCW flow will increase. This will cause increase in the size, cost and auxiliary power consumption of DMCW Pumps and DMCW circuit piping without any advantage to system. Hence DMCW temp rise shall be maintained as per system requirement viz. 7.6 degC for TG and 7.4 degC for SG PHE's .Pl.confirm.	Bid spec prevails
16	1	3.2.1	A minimum of 20 % margin shall be considered over and above the total required flow and heat load to compute the design DMCW flow and design heat load respectively in the closed circuit.	Margin on flow and heatload shall be as per bidders standard practice.	Margin shall be 20% over the design heat load only.
17	1	3.2.3	...All DMCW piping in the discharge of DMCW pumps shall be sized for a velocity not exceeding 2 m/sec under all circumstances.	Please allow us to consider velocity upto 2.5 m/s for piping at pump discharge.	Bid spec prevails
18	1	3.2.5	The capacity of the make up tank shall be adequate to provide a minimum of one (1) hour storage capacity in between the maximum and minimum operating levels based on the make up demand.	It is not possible to establish the make up tank capacity from the criteria specified. We propose to have a single tank of capacity 10 Cub. M for the DMCW make up. Please confirm.	Will be evaluated after recepit of detailed scheme by bidder.
19	1	3.3.2	Regarding capacity of Boiler Fill Pump - capable of filling up boiler and deaerator in one (1) hour	The capacity should be adequate to fill boiler OR deaerator in maximum TWO (2) hours (higher of the two). Please confirm.	Agreed
20	1	3.3.3	All piping in the discharge side of the BF pumps shall be sized for a velocity not exceeding 2 m/sec under any circumstances.	We request you to allow using velocity upto 2.5 m/s for pump discharge. As such this pump will be operational during start-up only.	Agreed

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III E2

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
21	1	3.4.2	The capacity to be delivered by the Cycle Make-up Pumps shall be assessed by the Bidder as per the following guideline : $Q_p = M \times [E1 \times Q_{BMCR} + E2 \times Q_{DMCW}]$ Where Q_p = Total Design Flow Rate (m³/hr) in Cycle Make Up Pumps E1 = Make-up % of Boiler Maximum Continuous Rating (BMCR) flow rate to be taken as Three (3) % (minimum). Q_{BMCR} = BMCR flow rate in m³/hr. E2 = Make-up % of total flow rate in DMCW system, shall be taken as one (3) % (minimum). Q_{DMCW} = Design DMCW flow rate in m³/hr. M = Margin over and above the required capacity to be delivered by the Cycle Make-up pumps, to be taken as five (5) % (minimum).	The capacity of cycle make-up pumps shall be assessed as per the formula indicated in this clause, however E1 i.e. Make-up % of Boiler Maximum Continuous Rating (BMCR) flow rate to be taken as one (1) % as cycle is designed for 1% only. And E2 i.e. Make-up % of total flow rate in DMCW system, shall be taken as one (1) %. Please confirm.	1%
22	1	3.4.2	Make-up % of Boiler Maximum Continuous Rating (BMCR) flow rate to be taken as Three (3) % (minimum).	For supercritical boilers boiler blowdown is not envisaged so 3 % make up is very high. Makeup shall be as per OEM's std practice.	1%
23	1	3.4.4	All piping in the discharge side of the Cycle Make-up pumps shall be sized for a velocity not exceeding 2 m/sec under any circumstances.	Velocity upto 2.5 m/s for piping at pump discharge may please be allowed.	Bid spec prevails
24	2	20	MOC for Pumps:- a) Casing-ASTM A296 Gr. CF8M b) Casing liner- ASTM A296 Gr. CF8M c) Diffuser-ASTM A296 Gr. CF8M.....	The specified ASTM code A296 does not exist. The MOC for casing, casing liner shall be to ASTM A 351 CF8M. Diffuser are not applicable as these pumps are with volute casing. Pl.confirm.	MOC for all components shall be compatible with A 351 CF8M

BHUSAVAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III E2

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
25	3A	5.11.2 (c), pg 56 of 113	Pump shaft input power required considering overloading of the pump assuming single pump operation in the event of tripping of the other pump(s) operating in parallel.	In the scope of work, ACW pumps are 2x100% configuration (no parallel operation is envisaged). Please clarify.	Agreed
26	3A	Technical Datasheet Vertical Pump- ACW pumps cl. No. 16.10	Suction Specific speed shall be limited to 9000 US units	Suction specific speed (based on NPSH required) may please be allowed upto 12000 US units. Please confirm.	Spec Prevails
27	3B	2.1.2	Concrete Volute Casing, Dry Pit Type Condenser Cooling Water Pumps	Vertical turbine pumps are suited for flow ranges between 20,00-50,000 m ³ /hr and the flow for present application falls in this range .Hence, we will be offering Vertical wet well type metallic casing CWP with Bell mouth, impeller and pump casing/diffuser construction. Such pumps have been supplied for numerous projects for 500/660/800 MW projects.Customer is requested to consider vertical wet well type metallic CWP also for this application.	Spec Prevails

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III E2

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
28	3B	2.1.2	Concrete Volute Casing, Dry Pit Type Condenser Cooling Water Pumps	Vertical turbine pumps are suited for flow ranges between 20,00-50,000 m ³ /hr and the flow for present application falls in this range .Hence we will be offering Vertical wet well type metallic casing CWP with Bell mouth, impeller and pump casing/diffuser construction.Such pumps have been supplied for numerous projects for 500/660/800 MW projects. MahaGenco is requested to consider vertical wet well type metallic CWP also for this application.	Spec Prevails
29	3B	5.1.5	The maximum closed valve head shall not be greater than 15% of the rated head including tolerance, to prevent over-pressurisation of the concrete volute	The maximum closed valve head shall be based on manufacturer's design for Concrete volute Pump. Please confirm.	Will be evaluated after receipt of detailed scheme by bidder.
30	3B	5.1.8	Pumps shall be suitable for sustained running against a closed discharge valve for upto 15 minutes without adversely affecting their life and performance.	This shall be based on manufacturer's design for Concrete Volute Pump considering the allowable temperature rise. Please confirm.	Will be evaluated after receipt of detailed scheme by bidder.
31	3B	5.1.12	Pump efficiency	Please clarify the clause. As this is EPC contract this provision may not be applicable.	Specification is self explanatory

BHUSAVAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III E2

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
32	4	4.4.1	The required heat load shall be computed by obtaining the summation of the maximum permissible heat loads encountered in the respective operating coolers of Boiler and TG Islands which shall be cooled by DMCW system. A minimum of 20 % margin over and above the total required heat load as obtained above shall be taken into account by the Bidder to work out the design heat load rejected by DMCW system and to be picked up by ACW system for the same.	As per cl. 3.2.1 Volume-III-E2, Section-II, the margin on heat load and flow is specified as 20 %. And as per this cl. 4.4.1 of Volume-III-E2, Section-4 the margin is specified as 20 % on heat load. We shall consider only 20% margin overheat load of DMCW system. Pumps and PHE shall be selected based on this criteria. Please confirm.	Margin shall be 20% over the design heat load only.
33	4	5.4	Bidder to work out. However ACW temprature rise not to exceed 5.5 degC	Please note that by limiting the temperature rise to 5.5°C, DMCW flow will increase. This will cause increase in the size, cost and auxiliary power consumption of DMCW Pumps and DMCW circuit piping without any advantage to system. Hence DMCW temp rise shall be maintained as per system requirement viz. 7.6 degC for TG and 7.4 degC for SG PHE's .Pl.confirm.	Bid spec prevails

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III E2

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
34	4	Annexure I cl. No. 2.1	All pressure retaining parts (e.g. Casing, Bowl Assembly, Discharge Head, Column Pipes etc.) shall be Hydrostatically tested at 200% of Pump Rated Head or at 150% of Shut-off head, whichever is higher, for at least 30 minutes. No leakage or pressure drop is allowed	All pressure retaining parts (e.g. Casing, Bowl Assembly, Discharge Head, Column Pipes etc.) shall be Hydrostatically tested at 200% of Pump Rated Head or at 150% of Shut-off head, whichever is higher, for at least 10 minutes. No leakage or pressure drop is allowed.	All Test/ inspection related points shall be reviewed during bid evaluation upon comprehensive review of bidder's test and inspection plan.
35	4	Datasheet A, Sr.no. 5.3, inlet temperature of water Sr. no. 5.4, outlet temperature of water	DMCW side- Bidder to work out. However, DMCW system temperature rise not to exceed 5.5 C. ACW side- Bidder to work out. However, ACW system temperature rise not to exceed 5.5 C.	The heat exchangers shall be designed with a Terminal Temperature Difference (TTD) of 3 Deg C (max). The outlet temperature of cooling water on the secondary circuit shall in no case exceed the design outlet temperature of C.W. in condenser.	Bid spec prevails
36	4	Datasheet A, Sr.no. 6.1, Design Standard	Design standard of Heat exchanger shall be ASME Section III & Section VIII / equivalent	Design standard of Heat exchanger shall be ASME Section VIII / equivalent	Agreed.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

RESPONSE TO PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1

VOLUME - III F

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III F

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
1	1	2.0	All the piping systems supplied shall be designed to operate without replacement and with normal maintenance for a plant service life of 30 years and shall withstand to the maximum sustained load.	We would like to clarify that piping systems shall be designed as per ASME B 31.1 & IBR. These codes do not explicitly specify service life. Please accept.	Bid Specification prevails.
2	1	4.1.1 (i)	Line drains from Main Steam, Hot Reheat, Cold Reheat, L.P. bypass & high pressure (above 40 kg/cm²) extraction lines shall be provided with double isolation valves in series for each branch - each located at the two extreme ties of the line drain route. The valve near the condenser shall be motorised one. High pressure drains (above 40 kg/cm²) shall have two valves in series and that near the condenser or flash box shall be motor operated and arranged to open and close to ensure minimum wear on one valve.	HP extraction lines shall be routed to flash tank instead of condenser with a control valve and isolation valve in the upstream of the control valve in each line placing both the valves near to the receiver (flash tank).	Bid Specification prevails.
3	1	Power Cycle Piping-Scope of Services	4.2.5. Preparation of detailed fabrication drawings (isometric) of shop fabricated piping which are of size 50 mm NB and above should be based on the "Released for Construction" drawings pertaining to power cycle piping layout prepared by the Contractor.	Preparation of detailed fabrication drawings (isometric) of shop fabricated piping which are of size 65 mm NB and above should be based on the "Released for Construction" drawings pertaining to power cycle piping layout prepared by the Contractor.	Bid Specification prevails.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III F

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
4	1	Power Cycle Piping-Scope of Services	4.2.7. The Contractor shall furnish separate sketches for each support, restraint, anchor, snubber, dampers etc.	The Contractor shall furnish separate sketches for each support, restraint, anchor, snubber, dampers etc. for size 65 mm NB above. For 50mm and below, only typical sketches will be furnished.	Bid Specification prevails.
5	1	Power Cycle Piping-Scope of Services	4.2.16. Drawing indicating the layout of pipe work shall be prepared in line with the flow diagrams and shall be provided as part of the Contract. Those drawings shall indicate the position of all supports, guides, restraints and anchors; all drain and vent connections and the position of all pipes. All piping systems shall be arranged to allow adequate falls in the direction of flow, except where otherwise approved by the engineer. At the points of drainage, drain pockets of ample size and approved construction shall be fitted as per details indicated in the enclosed drawings.	Piping layout drawings can not be a part of Contract because those activities can be done in detail design stage. Piping layout drawings can not indicate hanger and supports position due to lack of space. Location and type of all supports, guides, restraints and anchor will be shown in Isometrics. All steam piping systems will be arranged to allow adequate falls in the direction of flow.	Bid Specification prevails.
6	1	5.2.5	Isometric drawings of piping for flexibility analysis	There will not be any separate stress isometrics submitted. The isometrics submitted for construction will also be having the stress related data.	Bid Specification prevails.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT**PRE -BID QUERIES from Prospective Bidders****Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III F**

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
7	1	7.0(Annexure-I)	7.0 Extraction line from MS equalising line: From MS equalising line to auxiliary steam header	We understand that the tap off for Auxiliary steam header from MS line is required when there is no steam available for cold start-up of the plant. As unit interconnection is provided for supplying steam to and from the adjacent unit of this plant, this tapping will not be required and hence the same will not be provided.	Bid Specification prevails.
8	1	Power Cycle Piping- Design and Construction	7.1.2. The Boiler feed discharge pipe-work shall be designed for the maximum final feed water temperature and the shut-off pressure of the boiler feed pump	Boiler Feed discharge pipe line upstream of feed control station shall be designed for hot shut off head of BFP. Boiler Feed discharge pipe line downstream of feed control station shall be designed for maximum pressure expected at Steam generator (economizer) and not for BFP shut off head. Feed control station shall be located upstream of HP heaters.	Agreed.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT**PRE -BID QUERIES from Prospective Bidders****Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III F**

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
9	1	7.1.2 (last para)	Regarding design pressure for boiler feed discharge pipe.	Feed Control Station shall be provided on the upstream side of HP heaters and there shall be no isolation valve on feed water discharge header to boiler. Piping downstream of feed control station shall be designed for the maximum pressure expected from SG side. This is as per the standard practice followed for supercritical power plants and is in line with IBR requirement. However, the piping upstream of feed control station shall be designed for BFP hot shut-off at minimum recirculation flow. Please confirm.	Confirm
10	1	7.1.2 c	Feed water Discharge velocity : 3-6 m/s	As per the standard practice, velocity can be upto 7 m/s for feed water discharge piping.	Bid Specification prevails.
11	1	7.1.4	Pipes shall not be less than 20 mm bore unless authorised by the Engineer.	As per volume-II,Sec-4,clause no.4.1.10(b),page no-74, all vent piping shall be of 15 NB minimum,which is contradicting with this clause.kindly clarify that below 20mm bore pipe can be use or not.	Clause not applicable for vent and drains

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III F

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
12	1	Power Cycle Piping-Fabrication	7.3. Except where otherwise specified all piping shall have butt-welded connections with a minimum of flanged joints necessary for maintenance.	Except where otherwise specified, pipes of size 65 mm NB and above shall have butt-welded connections and of size 50 mm NB and below shall have socket-welded connection with a minimum of flanged joints necessary for maintenance.	Bid Specification prevails.
13	1	Power Cycle Piping-Fabrication	7.3.1. Support attachments for major piping shall be done at shop.	Support attachments for critical piping shall be done at shop.	Bid Specification prevails.
14	1	7.3.4	Mitred bends and elbows will not be accepted unless otherwise specified	For larger diameter pipes like Flash tank vent and BFPT Exhaust duct, only mitred bends shall be provided.	Bid Specification prevails.
15	1	- 7.3.8	Throughout section-1 of Volume. IIIF, 50NB piping is included in large bore piping. For Ex. Pipes of size 50 NB and above shall be shop fabricated and of size 40 NB and below shall be field run.	Pipes size 50NB and below shall be treated as small bore piping and above 50NB shall be treated as small bore piping and accordingly all the clauses of the specification are applicable. Deviation against the example mentioned: Pipe of sizes above 50NB shall be shop fabricated and sizes 50NB and below shall be field run .	Bid Specification prevails.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III F

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
16	1	Power Cycle Piping- Hangers, Supports, Anchors and Restraints	7.4.5. For Variable Spring : a) The variation in supporting effort between hot and cold condition does not exceed 25% of the load, which is higher of the operating condition and cold setting load. c) Thermal deflection between hot & cold conditions does not exceed 40 mm.	Thermal deflection limit of 40 mm for variable spring is too strict. Then Bidder would like to delete deflection limit since load variability limit has been specified as 25%.	Bid Specification prevails.
17	1	7.4.8	Owner shall provide only the main steel work or embedded plates in the concrete.	Since it is a full EPC project so we presume that these all are in bidder scope. Owner is requested to clarify his scope of supply for full plant.	Bidders understanding is correct.
18	1	7.5.1.1	Control station configuration for continuous & Intermittent requirements	Bypass for control valve stations will only be provided where ever it is necessary from process point of view. Further this requirement will not be applicable for ON-OFF type control valves	Specification is self- explanatory

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
19	1	7.5.1.1	Regarding configuration of control stations	In line with standard practice followed the following configuration is suggested: i) control valve in the bypass of main control valve is not required, except main condensate control valve. ii) motorised isolation valve shall be provided on the upstream of only low load feed control valve, i.e. high pressure service. All other control valves shall have manual isolation valve on the upstream. iii) Drain valve shall be provided at the upstream or downstream of control valve as per layout requirement. iv) motor operated inching type regulating valve is not required even for some intermittent services like CEP minimum recirculation, alternate drains of heaters etc. v) Motorised valve in the bypass of control valve need not have isolation valves on the upstream and downstream. Please confirm.	Will be evaluated after receipt of detailed scheme by bidder on a case to case basis.
20	1	7.5.1.4	All valves shall, unless otherwise approved, have ends prepared for butt-welding and the internal diameter shall be the same as the internal diameter of the pipes to be joined.	Except the control valves, All valves shall be the same internal diameter as the internal diameter of the pipes to be joined. Kindly clarify.	Agreed.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
21	1	7.5.1.9	Valves in general shall preferably be of such design as to permit repacking while in service by providing back seating arrangement duly tested during manufacture.	Control valves will not be provided with back seating arrangements as maintenance of control valves is not possible during operation.	Agreed.
22	1	7.5.1.11	Valves requiring sealing water shall be equipped with lantern ring to admit pressurised water for gland-sealing.	Garloc packing may also be used as an alternative.	Bid Specification prevails.
23	1	7.5.1.13	All regulating valves shall be designed to prevent erosion of the valve plugs and seats when the valves are operated partially opened. The valves shall have contoured plug.	Regulating valves may also have cage type of plugs depending on the valve suppliers and hence the same shall be finalised during detail engineering.	Bid Specification prevails.
24	1	Power Cycle Piping- Valves and Accessories	7.5.1.19. All valves shall be fitted with indicators so that it may be readily seen whether the valves are open or shut.	For valves NB 50mm and below, indicator is not provided because of small lift.	Agreed.
25	1	7.5.1.22	Each valve hand wheel shall be fitted with a circular nameplate of approved material indicating the valve tag number, duty or service intended and the function of the valve.	Name plate shall be of rectangular and fitted on to the valve only.	Agreed.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
26	1	7.5.1.23 4.5.1(r)	Wherever practicable, heavy valves of total weight including actuator, drive motor, integral by-pass etc. equal to or greater than 500 kg shall be provided with suitable lugs to permit direct suspension by hanger rods or direct resting on bottom support, as applicable.	No valve will be provided with any of the supporting attachment. Weight of the inline components will suitably be supported from the piping which is in turn supported from supporting arrangements. The valves having very long actuator (Approx. 2-3M) oriented in horizontal direction may have supporting arrangements for supporting the actuator only.	Bid Specification prevails.
27	1	Power Cycle Piping-Valves and Accessories	7.5.1.28. All sampling and root valves shall be of integral body bonnet type.	Optionally Sampling and root valves can be of the pressure-seal bonnet type.	Bid Specification prevails.
28	1	7.5.2.8.(a) 4.5.1.h(i)	Motor operated valves shall be fitted with both hand and motor operating gears and where a by-pass valve is provided, this also shall be provided with both hand and motor operated gear and interlock to ensure that the by-pass valve is opened before the main valves Bypass valves for larger gate valves.	Valves intended for inching duty shall not be provided with integral bypass/bypass valves. Though the main valve is of motor operated, manual bypass valve will be provided, if sufficient/required.	Bid Specification prevails.
29	1	8.1.10	Line drains from Main Steam, Hot Reheat, Cold Reheat, L.P. bypass & high pressure (above 40 kg/cm ²) extraction lines shall be provided with double isolation valves in series for each branch - each located at the two extreme ties of the line drain route. The valve near the condenser shall be motorised one. High pressure drains (above 40 kg/cm ²) shall have two valves in series and that near the condenser or flash box shall be motor operated and arranged to open and close to ensure minimum wear on one valve.	HP extraction lines shall be routed to flash tank instead of condenser with a control valve and isolation valve in the upstream of the control valve in each line placing both the valves near to the receiver (flash tank).	Bid Specification prevails.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
30	1	8.1.10	Low-pressure drains shall have steam traps of an approved design complete with strainers, isolating valves and by-pass valves. Low-pressure drains shall have an isolating valve at the point of take-off from the pipe or vessel to be drained or as near as possible for convenient operation.	No low pressure drain shall be provided with by-pass valves. Also instead of provided two isolation valves low pressure drains will be provided with control valves and isolation valves in the upstream and downstream of the control valve placing all the valves near to the receiver.	Bid Specification prevails.
31	1	8.1.10, para 2	Regarding non return valve in high pressure drain lines	All drains shall be sequenced as per their pressure. Which prevents the possibility of any backflow. Therefore, non return valve in drain lines is not required. Please confirm.	Bid Specification prevails.
32	1	9.0(Annexure-I) 37.0(Annexure-I)	Extraction from BFP discharge: 1. Between BFP discharge and H.P. By-pass 2. Between BFP discharge and PRDS All extraction from Main Feed Water line: (a) To Auxiliary Steam pressure reducing de-superheating station (c) HP By-pass spray	1) Spray line for HP Bypass will be taken from BFP interstate (intermediate discharge) instead of from BFP discharge as per normal practice. 2) With reference to explanation given in Sr. No. 19 above (Main steam) pressure reducing desuper heating station is not required and hence the piping between BFP discharge and PRDS shall not be provided.	Bid Specification prevails.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
33	1	Annexure-II/Material of Construction for Piping & Fitting & Valves	Forged valves for small bore piping (Pipe size less than or equal to 50NB)	Cast steel valves can also be considered based on applicability to the system	Bid Specification prevails.
34	1	Annexure-II 1.1.2, 1.1.3, 1.1.4 1.2.2, 1.2.3, 1.2.4 1.3.2, 1.3.3, 1.3.4 2.2, 2.3, 2.4 3.2, 3.3, 3.4	Elbows / Reducer / Tees /Caps For Size ≤ 40 NB For Size ≥ 50 NB Flange For Size ≤ 40 NB For Size ≥ 50 NB Valve For Size ≤ 40 NB For Size ≥ 50 NB	Our understanding is as follows: Elbows / Reducer / Tees /Caps For Size ≤ 50 NB For Size > 50 NB Flange For Size ≤ 50 NB For Size > 50 NB Valve For Size ≤ 50 NB For Size > 50 NB Please clarify	Bid Specification prevails.
35	2	2.1.17	ANSI B-36.10 : Steel pipes thickness	ANSI B-36.10 :Steel Pipes Dimension.	Agreed.
36	2	4.1.1(a)(ii)	Water-Pump discharge /distribution Below 200 NB -1.8 m/s 200-400 NB -2.2 m/s	As recommended in CRANE handbook, fluid velocity up to 2.5 m/s is permit for general purpose water services for these sizes of pipes, kindly clarify.	Bid Specification prevails.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
37	2	4.1.9	Unless otherwise specified, all pipe work shall be suitable for a minimum pressure of 10.0 kg/cm ² (g) at 80°C or as required by the design of the different piping system, if higher.	All pipe work shall be suitable for minimum pressure of 10kg/cm ² at 60 °C or as required by the design of the different piping system. kindly clarify.	Bid Specification prevails.
38	2	4.1.10	Drain Pipe work (a) Low pressure drains shall have an isolating valve at the point of take-off from the pipe or vessel to be drained, or as near as possible for conventional operation (b) Unless otherwise stated, all drain piping shall be of 25 NB minimum and all vent piping shall be of 15 NB minimum. For pipes up to 40 NB, pipe wall thickness shall be as per schedule 80 of ANSI B36.10. (c) Unless otherwise stated, wherever a main or branch of any pipeline is terminated with a valve, such terminal valve shall be provided with a blank flange/blanking cap at the free end.	As per bidder's standard practice, thickness of the pipe will be selected as per process parameters in drain lines. Please confirm acceptance of bidder's standard practice.	Specification is self- explanatory
39	2	4.1.13	HFO oil line shall be traced by steam tracers.	Please clarify if electrical tracing is permitted.	Bid Specification prevails.
40	2	4.5.1(h)	Gate valves, in addition shall be provided with following extra features (i) Bypass valve for larger valves	Please clarify the meaning of larger valves.	≥Class 600 : 200 NB and larger Class 300 and 150 : 350 NB and larger

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
41	2	4.5.1.h(i)	Motor operated valves shall be fitted with both hand and motor operating gears and where a by-pass valve is provided, this also shall be provided with both hand and motor operated gear and interlock to ensure that the by-pass valve is opened before the main valves Bypass valves for larger gate valves.	Valves intended for inching duty shall not be provided with integral bypass/bypass valves. Though the main valve is of motor operated, manual bypass valve will be provided, if sufficient/required.	Bid Specification prevails.
42	2	4.5.1.(r)	Wherever practicable, heavy valves of total weight including actuator, drive motor, integral by-pass etc. equal to or greater than 500 kg shall be provided with suitable lugs to permit direct suspension by hanger rods or direct resting on bottom support, as applicable.	No valve will be provided with any of the supporting attachment. Weight of the inline components will suitably be supported from the piping which is in turn supported from supporting arrangements. The valves having very long actuator (Approx. 2-3M) oriented in horizontal direction may have supporting arrangements for supporting the actuator only.	Bid Specification prevails.
43	2	5.9 (d)	Overhead piping shall have a minimum overhead clearance of 4 meters above walkways and working areas and 6 meters above roadways unless otherwise approved by the Engineer. Inside TG hall, headroom clearance for piping should be minimum 2 metres.	As per volume-II,Sec-4,clause no.6.2.5,page no-71 headroom can be 3 meters in outlaying area. And volume-II,Sec-4,clause no.6.2.5,page no-70 headroom shall be 7metre for all road/rail crossing.kindly clarify.	Clause 6.2.5 , Vol II shall prevail.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
44	2	Annexure-I	Specification of pipes for different purposes	Water quality for DMCW system for TG&SG Aux.'s is passivated Demineralised cooling water. Pipe material for same shall be Carbon steel IS-1239 (Heavy Grade) for pipe size upto and including 150NB & carbon steel as per IS:2062, Gr-B rolled and welded conforming to IS:3589 for pipe size of 200NB and above. Pl.confirm.	It is clarified that piping for passivated DMCW shall be ASTM A 106

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
45	2	Specification of Pipes for Different Services (piping materials)	Piping material for various services such as DM water, Instrument air and service air, clarified water, DMCW & drinking water.	Following piping material is proposed: DM water system - The SS material will be used. Inst. air & Drinking water system - IS 1239 (Gal) heavy of ERW construction will be used for sizes upto NB150 and beyond NB150 the pipe material will be IS 3589 (galvanized). The joint will be of screwed connection. Service air, Clarified water & DMCW system - IS1239 (black) heavy of ERW construction will be used for sizes upto NB150. Beyond NB150 the material will be IS 3589. The joint will be of welded connection. The fitting material will be compatible with piping material. Please confirm.	Bid Specification prevails.
46	3	3.2.1	The expansion joints will be used on C.W. Pipes at inlet and outlet of condenser and at CW pump suction to absorb relative movement between C.W. Pipes and respective equipment.	CW pumps are vertical turbine type pumps. It does not required expansion joint in suction.kindly clarify	Agreed.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
47	3	4.1.4	All flanged tees and blank flanges for tapping water supply from these pipelines to meet the necessity of Owner's other equipment are included. All materials required for the same shall be supplied.	Owner is requested to provide specific requirement for his other equipment clearly. So bidder provide the tapping for the same.	Bidder shall review the terminal points and provide as deemed necessary.
48	3	Data sheet for butterfly valves	Material of construction of body/disc	We request you to accept alternative material of fabricated steel (IS 2062) for the large butterfly valves.	Agreed.
49	4	1.1.2	(a) Design ambient temperature 45°C	Design ambient temperature should be kept at 40°C. Otherwise, there is excessive/impractical increase in Insulation Thicknesses due to introduction of thickness calculation clause as per ASTM C 680 & high ambient temperature of 45°C. The combined effect of both the stipulations will result in very high insulation thicknesses (of the order of 500-650mm in some cases), which will lead to highly congested piping layout and difficulty in pipe supporting.Pl.confirm.	Bid Specification prevails.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
50	4	1.12, pg 125 of 159	Insulation thickness shall be computed on the basis of the following data (g) Overall heat transfer coefficient and insulation thickness shall be calculated as per ASTM C-680-89	The tender specifies stringent data for selection of insulation like surface temperature- 60 deg C, Ambient temperature- 45 deg C, wind velocity- 0.25m/s> over and above this if the heat transfer coefficient and insulation thickness are calculated as per ASTM C680, this will result in very large insulation thicknesses and pose severe problems in layout of piping especially in TG Hall as found from our experience. Hence the heat transfer coefficient and insulation thickness may be allowed to be calculated as per the conventional Langmuir equations instead of ASTM C680 for the selection criteria mentioned in the tender.	Bid Specification prevails.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
51	4	1.1.2	(e) Surface Wind Velocity = 0.25m/sec	Surface Wind Velocity should be kept as, not less than, 0.5m/sec (inside TG building) & 1m/sec (outside TG building). Otherwise, there is excessive/impractical increase in Insulation Thicknesses due to computation as per ASTM C 680 & low Wind Velocity of 0.25m/sec. This combined with high ambient temperature of 45°C will result in very high insulation thicknesses (of the order of 650-700mm in some cases), which will lead to highly congested piping layout and great difficulty in pipe supporting. Pl.confirm.	Bid Specification prevails.
52	4	Thermal Insulation	3.1.1 Thermal insulating Materials -preformed bonded mineral wool sections, bonded mineral wool mattresses, loose mineral wool and lightly resin bonded glass wool shall be provided.	For piping insulation, Rockwool will be considered as an option. Glass wool is carcinogenic in nature and thus recommended not to be used.	Bid Specification prevails.
53	4	Thermal Insulation- General Information	1.1.2. Insulation thickness shall be calculated on the basis of a) Design ambient temperature: 45 DegC e) Surface wind velocity: 0.25m/sec	Insulation thickness shall be calculated on basis of a) Design ambient temperature: 40 Deg.C, b) Surface Wind velocity=1 m/s	Bid Specification prevails.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
54	4	Thermal Insulation-Materials specification	4.9. Sheathing material for all insulated surfaces, equipments, piping etc. confirming to ASTM B 209- 1060 temper H-14 or IS 737 Gr 19000 / H2, shall be provided as per following: (a) For dia of insulated surfaces of 450 mm & above and for flat surfaces:16 SWG (c) For steam generator and ESP outer casing: 16 SWG corrugated Aluminium for SG	a) We envisage 0.914 mm thick sheet, instead of 16 SWG, due to bending limitation. c) For steam generator outer casing, 1.2 mm (18 SWG) thick corrugated Aluminium sheet is envisaged, in line with clause no. 4.9. of section-4, Volume- III F	Bid Specification prevails.
55	Annexure-A	2.1.6	All strainers shall be subjected to hydrostatic test. The test pressure shall be twice the design pressure.	All strainers will be subjected to hydrostatic test. The test pressure will be 1.5 times the design pressure.	Bid Specification prevails.
56	Annexure-A	2.1.6	All steam traps shall be subjected to hydrostatic test at twice the design pressure. IBR certification shall be furnished for all steam traps.	All steam traps shall be subjected to hydrostatic test at 1.5 times the design pressure.	Bid Specification prevails.
57	Annexure-A	2.2.1	All piping, valves and specialties after installation, shall be tested hydraulically at a pressure, one half times that of the maximum attainable pressure in the system or two (2) times the design pressure whichever is higher, to check against leak tightness.	All piping, valves and specialties after installation, will be tested hydraulically at 1.5 times the design pressure.	Agreed.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
58	Annexure-A	2.2.2	All manually operated valves/gates shall be operated throughout 100% of the travel and these should function without any trouble whatsoever.	Manually operated Valves/gates will randomly checked at site.	All Test/ inspection related points shall be reviewed and finalised during detailed engineering.
59	Annexure-A	3.0	Spark Test, Adhesion Test and Material Test for primer and enameled & Coal Tar Tapes shall be as per AWWA-C-203-91.	Spark Test, Adhesion Test and Material Test for enameled & Coal Tar Tapes shall be as per AWWA-C-203-91. Request client to withdraw this testing requirement for Primer coat. Although material Certificate shall be submitted to client for primer also.	
60	Annexure-II	pg 61 of 159	MOC for fittings, fittings and valves, pipes in power cycle piping- seamless construction	It may be noted that large diameter thin walled pipes and fittings in Power Cycle piping will not be of seamless construction due to non availability in market. As per accepted industry practice Electro fusion welded pipes meeting ASTM/ ASME standards will be used for pipe sizes of Nb 550 and above, where the design pressure and temperature are such that it calls for ASME 300 class and below for wall thickness.	

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RESPONSE TO PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1

VOLUME - III G

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
1	1	1.2.9 & 2.2	Total Six(6) air compressor (three (#) for IA Compressor and three(3) for SA system) Shall be used to cater the instrument air requirement and service air requirement of total plant except for coal handling plant , ash handling plant and coal mill reject system.	For Mill reject handling system, dedicated compressed air system for conveying / process provision shall be provided. However, instrument air for Mill reject handling system will be supplied from plant compressed air system. Please confirm.	Confirmed
2	1	2.1	Service air compressor	The requirement of service air is comparatively less. Specification calls for capacity of SA compressor same as IA compressor. So considering the above we feel that 2 nos. service air compressors are adequate. This will meet the complete station service air requirements and also provide standby capacity,	Bid specification prevail
3	1	2.3	Air dryer	The capacity of the air dryer can be the same as air compressor capacity because the capacity margins are already built into the compressor capacity	Bid specification prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
4	1	2.4	Instrument and service air receiver of capacity equal to that of each compressor capacity	Capacity of receiver shall be sized as per criterion given in clause no.4.4. However minimum receiver capacity shall be 10 m3 as mentioned in cl. No. 8.2.7 of Data sheet-A. Clause 2.4 is contradictory to clause 4.4. We propose to proceed with clause 4.4. Please confirm.	Specification is self explanatory Please refer clause no.4.1.5 Cl.no:2.4 can be read as no. of instument air /service air receivers shall be equal to no. of instrument air/service
5	1	4.15	The capacity of each Air Receiver shall be determined in accordance with----- The water filled volume of each Air Receiver shall be calculated in accordance with the guidelines or 10 m3, whichever is higher.	Nominal 10 m3 capacity for each Air Receivers (IA/SA) shall be provided. Pl.confirm.	Specification is self explanatory
6	1	6.7	COMPRESSOR CASING, ROTOR AND SHAFT etc.	Material of Construction for Air Compressor & dryer shall be as per reputed manufacturer's standard product. Kindly Confirm.	Bid specification prevail
7	1		Air drying plant of capacity (1.10 times IA compressor capacity) and number equal to that of each instrument air compressor shall be installed in order to supply moisture free instrument air.	Adequate margin while arriving at main plant compressor sizing will be taken. Additional margin for ADP for IA Compressor is not required, in view of above Air drying plant shall be of matching capacity of IA compressors shall be provided. Kindly Confirm.	Bid specification prevail
8	1	6.15.1	ADP refrigerant type	HOC type may also be considered. Owner may pl review.	Bid specification prevail
9			Compressed air system	Capacity seems to be high .	Bid specification prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
10	2	3.6 & 3.7	CW-ACW Pump House and its associated electrical room, Fuel Oil Heating & Pressurising pump house and its associated electrical room.	Control rooms of these mentioned areas shall be provided with Air-conditioning system, however Electrical rooms of these areas shall be covered under ventilation system package.Pl.confirm.	Confirmed
11	2	3.6 & 3.7	Supply Fans of Evaporative type Ventilation System shall be 2 x 50% Capacity for each Air washer unit/ <i>each Unitary Air Filtration system.</i> while Water Circulating Pumps shall be 2 x 100 % for each Air washer unit/ each Unitary Air Filtration system.	Air-washers shall be provided with 2X50% capacity supply Fans, however due to constructional constraints UAF shall have 1X100% capacity supply Fan shall be provided. Further as 100% standby UAF has been asked in the specification. Standby capacity Fans in each UAF are not required. Pl.confirm.	Bid specification prevail
12	2	3.8	Battery Charger Room	Battery charger room will be provided with Air Conditioning System. Please confirm.	Confirmed
13	2	3.15[5.1.2(e)]	Air Conditioning System Plant Rooms	Air Conditioning system plant room will be provided with Dry Ventilation System. Please confirm	Bid specification prevail
14	2	3.15 - Last Para	In order to avoid this.....in the back of mill area.	It may be noted that as per layout, mills are integral part of boiler structure and accordingly, natural ventilation will be available. Hence, there is no requirement of forced ventilation.	Bid specification prevail

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
15	2	3.16.15	Permanent store, inflammable store	For inflammable store, wall mounted exhaust fans with fire dampers shall be provided. Fans shall be of spark proof construction and with flameproof motors. For other permanent store, wall mounted exhaust air fans (not spark proof construction) without fire damper will be provided. Motors also will not be flameproof construction.	Confirmed
16	2	3.17	Other areas, which contain PLC based control requiring air conditioning system.	1) PLCs for following areas will be kept in ground floor of TG building and will be under wet ventilation system A) PLC for Condensate Polishing System B) PLC for OLTCS and Debris filter System 2) PLCs/Microprocessor panel kept in AC Plant Room will be kept in dry ventilation. PLCs shall be suitable for expected temperature.	Bid specification prevail
17	2	4.3	Air Conditioning System with <i>Water cooled Precision type Packaged Air-Conditioners / Split Air Conditioners/Window Air Conditioners</i> and associated accessories / auxiliaries for Various Control room areas of different Auxiliary Buildings, Dining room of Canteen Building.	Air Conditioning System with <i>Air- cooled Precision type Packaged Air-Conditioners / Split Air Conditioners/Window Air Conditioners</i> and associated accessories / auxiliaries for Various Control room areas of different Auxiliary Buildings, Dining room of Canteen Building shall be provided. Pl.confirm.	Bid specification prevail

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III G

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
18	2	4.1 & 4.2	Central Chilled Water Air-conditioning system	Combined Central Chilled Water Air-conditioning plant system shall be provided for Main Power house control room areas and ESP control room areas.Pl.confirm.	Bid specification prevail
19	2	4.3 & 5.2.4	Air Conditioning System Dining room of Canteen Building Water cooled.....on the total cooling load.	Precision type air conditioners will be provided only for control room in ESP Building & Control room, office & lab area of DM Plant Building.	Bid specification prevail
20	2	5.1.1	Design for AC	The DBT for summer indicated here is quite high. For design of the air conditioning and ventilation systems it is standard practice to adopt data from nearest station of ISHRAE standard. We request you to confirm the above.	Bid specification prevail
21	2	5.1.1 of AC portion and 5.2.1 of Ventilation portion.	Design ambient Conditions	Design ambient conditions for Air Conditioning System and Ventilation system for Summer are different. Generally for design of HVAC system outdoor ambient conditions are same for AC and Ventilation. We request you to clarify the same.	The parameter indicated in 5.1.1 of AC System shall prevail for design of ventilation system.
22	2	5.2.1 (d)	These condenser water pumps VFD control buildings	We request you to allow following option also for AC system of ESP cum VFD Control building: "For PAC units of ESP cum VFD control building dedicated cooling water pumps (2x100%) and cooling towers (2x100%) shall be provided."	Agreed

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PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III G

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
23	2	5.2.1 a,b,c	AC equipment	For the AC of control room area in TG building, ESP building and ESP building we recommend that a common chilling plant with 3x50% chillers can be adopted. Providing 2x100% chillers individually for these areas is not economical.	Bid specification prevail
24	3	5.2.2	All AHUs shall have standby equipment for each area. Minimum total capacity shall be 2 x 100% for each area	Considering the high equipment load in Control Room and high latent load in Service Building, capacities of Air Handling Units will be high. In view of this we request you to consider following criteria for AHU selection: 1) For Control Room : N+1, Air Handling Units (where N = no. of units required for 100 % capacity, 2) For Service Building & Other areas :Minimum total capacity shall be 2 X 60%. Owner is requested to review this criteria.	Bid specification prevails
25	2	5.2.3	Chilled water system shall use de-mineralized water,.....into the chilled water expansion tank.	Make up water for AC system will be from service water tank. Water treatment for AC system will be used in case it is found this water is not suitable for the AC System.	Bid specification prevail
26	2	5.3.1 (a) & 6.3.4	Number of air washer units	Under clause 5.3.1 (a) number of air washer unit is specified as three (3) and under clause 6.3.4 number of air washer unit is specified as four (4). Please clarify.	Number of air washer units shall be considered as minimum four(4).
27	2	6.1.7	The desired pressure shall be 8.0 kg/cm2 (g)	Pressure of make-up water shall be as per system requirement.	Bid specification prevail
28	2	6.11.3	Compressors - The out door unit consists of reciprocating type compressor which is suitable to 415 V / 3 Phase supply.	Type of compressor shall be rotary/scroll or reciprocating based on Supplier standard design.	rotary/scroll compressors are also acceptable.

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PRE -BID QUERIES from Prospective Bidders
Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III G

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
29	3	5.2.9	Air washer efficiency	Please confirm that the efficiency mentioned here is for the TG hall air washer. For unitary air washer this efficiency is not applicable.	Confirmed(90% efficiency for TG air washer) and not applicable for unitary air washer.
30	3	5.2.11	Supply air fans and/or exhaust air fans provided for ventilation of each area shall be associated with local starter panels.	All ventilation fans shall be provided with local DOL starters, viz. starters shall not be provided at respective switchgears.	Specification is self explanatory
31	3	5.2.12	All dry type transformers shall be provided with independent exhaust fans.	We shall consider Dry type transformer ventilation system as natural air ventilation "AN" in line with Volume IV-B, Section 2, Cl. 4.4. Hence, no exhaust fans will be considered.	Confirmed
32	3	Page No.-126 of 171 Clause 5.3.1b	Regarding scheme of UAF	Since capacity of UAF is below 1,00,000 CMH , we are proposing for 1 x 100% SISW centrifugal fan instead of 2 x 50 % DIDW Centrifugal fan as in the case of Air Washer.	Bid specification prevail
33	3	Page No.-133 of 171 Clause 6.1.6.1 n	Regarding MOC of Rain Protection Cowl, hoods & casing of Axial Flow Fans shall be hot dip galvanized	Rain protection cowl and hoods shall be spray galvanized / hot dip galvanized as per recommendation of fan vendor.	Bid specification prevail

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT**PRE -BID QUERIES from Prospective Bidders****Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III G**

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
34	Vol.-VII-A2	Drg. No. PE-189-PF-213 Issue- P2	Instrument Air -Receiver (Package specific air-receivers) of 5 m3, 2 m3 & 2 m3 (3 nos.)	Package specific Air-receiver of 5 m3 capacity shall be provided for IA distribution for various uses of power house areas, however Package specific Air-receiver of 2 m3 capacity (2 nos.) are not envisaged, as the quantity of Instrument air as required for Fuel Oil Heaters & its Pump house and Mill reject Handling system are very less and the same shall be provided from the above unit receiver. Pl.confirm.	Bid specification prevail
35	Vol.-VII-A2	Drg. No. PE-189-PF-214 Issue- P2	Service Air -Receiver (Package specific air-receivers) of 5 m3, 2 m3 (1 no. each).	As the service Air requirement is intermittent and very less in quantity, hence Package specific Air-receiver of 5 m3 & 2 m3 capacity, are not envisaged, however the total service air requirements shall be taken care from the main service air system. Pl.confirm.	Bid specification prevail

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RESPONSE TO PRE - BID QUERIES

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BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III H

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
1		3.1 Notes 2 and 3	Specification calls 1) Total number of hydrants in fuel oil tank area is approximately four (4). 2). Total number of water monitors in fuel oil tank area is approximately four (4).	Fuel oil tanks is a part of 2X500MW unit scope, hence the same is not applicable. Bidder will provide the fire protection system for Fuel oil transfer pump house in existing plant and 1 x 660 MW expansion. We request you to provide a terminal point of DN 150 from existing 2 x 500 MW unit ring main for Fuel oil transfer pump house fire protection needs.	TP=Near transfer pump house area.
2		3.1 (q) and Note no. 4	Hydrant system for switchyard. & Total no of Hydrant points in 400 kV switchyard area is approx 50 (fifty).	400 kV switchyard is not in the scope of EPC bidder. Please clarify the scope of fire hydrant and fire detection system for switchyard clearly.	Bid specification prevails. Hydrant points shall be provided along the periphery of the switchyard
3		3.2.2	Specification calls of HVWS For (b) DG set and Compressor room.	HVWS will be provided for DG Set fuel oil tanks, if capacity is more than 1000 Ltrs/Tank and compressor room is not hazardous area hence the same is not considered.	Bid specification prevails
4		3.3b	Spray system	The transformer rectifier units on the ESP are small size. It is not a standard practice to provide spray system for these TR sets. Please review and clarify.	Agreed. But hydrant points location shall be provided during detailing.
5		3.3 B)	Specification calls for HV Transformer Rectifier sets at ESP roof top meeting the requirement of NFPA.	The ESP roof top transformers will be dry type (non oil filled type), hence the MVWS system is not considered.	Agreed. But hydrant points location shall be provided during detailing.

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PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III H

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
6		5.4.6 & 7.10.1.1 © & 7.10.2.2	Main fire detection and alarm panels in CCR, local fire alarm panels and repeater fire alarm panel in fire station shall be integrated through dual redundant optical fibre data highway connection in ring main topology. And Number of Local fire alarm panels shall be as required and as finalised during detailed engineering. And Microprocessor based fire detection and alarm panels in CCR, AHP, CHP, Fuel oil area, WTP, ESP.	Please clarify the number of fire detection and alarm panels to be integrated through dual redundant optical fibre data highway connection in ring main topology.	Specification is self explanatory
7		Notes 2 and 3	Fuel oil area	We understand that the fuel oil area referred here is the fuel oil day tank area of the proposed 660 MW plant. For existing fuel oil area, the Bidder need not consider any hydrant or monitor. Please confirm.	Bid specification prevails
8		3.8	Specification calls for Rate of rise cum fixed temperature heat detectors shall be used for Boiler burner fronts & turbine oil tanks. Heat detectors shall be analogue addressable type.	We propose to provide QBD for turbine oil tank fire protection. Please confirm.	Confirmed
9		3.12.5	NFPA/BS guideline/codes shall be followed for fire alarm system.	In addition to the mentioned codes, we propose to include the IS Code also.	Confirmed

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PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III H

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
10	1	3.12.7	The Cable Spreader Room and Cable Vault shall be divided into a smaller risk zones. These zones shall be separated by 120 minutes rating fire barrier walls.	We have not envisaged fire barriers within the cable vault for separation of zones.	Bid specification prevails
11		3.22	Inert gas system: Specification calls for inert gas system distribution through Deluge valve.	Deluge valve is not suitable for inert gas distribution system. Hence Bidder will propose the suitable valves. Please confirm.	During Detailed Engineering
12		5.1.22 7.6.18 Data sheet (Detectors)K.In fra red flame detector. Si.No 6	Specification calls for Dual wavelength Infrared flame detectors for boiler burner fronts and turbine oil tanks.	IR flame detector works on the radiation principle, if any welding activities performed in the boiler burner area during maintained time there will be a chances of giving false alarm, Hence Bidder will propose the QBD and ROR detector in boiler burner front and QBD in Turbine oil tanks.	Bid specification prevails
13		5.2.7	Design & construction of foundation of fire water steel storage tanks mentioned above	Since there are no separate steel storage tanks for Fire water. Fire water will be taken from raw water storage tank. Please confirm.	Confirmed

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Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III H

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
14		6.1.2 k)	Specification calls for For Coal Conveyors, the Medium Velocity Spray System (MVWS System) for each zone shall consist of fusible type sprinklers capable of fusing at fixed temperature mounted on a water pipe and shall cover both forward and return belts of conveyors including hoppers and feeders etc. as per TAC requirements for sprinkler system/NFPA codes.	We will consider Medium velocity spray nozzle for coal conveyer instead of fusible type sprinklers. However for the detection purpose, LHS cable and IR detector will be provided as per specification.	Bid specification prevails
15		6.1.6 c)	Specification calls for Water velocity in Fire water pipes shall be as per TAC recommendation. However, Velocity of water through pipelines at pump suction and discharge shall be limited to 1.2 m/sec to 1.5 m/sec. and 2.1 m/sec to 2.5 m/sec respectively.	However velocity for the pipes in the ring main will be considered as per TAC.	Bid specification prevails
16		6.1.6 f)	Specification call for Cut-off gate valves shall be provided for fire ring main loop	We would like to propose the butterfly valve instead of gate valve as per TAC Cl.No 7.5.11 Note 3) for ring main loop	To be taken up during detailing.
17		6.2.3	Specification calls for Satellite Fire Alarm panels shall be strategically located in different areas of the Power Plant considering zone-wise detection.	All the areas will be covered under the fire alarm panels, hence there is no requirement of satellite fire alarm panel.	Agreed.
18		7.10.2.2	Specification calls for Microprocessor based Fire Detection and Alarm Panels in CCR, AHP, CHP, Fuel Oil Area, WTP, ESP.	Number of fire alarm panels is not clear. We will provide the fire alarm panel in CHP & Main control room building and one repeater fire alarm panel in Fire station building.	Bid specification prevails

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
19		7.12. B)	Specification calls for Drive Unit Power rating for the fire water pumps shall be selected such that it is equal to higher of the two conditions (i) 110% of the duty point power requirement. (ii) Motor input power required at 150% of the duty point capacity of pump.	Si.No ii) will be renamed as motor input power required at 150 % of rated capacity at a head of not less than 65 % of the rated head a per TAC.	Bid specification prevails
20		Data sheet (Detectors)K.In fra red detector Si.No 5	IR detector areas	Infra red detectors has not been mentioned in the data sheet, However the same will be considered in Coal conveyer areas.	Agreed.
21	1	Volume - III-C/5.12.2 Page - 61 of 245	The degree of protection of panel including transformer and rectifier unit shall be IP 62. In case the above degree of protection is not achieved for transformer & rectifier unit, then the transformer & rectifier unit shall be placed in SWGR/MCC room with IP-42 degree of protection.	It is not practically possible to achieve IP-62 degree of protection for transformer and rectifier enclosure as it requires constant ventilation. Hence we are left with the option of locating the rectifier and transformer at MCC/switchgear room. We propose to use a single panel for each ILMS which shall be located near ILMS equipment to reduce DC cables. Kindly confirm.	Specification is self explanatory
22		Corrigendum-I/Sr. No. 3	To be added: 5.1.32 Transformers of 220 KVA and above shall be Provided with Nitrogen Injection based Fire Protection System in addition to HVW Spray system.	As per standard industrial practice Transformer of above 220 MVA shall be provided with Nitrogen Injection based Fire Protection System in addition to HVW Spray system. Please confirm.	Nitrogen Injection based Fire Protection system shall be provided to Generator transformer, Station transformer and Unit Aux. Transformer (in addition to HVW Spray system.)

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RESPONSE TO PRE - BID QUERIES

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PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III I

S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
1	1/B	3.1	Scope of supply : 3.1.1 b)	In the tender technical specifications, type of passenger and passenger cum goods elevator (Conventional/ Panoramic) is not mentioned. Customer is requested to review & confirm.	Conventional.
2	1/A	Annexure-I : List of EOT Cranes Annexure-I : List of Location for monorail hoist Volume-III-E1/ Section-1/3.2.9 & 3.5.4	EOT Crane :- Filter water pump house Hoist :- Monorail hoist for water and waste water treatment system EOT Crane for Filtered water pump house, EOT Crane for Effluent water treatment	We shall consider Hoist for water and waste water treatment system. This shall include Filtered water pump house, Effluent water treatment area (central monitoring basin & clear water transfer pump house), Sludge pump house, chemical house etc. Please confirm the requirement.	Bid specification prevails

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
3	1/A	Annexure-I Sl. No. 1	Turbine hall -2 (Two)	As per Volume II, section-5, clause no 2.2 (Page no 132 of 555), two options for Generator stator lifting are given. For option (a) using turbine cranes, two cranes will be required. But for option (b) with separate lifting arrangement from outside turbine hall, only one crane is sufficient for Turbine hall. So please clarify why two cranes are mentioned in this clause if Generator stator is not lifted with tandem operation of cranes.	For simultaneous operation and maintenance
4	1-A	3.12.1 to 3.12.6	Schedule of Brakes	One(1) no. Electrohydraulic thruster (EHT) type brake along with One (1) no. DCEM type brake for each Main Hoist, Auxiliary hoist, Cross traverse, Long traverse motion shall be provided. Brake for Main Hoist (creep) and Auxiliary hoist (creep) is not applicable. Since there are no pony motors for creep speed. Customer is requested to confirm.	Bid specification prevails
5	1-A	4.1 & 4.2 of Datasheet-A	MOC of Bridge Girder : IS 2062 Gr.B MOC for other structural members : IS 2062 Gr.B	As per latest Indian standard IS:2062 (Amendment No. 1 March 2009), we are considering "Grade BR" for Bridge Girder & other structural steel members of EOT Crane. Please confirm.	Bid specification prevails

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
6	1-A	4.1.1	The Safe Working load (Y) for EOT crane shall be computed as $Y = 1.25 a$, (Where a= Weight of Single heaviest equipment expected to be handled. (Excluding Generator Stator subject to a minimum capacity of 130 Tonnes for EOT crane at TG Hall)	Nominal carrying capacity (SWL) of TG hall crane will have 5% margin over and above weight the heaviest equipment to be lifted. Further, kindly note that 5% margin has been provided in case of TG hall crane in all our earlier excuted projects of major customers .Pl.confirm.	Corrigendum - I shall prevail.
7	1-A	4.1.1 & Corrigendum - 1	The safe working load (Y) for E.O.T. cranes shall be computed as $Y = 1.25 a$ Where a = Weight of single heaviest equipment expected to be handled.	Bidder proposes crane capacity considering 25% margin on single heaviest equipment (excluding Generator Stator) . Please confirm.	Corrigendum - I shall prevail.

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
8	1-A	4.1.1	The safe working load (Y) for E.O.T. cranes shall be computed as $Y = 1.25 a$	Please note that as per relevant clause of design criteria, Motor will be oversized than actual requirement.	Corrigendum - I shall prevail.
			Where a = Weight of single heaviest equipment expected to be handled. (Excluding Generator Stator subject to a minimum capacity of 130 Tonnes for EOT crane at TG Hall)	Kindly refer below Example for 75T weight of heaviest component to be lifted :- a) Safe working load of EOT Crane will be $75 \times 1.25 = 94T$. b) As per hoist motors shall be rated to lift 125% of the design load on the hook at the rated speed, Load to be considered for motor will be $94 \times 1.25 = 117 T$ c) As per Motor ratings calculated keeping margin of at least 25% over the maximum power requirement, Motor will be safe for loading $117 \times 1.25 = 147 T$ From above Example, Please note that for handling only 75T Weight, Motor will be designed/ capable for handling 147T Load, Which is very higher side. Hence, we request you to optimize the design margin.	
		5.20.6	Motor ratings shall be calculated keeping margin of at least 25% over the maximum power requirement. Further, the hoist motors shall be rated to lift 125% of the design load on the hook at the rated speed.		

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
9	1-A	4.1.1	The safe working load (Y) for E.O.T. cranes shall be computed as $Y = 1.25 a$	Please note that as per relevant clause of design criteria, Motor will be overdesigned than actual requirement.	
		5.20.6	Where a = Weight of single heaviest equipment expected to be handled. (Excluding Generator Stator subject to a minimum capacity of 130 Tonnes for EOT crane at TG Hall) Motor ratings shall be calculated keeping margin of at least 25% over the maximum power requirement. Further, the hoist motors shall be rated to lift 125% of the design load on the hook at the rated speed.	Kindly refer below Example for 75T weight of heaviest component to be lifted :- a) Safe working load of EOT Crane will be $75 \times 1.25 = 94T$. b) As per hoist motors shall be rated to lift 125% of the design load on the hook at the rated speed, Load to be considered for motor will be $94 \times 1.25 = 117 T$ c) As per Motor ratings calculated keeping margin of at least 25% over the maximum power requirement, Motor will be safe for loading $117 \times 1.25 = 147 T$ From above Example, Please note that for handling only 75T Weight, Motor will be designed/ capable for handling 147T Load, Which is very higher side. Hence, we request you to optimize the design margin.	

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
10	1-A	4.4.1	The lifting Hooks in vertical position shall reach at least 2.5m in case of all cranes .	The requirement is not clear. Customer is requested to clarify.	The lifting hooks in vertical position should reach at least upto 5m from the end stopper in case of turbine hall cranes and upto 2.5m in case of all other cranes.
11	1-A	4.4.2	Either the main or the auxilliary hook in vertical position should reach at least upto 1.0 m for all cranes .	The requirement is not clear. Customer is requested to clarify.	Either the main or the auxiliary hook in vertical position should reach at least upto 1.5m from the runaway rails in case of turbine hall cranes and upto 1.0m for all other cranes.
12	1-A	5.12.3	The rail section shall be as per IS:3443.	Rail section as per BS:11 shall also be acceptable. Please confirm.	Bid specification prevails
13	1-A	5.13.1	The rope shall confirm to I.S. 1835, I.S. 1804 and I.S. 2266. The rope shall be parallel right hand lay having 6 x 37 constructions with hemp core.	Please note that we shall consider 6 x 36 or 6 x 37 construction wire rope with fiber/steel core as per IS:2266. Please confirm.	Bid specification prevails

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
16	1-A	5.25.2	The runway conductors shall be of M.S. angle sections, liberally sized so as not to exceed current density of 0.42 Amps/mm ² . 14 SWG M.S. sheet protection guard shall be provided for the entire routes of DSL conductors (top & bottom) with adequate structures.	We shall consider Shrouded copper type runway conductor instead of MS angle Section, due to following features of Shrouded copper type runway conductor:- 1) It is insulated and accident free. 2) It is color coded R Y B G. 3) No protection guard required. 4) No sparking-Spring loaded current collector provides pressurized electrical contact. 5) It is better resistance to atmospheric conditions. Please confirm.	Bid specification prevails
17	1-A	5.9.2 5.14.1 (c)	Gears shall be of cast or forged steel and pinions shall be forged steel and shall be machine cut. The drum gear shall be cast steel as per IS: 2707 Gr. II.	We shall consider MOC of Gears/Pinion as per Cl. No. 5.9.2. Please confirm.	Bid specification prevails
18	1-A	Annexure-I : List of EOT Cranes Volume-II/ Section-3/C/1.3.16	EOT Crane :- Maintenance Building of coal handling plant Hoist :- Maintenance Building of coal handling plant	We shall consider Hoist for Maintenance Building of coal handling plant. Please confirm the requirement.	CHP maintenance Building will have EOT crane of 5T capacity.

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S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
19	1-A	Annexure-I Sr.No. 1.0	Turbine Hall - Two (2)	As per layout requirement one (1) no. EOT Crane for TG Hall will be adequate. Please <u>review and confirm</u>	Bid specification prevails
20	1/A	Ann-1	CWPH crane	For CWPH one semigantry crane for handling stop log gates/screens is adequate. Please review.	Bid specification prevails
21	1/A 1/C	Annexure-I : List of EOT Cranes Annexure-I : List of Location for monorail hoist	EOT Crane :- Compressor hall Hoist :- Compressor house	We shall consider Hoist for compressor house. Please confirm the requirement.	Compressor house shall be provided with crane.
22	1/A 1/C	Annexure-I : List of EOT Cranes Annexure-I : List of Location for monorail hoist Volume-III-E1/ Section-1/3.1.1 (e)	EOT Crane :- Raw water Pump house Hoist :- Raw water / Fire water pump house EOT Crane :- Raw water Pump house	We shall consider Hoist for Raw Water Pump house. Please confirm the requirement.	Raw water pump shall be provided with crane whereas firewater pump house shall have electric hoist.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III I

S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
23	1-B	6.10.0	Emergency Exit	In view of practical difficulties in utilising emergency exit at the time of emergency for evacuating the passengers from car, ARD (Automatic Rescue Device) is being provided by most of the elevator manufacturers around the world. Also , the requirement of emergency exit has been removed from IS as per amendment no. 1 of IS :14665 Part-IV Section -3. In line with above reputed elevator manufacturere have discontinued the provision of emergency exit. Customer is requested to review/confirm the requirement.	Confirmed
24	1-B	Annexure-I, 2.0	Controller - IP:54	All reputed supplier provide controller with IP 21 for indoor duty. Further we propose to provide Air condition in the M/C Room, Hence IP 21 controller is adequate. Kindly confirm acceptance.	Bid specification prevails
25	1-B	Data Sheet -A	Rated Speed of Lift = 0.5M/sec	As per normal practice and previous excuted projects rated speed of the lift shall be 1.0m/s. Customer is requested to review the same and confirm.	Rated speed of Elevator=1m/sec.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III I

S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
26	1-B	Data Sheet -A	16.0 Power Supply: b) Lighting & fan inside the car.	Power supply for Lighting and fan inside the car shall be 240volts, 1 phase, 50 c /s, 2 wire system. Kindly review and confirm.	Confirmed.Power supply for Lighting and fan inside the car shall be 240volts, 1 phase, 50 c /s, 2 wire system with provision of proper earthing.
27	1-B	Data Sheet -A	17.0 Other Requirements: e) Scrolling indicator.	Pl note that hall lantern and gong are applicable only when there is a group of elevator like four (4) car groups or more car groups. For single elevator these are not required. Please review requirement & confirm.	scrolling indicator shall be prevail
28	1/B	4.7	The Elevators under this section shall be treated as "Fire Lift"	As per latest amendment of IS:14665, Passenger and goods Fire lift shall have following minimum requirement :-	Rated speed of Elevator=1m/sec.
29	1/B	Datasheet A (Elevator for steam generator, Power house building, Service building)	Suitable arrangement shall provide to intimate unit control room during emergency in the form of audio-visual alarm.	It is not possible to install audio-visual alarm in unit control room. However, audio alarm shall be provided on Ground floor / Pit of Elevator. Please confirm.	Bid specification prevails

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III I

S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
30	1/B	Datasheet A (Elevator for steam generator, Power house building, Service building) Cl No. 4.4 (Chimney)	Position of machine room :- Directly above the lift shaft/Top of hoist way.	Machine room / Gear less elevators can also be used. Please confirm.	Bid specification prevails
31	1/A 3/C	Annexure-I : List of EOT Cranes Annexure-I : List of Location for monorail hoist Volume-III-E1/ Section-1/3.2.9 & 3.5.4	EOT Crane :- Filter water pump house Hoist :- Monorail hoist for water and waste water treatment system EOT Crane for Filtered water pump house, EOT Crane for Effluent water treatment	We shall consider Hoist for water and waste water treatment system. This shall include Filtered water pump house, Effluent water treatment area (central monitoring basin & clear water transfer pump house), Sludge pump house, chemical house etc. Please confirm the requirement.	EOT Crane=Filter water pump house Hoist=Monorail hoist for water and waste water treatment system,Effluent water treatment

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT**PRE -BID QUERIES from Prospective Bidders****Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III I**

S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
32	3/D	5.0	Painting	Painting for Condensate storage tank shall be followed as per our standard practice for non coastal projects which is as follows: Internal(Surface Preparation blast clean to SA2.5)) ,Primer 1 coat of epoxy resin based zinc phosphate high build primer (2 pack), DFT50-70microns , Finish 2 coats of solvent free epoxy paint ,DFT 200 microns each, total internal DFT (450-470 microns). External (Surface Preparation Hand power/power toolcleaning/wire brushing to ST2 , primer 2 coats of red oxide zinc chromate primer (IS2074) of 25-35 microns DFT each, Finish 2 coats of synthetic enamel (IS2932) paint of 20-25 microns DFT each, total DFT 90-120 microns). Underneath (Surface preparation Blast clean to SA2.5, Primer 1 coat of high built coal tar epoxy suitably pigmented, DFT 80-100microns, Finish not applicable, total DFT 80-10 microns). Final colour of tank shall be sea green shade no. 217. Pl.confirm.	Bid specification prevails

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III I

S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
33	1/C	4.1.2 & 4.1.3 VOLUME-II/ Section-4/7.3 (Page 73 of 555)	Hoist of capacity upto 3 tones shall be manual hoist. Hoist of capacity equal and above 3 tones shall be electric hoist. Motorised lifting devices, i.e. hoists, chain pulleys, jacks, etc. shall be provided for handling and carrying out maintenance of any equipment and/or part. Suitable beams, hooks etc. for this purpose shall be provided in the Buildings.	Hoist of capacity upto 3 tonnes shall be manual hoist. Hoist of capacity equal and above 3 tones shall be electric hoist. Above criteria shall be applicable for all the hoist covered under this plant. Please confirm.	Hoists above 1T shall be electric
34	3/D	Annexure-I Schedule of Miscellaneous steel tanks (2)	Condensate Storage tank near Compressor House.	As per the present clause, one (1) no. of Condensate storage tank of 1000 m3 capacity is to be provided. However, we propose two (2) no.of Condensate storage tank of 1000 m3 capacity each that will serve the purpose of stand by during any maintenance and also during boiler cleaning and flushing operation. Please confirm.	To be taken up During detail engineering

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III I

S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
35	Annexue-A	Clause No. 8.0 Page 317 of 328	CHEMICAL LAB EQUIPMENTS: Quality checks to be carried out for chemical lab equipment shall include but not limited to following: a) Physical & chemical properties of material of construction. b) Dimensional check of all fabricated vessels as required. c) Type, routine & acceptance test of electrical items, functional test of panels.	Please delete this requirement.	Bid specification prevails
36	Section -5, Annexure - III	Cl. No. 2.0, Page 317 of 328	Name of Venodrs	Along with vendors suggested in the tender document , the Contractor shall propose vendors registered with him for supply of Chemical Lab Equipment . Please confirm that such vendors shall also be considered by MahaGenco.	Refer Volume-II clarification

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - III I

S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
37	Volume-III-I/ Section-1/A	Annexure-I : List of EOT Cranes	EOT Crane :- Fuel oil pump house, Fuel oil transfer pump house (if required)	We shall consider Hoist for Fuel oil pump house and Fuel oil transfer pump house. Please confirm the requirement.	EOT Crane=Fuel oil pump house,Fuel oil transfer pump house.
	Volume-III-I/ Section-1/C	Annexure-I : List of Location for monorail hoist	Hoist :- Fuel oil pressurising pump house, Fuel oil transferring pump house		
	Volume-III- A/ Section-3	2.15	Under slung Crane :- Fuel oil pump house		

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

RESPONSE TO PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1

VOLUME - IV A

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
1	1	1	(m) Gantry in Transformer yard.	Please refer sr. No. 2 above, as this scope is very less, related to Switchyard Package with overall engineering by Switchyard Contractor, Bidder requests client to exclude this scope.	specification prevails. (Intermediate gantry in Bidder scope)
2	1	1	(r) Lighting system for power plant area.	Bidder excludes the areas indicated in Exclusions, Volume-II, Section-3, Clause No.-3 and the areas marked as "Not in EPC scope". For Area and Street Lighting Bidder requests client to mark the Co-Ordinates in Plot Plan for Bidder's understanding.	Noted. Complete area covering the plot plan in addition all the areas wherever equipment is supplied and erected by EPC contractor.
3	1	1.1	The scope of work shall cover all the electrical works related to entire power plant generation & power evacuation, in plant power distribution, power plant lighting, cabling, grounding, lightning protection etc. for design, supply, construction, installation, testing and putting into successful commercial operation of the power plant and power evacuation electrical system on EPC basis.	We understand that the switchyard is not in bidder scope of work. Hence clarify on "electrical system for power evacuation shall be in bidder scope of work".	Bid specification prevails. The switchyard is excluded. However, all works related to the electrical system for power evacuation as mentioned in specification is in EPC contractor's scope.
	1	1.2	...electrical work along with mandatory spares, 3 years O&M spares as detailed hereinafter.	We confirm to provision of commissioning spares and start-up spares. Special tools and tackles are also considered by us as per the recommendations of the manufacturers. Mandatory spares are not included.	Bid specification prevails.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
	1	1.6(j)	(j) 400/11.5/11.5 kV Station Transformers	Bidder wishes to clarify that for a GCB scheme the Station Transformer may not be applicable.	Bid specification prevails. GCB scheme not required.
4	1	1.6	(k) 330kV Lightning Arrestors (l) 400kV Class Bus Post Insulators	HV Switchyard is excluded from Bidder's scope. LA, BPI & Tube Bus constitute very little scope related to HV Switchyard for which the Design & Engineering like Layout Plan & Elevation , Insulation Co-ordination, Equipment Selection and Supply etc. are already being done by Switchyard Contractor. In view of the above Bidder requests to exclude this from EPC Contractor's scope.	Bid specification prevails.
5	Sec-1	1.6 (l),(m)	400kV Class BPI and Gantry in Transformer Yard	400kV Class BPI for HT and ST and Gantry in Transformer Yard will be in switchyard scope as a standard scope and practice for power evacuation system. Pl.confirm.	Bid specification prevails.
6	Sec-1	1.6 (t)	Variable Frequency drives	VFD is not applicable for ID Fan. Pl.confirm	If radial fan is provided then VFD shall be applicable. Refer Corrigendum (II).
7	1	1.7.n	Electrical building/room for condensate transfer pump house	We have not envisaged separate electrical room for Condensate Transfer PH.	Separate electrical room for Condensate Transfer PH to be provided, if it is not located within the turbine building

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
8	1	1.8.1(b)	Electrical system studies by manual calculations & ETAP except load flow & transient stability study which may be done on approved software.	Bidder wishes to clarify that load flow & transient stability is done on ETAP as per currently accepted Industry Practice. Bidder requests client to allow ETAP for all Electrical Studies.	1. Load flow & transient stability study shall be done on ETAP. 2. All other studies shall be done by manual calculation. And E-Tap. Refer Corrigendum II.
9	1	1.8.1-b	Electrical system studies by manual calculations	Only ETAP system study will be done & manual calculations will not be submitted	
10	Sec-1	1.8.1(b)	Electrical system studies by manual calculations & E-Tap software except Load flow and transient stability study which may be done on approved software.	Following may please be noted with electrical system studies and sizing calculation viz software calculation and manual calculation: a. For Short Circuit levels, Voltage drops, Grounding, Relay setting, Relay co-ordination, Load flow and transient stability study will be done by E-Tap software. No manual calculation will provided for above studies.	
11	1	1.8.1(e)	Electrical layouts, showing equipment location, cable trays, cable trenches in transformer yard, overhead cable routes (cable bridge, cable trestle) etc. Only cable trenches are acceptable in Transformer yard for cable laying.	Bidder requests Customer to allow underground cable ducts as an additional option for Cabling.	Bid specification prevails. (Near transformer yard at road crossing cable duct shall be provided.)

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
12	1	2.1.1	EHV connection for Generator transformers and station transformers at Bus Post Insulator (BPI) shall be done by switchyard contractor. Balance connection from Bus Post Insulator (BPI) to LA and then LA to bushing of Generator Transformers and Station Transformer's bushing shall be arranged by power plant EPC contractor. The connector for drop conductor to BPI shall also be arranged by power plant EPC contractor. Supply of conductor and stringing of over head conductors from Power House wall to nearest intermediate gantry of 400 kV and intermediate gantry to 400 kV switchyard gantry will be done by switchyard contractor. All 330 kV Lightning Arrestors and 400kV Bus Post Insulators including connector, intermediate gantries will be supplied & Installed including Civil foundation under this power plant EPC package. Provision of hooking arrangement at A-axis wall shall be in power plant EPC package. Installation of 330 kV LA, 400kV BPI, 400kV intermediate gantry including civil foundation, grounding etc will be under the scope of power plant EPC Bidder.	Bidder requests client to exclude High Voltage Switchyard electrical items & Structures (Towers & Gentries) from EPC Contractor's scope. In Bidder's point of view, only Civil Foundations may be retained in EPC Contractor's Scope.	Bid specification prevails.
13	1	2.1.1	Terminal Point :- All 330kV Lightning Arrestors & 400kV Bus Post Insulators including connector, intermediate gantries will be supplied & installed including Civil foundation under this power plant EPC package. Provision of hooking arrangement at A-axis wall shall be in power plant EPC package.	Our scope limited to HV Bushing of GT & ST. Supply & installation of 330kV Lightning Arrestors & 400kV Bus Post Insulators including connector, intermediate gantries & Provision of hooking arrangement at A-axis wall are excluded.	Bid specification prevails.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project**Pre - Bid Queries****Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A**

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
14	Sec-1	2.1.1	EHV connection for GT and ST at BPI shall be done by switchyard contactor. Balance connection from BPI to LA and LA to bushing of GT and ST bushing shall be arranged by Plant EPC contractor. The connector for drop conductors to BPI shall also be arranged by EPC contractor. All 330kV LA and 400kV BPI including connector, intermediate gantries will be supplied and installed including civil foundation under this Power Plant EPC package.	Balance connection from BPI to LA and LA to bushing of GT and ST bushing shall be arranged by switchyard contactor as a standard practice for power evacuation system. The connector for drop conductors to BPI and all 330kV LA and 400kV BPI including connector, intermediate gantries will be supplied & installed including civil foundation by switchyard contactor as a standard practice for power evacuation system. Being a small scope this can be included in switchyard contractor scope. Pl.confirm.	Bid specification prevails.
15	Vol-IVA, Section-1	Cl. No 2.1.1, Page no 19 of 440	Intermediate 400kV Gantry	As EPC terminal point is connectors from the string line to connect the transformer bushing through BPI and LA hence the intermediate gantry (if required) shall be excluded from scope. Please confirm.	Bid specification prevails
16	1	2.1.2	The transformer yard in front of power house shall include supply and installation of all transformers, busducts, LA, BPI etc.	Bidder's understanding is that LA & BPI are part of 400kV switchyard package and need not be considered in the scope of bidder. Please confirm.	Bid specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
17	Sec-1	2.1.2 (b)	All cable trenches and tray work within power plant area & upto the 400kV Switchyard fencing/ Switchyard control room as per switchyard requirement	All cable trenches and tray work within power plant area & upto the 400kV Switchyard fencing only will be done EPC contractor. From Switchyard fencing to Switchyard control room the scope for trench and traay work will be in switchyard contractor sscope. Pl.confirm.	Refer corrigendum (II)
18	1	2.1.2 (b)	All cable Trenches and tray work within power plant area & up to the 400 kV Switchyard fencing/Switchyard Control Room as per Switchyard requirement.	We understand that civil work inside switchyard boundary is excluded from bidder scope. Hence we will consider cable trenches / trays up to switchyard boundary in bidder scope. Please confirm.	Refer corrigendum (II)
19	1	2.1.2 (b) & 2.1.2 (f (v))	All cable Trenches and tray work within power plant area & up to the 400 kV Switchyard fencing/Switchyard Control Room as per Switchyard requirement. & Earthing grid interconnection	Please share following documents: 1) Documents indicating the physical location of the switchyard control room. 2) Specific interface requirement with main plant. 3) Earthing grid co-ordinates for switchyard earth grid. 4) Kindly provide the distance/coordinates of the existing grid of 2x500 MW unit.	1. Refer above point. 2. Earthing inter connection conductor to be laid below each bay of ST & GT with switchyard grounding grid. 3. Earth grid inter connection shall be provided in suitable location. Refer Corrigendum (II) .

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
20	1	2.1.2.f.ii	"Providing necessary out going feeders as specified in Section I of Volume IV-A"	We could not find any specific usage requirement for Owner/others. In absence of anything specific, we are not considering any feeder other than that required for our purposes (including contractual spares).	1. Key SLD showing 11 kV feeders, 2 nos. for switchyard. 2. Further LT spare feeder requirement would be decided during detailed engineering.
21	Sec-1	2.1.2 (e) and Ann.-D sr. no. 3.0	Complete cabling work..... Power Plant EPC vendor shall also provide required no. of cable trays for laying HT Cable, LT Power and Control and all other cables for interfacing with 400kV Switchyard	Required no. of Cable Trays and Cabling material(excluding Cables) from Switchyard fencing and upto Switchyard control Room/ MB and switchyard equipment will be in switchyard contractor scope. Pl.confirm.	Refer Corrigendum (II) Annex.D,Table-1
	1	2.1.2.e	Complete cabling work including inter connection between 400kV switchyard and respective control room required for interfacing with power plant and 400kV switchyard. Power plant EPC vendor shall also provide required number of cable trays for laying HT cable, LT power and control & all other cables for interfacing with 400kV switchyard. (Ref:Annexure-D)	The scope of interconnecting cable shall be between equipment where at least one end of equipment is supplied by bidder.	Refer Corrigendum (II) Annex.D,Table-1
22	1	2.1.2 (f) iii	Feeders for chimney, NDCT etc.	Please clarify whether bidder may optimize the allocation / source according to layout requirements.	Bid specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
23	1	0	Power Plant grounding grid is to be interconnected with existing 500 MW unit grounding grid at 4 locations. This is in scope of power plant EPC vendor.	Bidder requests Customer to indicate the Co-Ordinates of the InterConnection Points of Earth Grid in Plot Plan for Bidder's Estimation.	Interconnections to be spaced equally from transformer yard to chimney. Refer dwg.PE-189-GA-101. Interconnections shall be starting from side adjacent to existing plant earth grid. Whatever civil work required for inter connection with existing 500 MW plant grid shall be in EPC contractor scope. Refer Corrigendum (II) , vol.IV-A
24	1	2.1.2.f.v	Power Plant grounding grid is to be interconnected with existing 500 MW unit grounding grid at 4 locations. This is in scope of power plant EPC vendor.	We are considering four point connection with existing plant grid. For optimization of earthing system, we propose to consider the existing earthgrid/mat while computing the earth grid for proposed plant . If required, number of interconnections shall be increased to six in order to avail the benefit.	Proposal of bidder is not acceptable. specification prevails. Earth grid for new plant to be designed independently.
25	1	3	RANGE OF VARIATION	As per CERC Grid Code Regulation No. L-1/18/2010-CERC dated 28-04-2010 and CEA Grid Standards 2010 the Voltage Variation of 400kV Grid is +/-5% i.e. 380kV to 420kV, Frequency Variation is 49.2Hz to 50.3Hz. Bidder requests Client to verify and revise these values accordingly. The highest voltage for 400kV system is 420kV and major equipment designs will not conform to a voltage of 440kV(400kV +10%). Similarly Voltage Variation at Generator Terminals is +/-5% and it would be outside P-Q capability of Generator to meet the voltage variation of +/- 10%.	Specification prevails. Annex.A, Cl.3 is not for generator voltage or grid voltage.
26	1	3.1.1	The bidder shall submit the copies of the English version of all relevant standards during detailed Engineering.	Making copies of IS, IEC & IEEE is not legally permitted.	Refer Corrigendum-II, vol.IV-A

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
27	1	3.3.(b)	The Unit Transformer shall be designed for 100% Capacity each to provide reliability against forced or planned outage of one Unit Transformer. Normally each Unit transformer shall be loaded 50% capacity.	As per Key SLD, there is no tie between Unit switchgear 1 to 2 to take care 100% unit load during one UT outage condition. In the event of one UT outage, we presume that the respective unit board will get the back up power supply from connected Station transformer. Please clarify.	Bid Specification prevails.
		3.1.2 (e) SEC 5	(e) In case of forced/planned outage of either UT, its load get transferred to respective ST bus with which they are interconnected through tie breaker.		
28	1	4.4	For equipment installed outdoor and exposed to direct sun rays, the effect of solar heat shall be considered in determining the design ambient temperature.	We propose that for the outdoor equipment having sun shade/hood, solar radiation effect will be excluded for equipment sizing. Hence, for bus ducts, we would consider sun shade/ hood.	Bid specification prevails. Latest IEEE C37.23, C37.24 standards to be followed.
29	1	5.4	The system connection is shown in drawing no. PE-189-EL-502: Station Connection Diagram and PE-189-EL-501: Key Single Line Diagram for Electrical systems.	Bidder requests client to allow Power Evacuation & Distribution Scheme as designed by Bidder to be proposed in Technical meeting all Technical Requirements, increased availability and reliability, optimised life cycle cost, ease of maintenance & operation and required redundancies.	Bid specification prevails. (Scheme stands)
30	1	5.6	The system configuration will be developed on the concept that failure of any auxiliary transformer or supply feeder will not affect full load operation or start-up/shut down of any unit.	we have not envisaged the failure of one transformer and one feeder simultaneously for design.	Bid specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
31	1	5.8.2	Unit loads are fed through Two (2) 35 MVA (minimum) Unit transformers (UT) connected directly to isolated phase generator bus duct of respective units	Bidder may optimise on sizing, quantity, impedances and winding configurations of Unit Transformers	Bid specification prevails
32	Sec-1	5.8.2 & 5.8.5	NGR connection through 2 nos. 1C-70 Sq.mm AL. XLPE Cable	NGR connection will be through 1 Run of 1C with cross section more than 150 Sq.mm.Pl.confirm.	Refer Corrigendum (II), vol.IV-A
33	1	5.8.4	Two (2) nos. of 90/45/45 MVA (minimum), 400/11.5/11.5 kV Station Transformers are considered. Each Station transformer will be connected to two (2) nos. 11 kV station switchgears each other. These station transformers will receive power from 400kV System. These station Transformers will cater to the station auxiliary loads.	Bidder may optimise on sizing, quantity, impedances and winding configurations of Station Transformers	Bid specification prevails
34	1	5.8.6	All motors rated 1000 kW and above shall be connected to 11 kV Switchgear and motors below 1000 kW & above 160 kW shall be connected to 3.3kV Switchgears. Two (2) nos. 3 MVA (min), 11/3.45 kV Unit Auxiliary Transformers (UAT) for power plant Unit auxiliary loads at 3.3kV System shall be provided.	For effective utilisation of voltages, Bidder's and Industry Standard Practice is Motors > 1500kW shall be fed from 11kV Switchgear and Motors above 200kW shall be fed from 3.3kV Switchgears. Sizing of 11/3.45kV MV Auxiliary Transformer shall be to Bidder's own sizing calculation.	Bid specification prevails
35	1	5.8.8	The following feeders shall be fed from 11kV, 3.3kV station switchgears and they shall be in addition to other required feeders of station switchgears..... e) 1 no. 11kv feeder for charging of spare GT	We will not envisage feeder for spare GT charging, if OEM for GT does not recommend to keep the spare GT charged.	Bid specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
36	Vol-IVA, Section-1	Cl. No 5.9.2, Page no 26 of 440	Unit and station loads will be fed through LT dry type transformers.....	We propose LT auxiliary transformers of oil type (ONAN) for BOP areas instead of dry type. Please confirm.	Bid specification prevails
37	1	5.9.7	Twelve (12) Nos. dry type LT Transformers, connected to ESP Six (6) Nos of LT PMCC by non-segregated phase bus duct, are envisaged. LT transformers shall be fed from 11KV unit switchgear feeder, Six (6) Nos.from each unit switchgear, through cables. AC & ventilations for ESP control building and VFD building shall be provided from this ESP switchboard. ID fan MCC shall be feed from ESP LTPMCC.	Quantity, Sizes, Voltage Ratios of ESP Transformers, LTPMCC's, 11kV feeder Distribution shall be as per Bidder's own Design. client to confirm.	Refer corrigendum (II), vol.IV-A
38	1	5.9.7	12 nos. dry type LT Transformers connected to ESP 6 nos. of LT PMCC by NSPBD are envisaged. LT Transformers shall be fed from 11kV Unit switchgear feeder 6 nos. from each switchgear through cables.	We confirm that adequate rating/quantity of 11/0.433kV ESP LT Transformers shall be provided & the same shall be connected to ESP LT PMCCs for feeding ESP loads. This ESP LT Transformers shall be fed from each 11kV Unit Switchgear.	Refer corrigendum (II), vol.IV-A
39	Sec-1,	5.9.7 & Main ESLD (Drg. No. PE-189-EL-501)	Twelve no. dry type transformers connected to 6 nos. ESP LT MCC by NSPBD. LT transformer shall be fed from 11kV unit switchgear feeder, six nos. from each unit switchgear. But in Main ESLD 11kV ESP switchgear is shown for feeding ESP LT transformer.	Pl. Note that ESP LT transformer will be fed from 11kV Unit switchgear as mentioned in cl. 5.9.7. Hence, no. 11kV ESP swgr. Is considered in line with technical specification.Pl.confirm	Refer corrigendum (II), vol.IV-A
		1.1(c) SEC 7			Refer corrigendum (II), vol.IV-A

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
40	1	5.9.7	Twelve (12) Nos. dry type LT Transformers, connected to ESP Six (6) Nos of LT PMCC by non-segregated phase bus duct, are envisaged. LT transformers shall be fed from 11KV unit switchgear feeder, Six (6) Nos. from each unit switchgear, through cables.	The number and type of Transformers/PMCC shall be decided based on ESP OEM & it shall be finalized during detail engineering.	Refer corrigendum (II), vol.IV-A
41	1	5.10.2 (Note: 2)	Minimum size of F.S. power cable shall be 2 C X 6 sq mm copper cable.	We propose to consider min size of Power cables with Cu conductor should be 4 sqmm as per standard practice	Bid specification prevails
42	1	5.10.5	All cable for DC system shall be F.S Copper Cable	F.S Cables shall be provided only for the applicable areas as per relevant standards	Bid specification prevails
43	Sec-1	5.11	VFD Panels for ID fans	VFD is not applicable for ID Fan. Pl.confirm	If radial fan is provided then VFD shall be applicable. Refer Corrigendum (II),vol.IV-A
44	1	5.11	Variable Frequency Drive Panel shall be considered for controlling Induced Draft Fan (ID) of the Boiler VFD shall microprocessor based digital control with necessary motor protection etc. The units should be capable of accepting 11kV, 3-phase , AC incoming supply of fixed frequency and voltage and feed the connected either synchronous motor or induction motor with step less variable frequency.	Since bidder will offer axial ID fan with blade pitch control VFD is not required and hence, not envisaged.	If radial fan is provided then VFD shall be applicable. Refer Corrigendum (II),vol.IV-A

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
45	1	6.1.1	GT, UT, UAT, ST and SAT will be installed in transformer yard. No other structure/equipment shall be acceptable	We propose air washer room & cylinder room, platforms for heater maintenance, clean and dirty lube oil storage tank, will be installed beyond A grid. Transformer yard shall start thereafter. Also, excitation transformer shall be located in transformer yard. Further, DG building may also be located in transformer yard.	Bid specification prevails
46	1	6.1.6	Switchyard gantry, intermediate gantry for GT & ST bays, stringing up to Powerhouse shall be matched with locations of GT & ST.	In line with above clarifications for Switchyard, Bidder intends to exclude this scope.	Bid Specification prevails.
47	1	6.1.12	Number of rails and rail gauge will be well coordinated with number of wheels and orientation of all large transformers including those in switchyard right from unloading bay of Power House.	Please note that the railway arrangement work for switchyard transformer is not envisaged, since switchyard is not in bidder's scope of work.	Bid Specification prevails.
48	1	6.3.1 & 6.4.6	Cable vault rooms will be provided below all electrical Switchgear/MCC rooms/control room, T.G. Building, at ESP control building, Switchgear building of CW/ACW Pump House, fuel oil pressuring pump house ,VFD building, D.M. Plant Building. RWP Building etc. Cable Vault shall be provided such that there is sufficient space for free movement of O & M personnel inside No trench shall be used below the Switch board. Cable vault room shall be provided below LT/HT switch Board.	Except for Turbine Hall and ESP Building, Cable Trenches may be allowed inside the Auxiliary Buildings which will be self contained and will connect to outdoor Cable way at a height duly sealed with water and fireproof sealant thereby eliminating the risk of water ingress	Bid specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
49	1	6.3.1 & 6.4.6	6.3.1: Cable vault rooms will be provided below all electrical Switchgear/MCC rooms/control room, T.G. Building, at ESP control building, Switchgear building of CW/ACW Pump House, fuel oil pressuring pump house ,VFD building, D.M. Plant Building. RWP Building etc..... 6.4.6: No trench shall be used below the Switch board. Cable vault room shall be provided below LT/HT switch Board.	We propose to use cable trenches for BOP buildings & non plant buildings.	Bid specification prevails
50	1	6.3.1	Sufficient clear space to accommodate a battery of identical capacity in future.	We will consider spare space for identical battery for auxiliary buildings. We do not envisaged spare space for identical set of battery inside Main Turbine building.	No spare space is required. Single tier battery system should be provided. Refer Corrigendum (II),vol.IV-A.
51	1	6.4.2	Minimum clearance between two HT/One (1) HT & LT switchgear panels, facing each other shall be maintained as 3000 mm. These distances shall be maintained for all other panels located inside the room. Minimum clearance between two other panels.	Minimum clearance between two HT/One (1) HT & LT switchgear panels shall be 3000 mm. 2(two) LT panels facing each in the same line of HT switchgear shall be maintained as 3000 mm. However for the all other LT panels in the same room facing each other, 2000 mm distance shall be maintained.	Bid specification prevails
52	1	6.4.3	Clearance from any obstruction like column, wall, vertical raceway on back side of switchgear shall be maintained as 1500 mm (min) & shall comply with manufacturer's standard	Clearance from any obstruction like column, wall, vertical raceway on back side of switchgear shall be maintained as 1000 mm (min) & shall comply with manufacturer's standard	Bid specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
53	1	6.4.5	Clearance between front face of switchgear & any obstruction like column, wall, vertical raceway etc. shall be maintained as 1500 mm (min) & shall comply with manufacturer's standard	Clearance between front face of switchgear & any obstruction like column, wall, vertical raceway etc. shall be maintained as 1000 mm (min) & shall comply with manufacturer's standard	Bid specification prevails
54	1	6.4.4	Minimum space between the sides of two switchgear between any two panels or between switchgear and the wall shall be 1500 mm	Clearance between adjacent panels in a row shall be less the 200 mm or more than 800 mm. Clearance between switchgear and the wall shall be 1000 mm	Bid specification prevails
55	1	6.4.8	All electrical room shall be provided with 2 doors in addition to the shutters provided for handling transformer, switchgear, panels etc.	We do not envisaged shutters for small LT switchgear rooms or control room where equipment can be easily handled through doors.	To be finalised during D.E.
56	1	6.4.9	During design stage adequate space shall be provided for expansion of board on either side to accommodate addition of panel to take care of unforeseen factors.	Kindly specify the space requirement. Presently we have not considered any space provision.	Space provision for one vertical section for only HT panels shall be considered. Refer Corrigendum (II),vol.IV-A.
57	1	6.4.11	All busduct shall enter the 3.3kV Switchgear from TOP & 415 PMCC/PCC from sides	415V Switchgear incomers shall be suitable for Side / Top Entry NSPBD.	Bid specification prevails
58	1	6.4.12	Clearance of 1500 mm in between panels in a row	Clearance between adjacent panels in a row shall be less the 200 mm or more than 800 mm. Clearance between switchgear and the wall shall be 1000 mm	Bid specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
59	1	6.4.15	Cable vault minimum 3.5 Mtr. clear height shall be maintained from finishing ground floor level	The minimum height of cable vault room shall be 3 Mtr. from bottom of beam to FFL.	Bid specification prevails
60	1	6.4.16	Minimum clearance from top of busduct to nearest obstruction shall be atleast 1000 mm	Clearance from top of busduct to nearest obstruction shall be as per actual layout requirement & clearance available from Bottom of the Beam to FFL. However minimum clearance of 200 mm shall be maintained from top of busduct to nearest obstruction.	confirmed.
61	1	6.4.19	Switchgear room/MCC room and cable vault shall be pressurized above the atmospheric pressure to prevent ingress of dust.	Bidder does not envisage requirement of pressurizing the cable vault room & hence same is not considered. Please confirm the acceptance.	confirmed.
62	1	6.5.1	" Interplant cable routing will be on overhead cable trays on pipe cum cable trestle or only cable trestle except where approved by purchaser/consultant." Major routes in boiler area to individual boiler drives, to and from ESP Building, Fly ash conveying compressor building, vacuum pump house & F.O. pump house, will be on overhead "Cable trays on pipe cum cable trestle or on only cable trestle." "Cables from Power House to 400 kV Switchyard Control Room shall be routed through RCC trenches to be engineered and constructed by the successful bidder."	Bidder requests Customer to allow underground cable ducts as an additional option for Cabling. This will facilitate easy overground access to Cranes and other Maintenance Handling in Congested areas.	Bid specification prevails.

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Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
63	1	6.5.1	Space for accommodating additional trays, which may come in future shall be provided in present cable route. Some trays may be required for future use by others, which will be finalized during detail engineering stage. The successful bidder of the EPC package shall provided such trays without any extra cost to purchaser.	In the absence of data on future requirements, we have not considered the additional cable trays in our scope.	Refer corrigendum (II), vol.IV-A
64	1	6.5.1	Space for accommodating additional trays, which may come in future shall be provided in present cable route. Some trays may be required for use by others, which will be finalised during detail engineering stage. The successful bidder of the power plant EPC package shall provide such trays without any extra cost to purchaser.	Please furnish the BOM for the additional tray (for future requirement / others use) to include in our estimation.	10% cable tray space to be provided for future requirements. Refer Corrigendum (II) ,vol.IV-A.
65	1	6.5.1	Interplant cable routing will be on overhead cable trays on pipe..... Space for accommodating additional trays, which may come in future shall be provided in present cable route. Some trays may be required for use by others, which will be finalized during detail engineering stage. The successful bidder of the power plant EPC package shall provide such trays without any extra cost to purchaser.	Since this is a BTG + BOP contract (full EPC), no additional trays are required for others. However, suitable margins shall be considered during design phase to take care of engineering uncertainties.	
66	1	6.6	Motor shall be provided with suitable expansion terminal box with proper arrangement for termination of aluminium power conductor when motor terminal box is not adequate for terminating the aluminium power cable.	We propose that Motor shall be provided with suitable extension terminal box with proper arrangement for termination of aluminium power cable when motor terminal box is not adequate for terminating the aluminium power cable.	confirmed.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
67	1	8.0	Bidder shall submit manual calculations along with ETAP calculation in support of electrical system study	Only ETAP system study will be done & manual calculations will not be submitted	Refer above point No.8
68	1	8.1	VOLTAGE REGULATION Condition Permissible voltage at motor terminal in percent of rated voltage (a) BFP Starting 75% (b) CWP Starting 80% (c) Coal mill 85%	Bidder requests client to specify the kW Rating of Motors instead of Service Designation to determine the Voltage Regulation at Starting for all motors. As Bidder is responsible for Overall Design, being an EPC Contractor, Bidder proposes the following Criteria of Voltage Regulation: Above 200kW to 1000kW - 85% Above 1000kW to 4000kW - 80% Above 4000kW - 75%	Bid specification prevails
69	1	10.1	In line with the present-day practice unitized control of the electrical system /equipment has been envisaged for the plant.	It may not be possible to maintain in all cases because of involvement of different sub vendors for packages.	Unitised control envisaged for only main plant. Refer Corrigendum (II),vol.IV-A.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project**Pre - Bid Queries****Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A**

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
70	1	10.9	One Back up electrical control panel (ECP) each the unit shall also be provided in the respective control room. The back-up control panel shall be stand-alone in mosaic grid configuration consisting of Generator manual synchronizing equipments and excitation control, metering equipment, breaker control switches for GTs, 11kV, 3.3 kV & 415V Unit/station switchgear incomers, tie and outgoing non-motor feeder breakers, synchronizing selector switches, Auto-Manual, Remote-Local and other selector switches as required along with annunciation windows, indications and mimic diagram (from 400kV level to 415V level). Cooler control for Generator Transformers, Unit Auxiliary transformer, Station auxiliary transformer, Cooler control & Tap changer control for Station transformers and Unit Transformers in Remote-Manual mode shall also be provided in the Back-up Control Panel. DG shall be ON/OFF control from DDCMIS/ EDMS as well as Electrical control panel. Number of non trip and trip annunciation facia shall also be provided. All the switches and other equipments on the panel shall be suitable for mosaic titles.	Bidder requests client to exclude Back-Up Control Panel(ECP) as these increases the Control elements and reduces effective Controllability & Reliability of the System with increased Control Location elections, Cable Terminations etc. For neat and optimised Layout and ease in Erection, Operation & Maintenance Complete Control through DCS is much superior. However for Electrical Control and Synchronisation of Generator and Generator Transformer, Bidder proposes a separate Bay Control Unit with necessary Hardware, Indications, Annunciations etc.	Bid Specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
71	1	10.9	One Back up The back-up control panel shall be stand-alone in mosaic grid configuration consisting of Generator manual synchronizing equipment and excitation control, metering equipment, breaker control switches for GTs, 11kV, 3.3 kV & 415V Unit/station switchgear incomers, tie and outgoing non-motor feeder breakers,.....	Generator control panel shall be provided in addition to the backup control panel which shall house generator controls, metering etc.	confirmed.
72	1	10.13	In case of internal faults in the generator transformer/generator/unit transformer both turbine and generator will automatically trip. For faults external to the generator and transformer, the generator breaker will open and the turbine, generator shall operated on house load.	Bidder requests client to add GCB as an option. In such Case Faults in the generator will lead to tripping of GCB, Generator & Turbine while Generator & Unit Transformer will remain switched on through 400kV GT CB and vice versa.	Bid specification prevails
73	1	10.13	There shall also have facility to change over from station to station board as well as unit to station change with BTS Scheme.	Bidder proposes redundancy in Station System by Distribution in which Change over from Station Board to Station Board is not required. Also the BTS scheme is applicable for 11kV only. All other voltages shall have loss of voltage dead bus transfer built in Switchgears.	Bid specification prevails
74	1	12.0-c	This will be achieved by providing lightning masts on stacks, cooling towers, power house building, towers in switchyard, flood light towers etc. and connecting these with ground grid.	We have not envisaged lightning mast provision in switchyard as it is not in our scope of work.	Refer Corrigendum (II),vol.IV-A.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
75	1	14.1	Equipment for testing & erection	Please quantify the equipment to be considered for testing & erection.	Bid specification prevails
76	1	15	Contractor shall be fully responsible for carrying out all coordination & liaison work with electrical inspectors, factory inspector & other statutory bodies for implementation of the work.	Noted. However we will discuss briefly during bid clarification meeting about the list of approvals that is in the scope of the Contractor.	Bid specification prevails
77	1	15	CO-ORDINATION WITH STATUTORY BODIES & OUTSIDE AGENCIES The Contractor shall be fully responsible for carrying out all co- ordination and liaison work with Electrical Inspectors, Factory Inspector, and other statutory bodies for implementation of the work.	Please note that the same shall be as per Vol- 1/ section-3, page- 333 for project execution related activity.	Bid specification prevails
78	1	16.3.4	Make of brought-out items are subject to Owner/Purchaser's approval. The contractor shall furnish relevant details to the Owner/Purchaser for his concurrence before procurement.	Make of major electrical equipment shall be as per Owner's approved list. However make of all brought out items shall be of reputed one & as per manufacture's standard only.	Bid specification prevails
79	1	21.0	Type Tests	Type test shall not be conducted on an equipment if type test report of similar or higher rated equipment is available which is not older than 5 years from the date of issue of LOI.	Bid specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
80	Vol-IVA, Section-1	Annexure-A, Page no 57 of 440	11kV and 3.3kV system fault current and time is 44KA for 3 sec and 40KA for 3 sec respectively...	The fault current on 11kV system shall be limited to 40KA by considering the % reactance's suitably and same shall be studied during system studies hence please accept the 11kV system fault current as 40KA. As the 11 kV and 3.3 kV system fault clearing time is less than 1 sec hence please accept the 11KV and 3.3kV systems fault time of 1 sec similar to 415V system.	Bid specification prevails.
81	1	Annx B - 1.8	EHV System Data :- Maximum short circuit level & duration shall be 50kA, 3 Sec	Rated short circuit current for 400kV System considered as 50kA, 1 Sec	Bid specification prevails
82	1	Annexure-C	cost figure for loss capitalization	We presume that Annexure C will not be applicable since the auxiliary power consumption will be guaranteed and shall be evaluated for additional loading. Please confirm.	Refer Corrigendum (II),vol.IV-A.
83		ANNEXURE - D TABLE 1, Sl.No.3.0 (CABLING SCOPE OF WORK)	SCOPE DIVISION AMONG EPC VENDORS Between power plant EPC vendor's equipment and (a)Switchyard vendor's equipment (b) Switchyard control room --- HV/MV/LV power cables, control cables, Instrumentation cables, FS cables, FO Cables, special cables etc for Power supply, Metering, Protection & SAS etc & Raceway systems	We understand that as per the scope division switchyard is not in our scope, Hence we are not considering the equipments & cables as mentioned in ANNEXURE - D TABLE 1, Sl.No.3.0 (CABLING SCOPE OF WORK). Kindly confirm	Refer Corrigendum (II),vol.IV-A.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
84	1	ANNEXURE - D TABLE :1 Sl.No.3.0 CABLING SCOPE OF WORK)	SCOPE DIVISION AMONG EPC VENDORS Power plant EPC vendor upto entry of switchyard boundary MB/ Equipment location as decided by switchyard vendor.	Since there is a conflict between these points mentioned in Tender specification regarding the Terminal point for Switchyard, We request owner to clarify the same.	Refer Corrigendum (II),vol.IV-A for cabling scope..
		4.11.1(VOL II) SEC 3	TERMINAL POINTS ELECTRICAL For interfacing/terminal point between the power plant package & switchyard, the bidder shall consider the following- HT bushings of Generator transformers and station transformer including H.V. terminal connector are in EPC contractor scope.		Bid specification prevails for terminal points.
85	1	3.0 ANNEXURE - D,	SCOPE DIVISION AMONG EPC VENDORS, TABLE 1 (CABLING SCOPE OF WORK) Power plant EPC vendor up to entry of switchyard boundary location as decided by switchyard vendor	Please clarify the terminal point of erection and commissioning scope of interconnection with 400kV switchyard.	Refer Corrigendum (II),vol.IV-A.
86	1	3.0 ANNEXURE - D	SCOPE DIVISION AMONG EPC VENDORS, , TABLE 1 (CABLING SCOPE OF WORK)	Please note that Bidder shall not consider any civil work inside boundary of switchyard.	Refer Corrigendum (II),vol.IV-A.
	1	Annx E	List of Approved Vendors - Electrical	Along with technical offer we will furnish additional sub vendor list with credentials for your kind review & approval. We would request approval of the same.	Bid specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
	1	Table-1, Sl. No.-3 & 4	Cabling Scope of Work	Bidder proposes to Split the Spreadsheet Column "Erection Testing & Commissioning" into two, "Erection" and "Testing & Commissioning". Bidder Requests "Testing & Commissioning" of cables under Sl. No. 3 & 4 in the scope of "Switchyard Vendor" and "Other Package Vendor" respectively. Only Raceway Erection may be in EPC vendor scope upto the Battery Limits specified.	Refer Corrigendum (II), vol.IV-A.
85	-	-	General:	Please confirm that the specified equipment rating are to be followed or the Bidder can change the equipment ratings as per the design requirement.	Bid Specification prevails
86	2	1	One Minute Power Frequency Withstand Voltage (KV rms)	Even though transformer will be designed to withstand power frequency Withstand voltage of 630kVrms the final Testing will be done as per Method 2 of IS 2026-III, Cl. 11.4.4.1 "U1 shall be $1.7 \times U_m / \sqrt{3}$ and U2 shall be $1.5 \times U_m / \sqrt{3}$ with $q=500\mu s$ ". Hence as per Method-2 ACSD test is not required.	Bid Specification prevails

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Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
87	2	1.1	21 / 420/ 3 kV, 1 phase, 275 MVA Generator Transformer: 4 nos. (3 nos. + 1no. Spare). All the transformers shall be provided with OCTC, cooling arrangements, fittings, accessories & all metering and protection devices etc. MVA rating of generator transformer, as indicated above, shall be considered as the minimum requirement for the project. Generator transformer offered by the bidder shall be sized according to the clause no. 3.0 of this section & higher rating shall be provided if required by sizing calculations.	As per current Logistics inside the factory and upto site it is possible to manufacture and transport three(3) phase Generator Transformer. Three(3) phase transformers are much more reliable, reduces complexity of Connections, reduces Auxiliary Power Consumption, occupies less space in Layout. (1) Bidder requests Customer to allow Three(3) phase Generator Transformer - One No. without any Spare as an option. (2) Bidder may be allowed to decide the MVA rating of the transformer as per Bidder's. 275MVA GT is not required as Aux Power Consumption must be deducted.	3ph GT is not acceptable, Bid Specification prevails
88	2	1.1	21 / 420/ 3 kV, 1 phase, 275 MVA Generator Transformer: 4 nos. (3 nos. + 1 no. Spare).	Bidder agrees to provide One (1) No. spare single phase generator transformer without radiator bank.	Bid Specification prevails
89	2	1.1	21/ 420/V3kV Single phase, 275MVA transformer, 4Nos. (3Nos.+1)	As per the Key SLD for Electrical System (PE-189-EL-501), three phase 825MVA Generator transformer is also acceptable. In case 3phase 825MVA transformer is considered, what is the standby requirement? The LV voltage of the Generator Transformer shall depend on the Generator Terminal voltage.	3ph GT is not acceptable, Bid Specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
90	2	3.2	GT shall be suitable to meet the Generator power rating of 660MW at 0.85 power factor lag without deducting the unit auxiliary power, excitation power or any other power. GT shall be sized with 10% design margin	Please refer to the clarification regarding Generator rating in Vol. III-B and clarify whether GT is to be sized for 693MW at 0.85 pf continuous. Bidder requests client to allow deduction due to Aux Power Consumption as this leads to correct sizing of Generator Transformer with respect to Voltage Regulation, Short Circuit Impedance etc.	Refer Corrigendum (II),vol.IV-A.
91	2	3.2	GT shall be suitable to meet the Generator power rating of 660MW at 0.85 power factor lag without deducting the unit auxiliary power, excitation power or any other power. GT shall be sized with 10% design margin.	We do not envisaged 10% design margin for GT sizing. Please confirm.	Refer Corrigendum (II),vol.IV-A.
92	2	3.3.4 3.5	The transformer shall be capable of operation at its rated kVA on any tap provided the voltage does not vary by more than $\pm 10\%$ of the rated voltage corresponding to the tap. The transformer shall be capable of continuous operation at rated output under the following condition: (a) Voltage variation : $\pm 10\%$ (b) Frequency variation : $\pm 5\%$ (c) Combined voltage and frequency : $\pm 10\%$ (absolute sum)	Please refer to Sl. No.20 above, Voltage variation shall be $\pm 5\%$ Also Frequency Variation is 49.2Hz to 50.3Hz.	Bid Specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
93	2	3.5 3.7 & data sheet-A, 1.1	The transformer shall be capable of continuous operation at rated output under the following condition: (a) Voltage variation : $\pm 10\%$	As per Section 1, Annexure B, Cl.1.4, maximum voltage at 400kV is 420kV. Also, generator is suitable for 5% voltage variation. Hence, voltage variation shall be $\pm 5\%$.	Bid Specification prevails
94	2	5.31	Tap-changing gear complete with tap position indicator, operation counter etc. For OLTC gear (where specified), oil surge relay (OSL) with shut-off valve, Local control cabinet and tap changer control in ECP (RTCC) and also DDCMIS/DCS.	Bidder has considered OCTC generator transformer as per tender document and thus this clause is not applicable to GT.	Refer Corrigendum (II), vol.IV-A.
95	Sec -2	4.8.1 & Datasheet A- 1.10.2	Each cooling unit shall be provided with two (2) nos. 50% capacity oil pumps and number of cooling fans. 2x50% or 6x20%	Clause 4.8.1 states about 2x 50 % radiator banks. However, clause 1.10.2 in Datasheet -A is not clear about it. We consider that 6x20% cooling configuration denotes coolers and not radiators. Kindly confirm	Refer Corrigendum (II), vol.IV-A.
96	Sec -2	4.9.2	Control panels shall be of CRCA sheet steel construction with protection class of IPW-55 for outdoor installation.	Control panels shall be of HRCA sheet steel construction may please be accepted.	Bid specification prevails
97	Vol-IVA, Section-2	Cl. No 6.1,6.2 and 6.3, Page no 106 of 440	Type test and special tests on GSUT	Valid type test and special test reports on similar rating equipment shall be furnished for approval hence no type tests/special test are considered in the offer. Please confirm.	Bid specification prevails
98	2,4,5 & 13	6.1 6.1 6.1 5.4	During manufacture and on completion, all transformers shall be subjected to the routine tests in accordance with latest IEC 60076 and its different parts.	All routine tests shall be conducted as per IEC 60076/IS 2026/Equivalent. Owner is requested to kindly confirm.	Bid specification prevails

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Pre - Bid Queries

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
99	Sec -2	6.1.1	ROUTINE TEST: Transformer tank with cooler shall be tested for leaks with normal head of oil plus 35 KN/m ² for a period of 8 hrs.	Kindly note that Oil leakage test shall be Routine test. However, Radiators shall be attached with only one transformer under leakage test, which shall undergo Type test. Please note that all radiators are separately tested for leakage at 2.0 kg/m ² . Kindly confirm.	confirmed.
100	Sec -2	6.1.2	ROUTINE TEST: During fabrication stage , tank shall be pressure tested with air at a pressure corresponding to twice the normal head of oil or normal pressure plus 35 kN/m ² whichever is lower for a period of one hour. The permanent deflection of flat plates should not exceed CBIP specified figures on release of excess of pressure of pressure test and on release of vacuum.	Kindly note that the pressure test with deflection measurement on transformer tank shall be carried out as a type test as per CBIP guidelines at fabrication stage (Refer clause 17.3.2 of CBIP manual) and not as a routine test as mentioned in the clause. However, please note that all the tanks shall be separately pressure tested during fabrication stage. Kindly confirm.	confirmed.
101	Sec -2	6.1.7	ROUTINE TESTS: Measurement of acoustic noise level	Kindly note that as per IEC 60076-1 clause 10.1.3, the measurement of acoustic sound level is a special test and shall be carried out as a type test on only one transformer. Kindly confirm.	confirmed.
102	Sec -2	6.1.8	ROUTINE TESTS: Measurement of power consumption of fans and pumps	Kindly note that as per IEC 60076-1 clause 10.1.3, the measurement of power consumption of fans and pumps is a special test and shall be carried out as a type test on only one transformer. Kindly confirm.	confirmed.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
103	Sec -2	6.1.9	ROUTINE TESTS: Measurement of zero sequence impedance on three phase unit.	Kindly note that as per IS 2026 and IEC 60076-1 clause 10.1.3, zero sequence impedance test is not applicable for single phase transformer and hence shall not be applicable. Therefore, this test shall not be conducted.	confirmed.
104	2	6.1.9	Measurement of Zero sequence Impedance on Three Phase Unit	Kindly note that as per per IS: 2026/ IEC-60076 /CBIP Manual, Zero sequence impedance test is not applicable for single phase Transformers.	confirmed.
105	2	6.1.16	Magnetic circuit test 10kV for 1min isolation test on transformer core to tank core to end frame and end frame to tank.	Please note that the Core Isolation Test shall be carried out at 2 KVrms instead of 10 KVrms for a period of 1 minute as per IEC - 60076.	Refer Corrigendum (II),vol.IV-A.
106	Sec -2	6.3 & Datasheet A (1.12 a)	Full wave lightning impulse test on HV terminal at 1426 kVp. Full wave lightning Impulse test on LV terminal at 126 kVp. Switching impulse test on HV terminal at 1180 kVp	Kindly note that the Impulse values in clause 6.3 seems to be a typographical error and shall be as per clause 1.12 a of DATASHEET-A. Kindly confirm.	Refer Corrigendum (II),vol.IV-A.
107	2	Data Sheet-A, 1.10.1	Type of Cooling & respective power Value % of rated power (ONAN/ONAF or ONAN/ ONAFI/ONAF2 OR ONAN/ONAF/OFAF) ONAN/ONAF/OFAF 165/220/275 MVA	Proposed Cooling of Generator Transformer shall be ODAF (Oil Directed Air Forced), ONAN & ONAF ratings shall be as per Transformer Vendor's design.	Bid Specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
108	2	1.10.1 Data sheet -A	Type of Cooling - ONAN/ONAF/OFAF	We propose to also consider ODAF cooling option for Generator Transformer.	Bid Specification prevails
109	2	Data Sheet-A, 1.11.2	Temperature Rise Temperature rise above design ambient temperature (a) in oil by thermometer 40°C (b) in winding by resistance 45°C	Temperature Rise shall be as per IEC-60076-2 as per the daily, monthly and yearly average temperatures of the Project Site. Bidder requests these information from client.	Bid Specification prevails
110	2	1.14 GT - Data sheet-A	z = 13.5% without positive tolerance	We request you to allow 13.5% with all tolerances. It is not recommended to impose restrictions on design tolerances on percentage impedance, for such critical equipment as GT.	Refer Corrigendum (II), vol.IV-A.
111	Sec -2	Annexure A	Auxiliary Equipment	Kindly provide the knee point voltage, excitation current and secondary resistance for the bushing CTs. These are system data and are related to the protection schemes involved. These are required for design the bushings CTs.	During detailed engineering
112	Sec -2	Annex A Note: 7(b) ii	Additional measurement: It should additionally measure other parameters such as moisture in oil , oil temperature, ambient temperature etc.	The model of any such DGA that has the facility of measuring oil temperature, ambient temperature etc is not known to us. Kindly provide us with a little clarity regarding your requirement or if the make of any such equipment is known to you then kindly provide us with the same.	Standard types and makes to be used.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
113	Sec-2	Annexure-A, Note 3	% impedance for GT shall not exceed 13.5% without any positive tolerance allowed	Impedance of GT will be decided as per short circuit and voltage drop studies.Pl.confirm	Refer Corrigendum (II),vol.IV-A.
114	3	1.1.1	Silica Gel Breathers	Silica Gel Breathers are not recommended in the pressurized duct as it will give vent to pressurized air.	Bid specification prevails
115	3	1.5	The bare wire electrodes for submerged arc welding shall be as follows: Filler wire: AWS-A-5.17-EH14 Flux will be agglomerated type of classification AWS-A-5.17-F7A2EH14	The bare wire electrodes for submerged arc welding shall be as per manufacturer standard as there will be some material which may require impact property and EH14 is high manganese material which might not be suitable. However established WPS/PQR shall be used for production welding. Owner is requested to please accept.	During detailed engineering
116	3	1.8	All welding electrodes shall be of Low Hydrogen type conforming to IS: 814 and shall be EB5426H3JX type. All electrodes, flux, wire etc. shall be of ADOR Welding Ltd., or ESAB India Ltd., or D & H Secheron Electrodes Pvt. Ltd. or Modi electrodes or equivalent as approved by Owner. Alternatively, flux coated arc welding (FCAW) conforming to AWS- E70T-5 which is a modified procedure of MIG/CO2 (solid wire) can be used.	Structures with 20mm & above will be welded with low hydrogen electrode. And for below 20mm it may be E 6013 or any other consumable as per manufacturer's recommendation. The electrodes for FCAW shall be as per manufacturer standard. However established WPS/PQR shall be used for production welding. Owner is requested to please accept.	During detailed engineering

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
117	3	3.8	The continuous current carrying capacity of IPBD shall consider the following :..... (b) 10% margin shall be considered on rating arrived at (a) above.	10% design margin need not be considered for IPBD sizing over and above 5% voltage variation . Please confirm.	Bid Specification prevails
118	3	3.8 (c)	Continuous type busduct enclosure shall be only considered	Please clarify the meaning of continuous type busduct.	Bid Specification prevails
119	3	4.1.1 & 4.14.1	Bus duct shall be isolated phase,continuous(bonded enclosure,)--natural air cooled with positive pressure (+100mm water column)---	To stop the ingress of moisture, busduct pressure slightly above atmosphere shall be sufficient. Inside pressure shall be 20-40 mm water column above atmosphere.	Refer Corrigendum (II), vol.IV-A.
120	3	4.2.8	Seal of bushings shall be provided at (a) Generator End. b) Generator Transformer End. (c) Unit Transformers end. (d) Excitation Transformer End etc.	We have not envisaged epoxy Seal-off bushings are not considered at wall frame location since busducts are air pressurized.	confirmed.
121	3	4.2.9		As our offered busduct is pressurized, drains are not envisaged and thus not considered. As this will give the open vent for pressurized air	Bid specification prevails
122	3	4.3.1, 4.5.1 & 2.8(B) Datasheet-A,	Porcelain insulators	We will offer IP design with epoxy insulators. Epoxy insulators are light in weight, easy for maintenance, higher in strength and gives higher creepage distance for the same height.	Bid specification prevails

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
123	3	4.11	The current transformers shall be cast-resin, ring type, mounted within the busduct enclosures and suitable for operation at an ambient temperature equal to rated busbar temperature.	The proposed current transformers for Generator Protection and Metering are mounted on generator bushings, not mounted within the bus duct enclosures.	confirmed.
124	3	5	Tests	Please note that water tightness and air tightness tests are type tests and not the routine tests and shall be performed at factory only. Routine test shall be done as per IS 8084.	Refer Corrigendum (II), vol.IV-A.
125	3	5.1, 5.2	Tests	Similar Type Test certificate shall be submitted for acceptance. No fresh type test shall be conducted. All routine tests shall be conducted at works as per IS: 8084	Bid specification prevails
126	Vol-IVA, Section-3	Cl. No 5.2, Page no 139 of 440	Type tests on bus duct	Valid type test report on similar rating equipment shall be furnished for approval hence no type tests are considered in the offer. Please confirm.	Bid specification prevails
127	3	2.5(a) DataSheetA	Temperature rise limits	Temperature rise limits above ambient temp. 50 deg C shall be in line with IS-8084, as below- 1). Enclosure- 30 deg C 2a). Conductor- 40 deg C for plain bolted 2b). Conductor- 55 deg C for silver plated	Refer Corrigendum (II), vol.IV-A.

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Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
128	3	2.6(d) DataSheetA	Creepage distance	Creepage distance for insulator shall be 20 mm/KV	Bid specification prevails
129	3	Data sheet-A, 2.6	(a) Bus Conductor Aluminium alloy Grade 19501 (60% IACS) (b) Bus enclosure Aluminium alloy Grade 63401 (56.5% IACS)	Material and Grade a) Conductor · Main Run & Delta Run : Al. Alloy, Gr. 19501 · Tap-off Run : Al. Alloy, Gr. 63401 b) Enclosure · Main Run & Delta Run : Al. Alloy, Gr. 19501 · Tap-off Run : Al. Alloy, Gr. 19501	Refer Corrigendum (II), vol.IV-A.
130	3	2.8(d) DataSheetA	Material of bus enclosure	Material of bus enclosure shall be Al alloy grade-19501 for main, delta & grade-31000 for tap-off section. Material for conductor shall be -19501 for main, delta & grade-63401 for tap-off section.	Refer Corrigendum (II), vol.IV-A.
131	3	Data sheet-A, 2.8	Insulators: Creep age: 31mm/kV	The bus ducts are air pressurized and outside air is prevented to enter inside. Hence, we consider 20mm/KV creepage distance for insulators & seal-off bushing for bus duct application which is sufficient. Please confirm.	Bid Specification Prevails.
132	3	6.6 DataSheetA	Duty cycle	Duty cycle shall be 5 minute in line with point no. 6.5 of data sheet-A	confirmed.

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Pre - Bid Queries

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
133	Sec-4	1.1	OLTC and RTCC in ECP for UT's	ECP will have raise-Lower control switch and Tap position indicators only as part of RTCC. No other relay, switch , indicating lamps and annunciation will be part of ECP(RTCC). However, even if it is required it will be provided as separate panel having interface with ECP (for Raise/lower command and Tap Position). Pl.confirm	Confirmed. Separate panel not required. Shall be provided on ECP
134		4.4.4	The OLTC gear shall be suitable for local and remote electrical control at ECP and local manual control. Further, there shall be provision of automatics operation through voltage sensing relay wherever specified.		
135		4.4.7	Necessary equipment switches , relay etc..The following minimum components shall be provided in the ECP		
		Section 4 / Page 156 / Cl.No. 3.3(b)	The Unit Transformer shall be designed for 100% Capacity each to provide reliability against forced or planned outage of one Unit Transformer. Normally each Unit transformer shall be loaded 50% capacity.		Bid Specification prevails.
136	Vol-IVA, Section-4		Type test and special tests on UT	Valid type test and special test reports on similar rating equipment shall be furnished for approval hence no type tests/special test are considered in the offer. Please confirm.	Bid specification prevails
137	4	10.13	For faults external to the generator and transformer, the generator breaker will open and the turbine, generator shall operated on house load.	Please clarify whether the mentioned breaker is 400kV switchyard breaker or any other breaker.	GCB is not acceptable
138	Sec-5	1.1	OLTC and RTCC in ECP for ST's	ECP will have raise-Lower control switch and Tap position indicators only as part of RTCC. No other relay, switch , indicating lamps and annunciation will be part of	Confirmed. Separate panel not required. Shall be provided on ECP

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
139		4.4.4	The OLTC gear shall be suitable for local and remote electrical control at ECP and local manual control. Further, there shall be provision of automatic operation through voltage sensing relay wherever specified.	ECP(RTCC). However, even if it is required it will be provided as separate panel having interface with ECP(for Raise/lower command and Tap Position). Pl.confirm	
140		4.4.7	Necessary equipment switches , relay etc..The following minimum components shall be provided in the ECP		
141	5	6	Rated voltage ratio (line to line) kV 400/11.5	Please confirm voltage ratio for Station transformer (400/11.5-11.5 or 400/11.5).	voltage ratio 400/11.5/11.5 kV Refer Corrigendum (II),vol.IV-A
142	Vol-IVA, Section-5	Cl. No 6.2 and 6.3, Page no 211 of 440	Type test and special tests on ST	Valid type test report and special test reports on similar rating equipment shall be furnished for approval hence no type tests/special test are considered in the offer. Please confirm.	Bid specification prevails
143	6	1.0	General, SPBD	Bidder may propose cables in place of SPBD during execution stage in case of layout constraint.	Bid specification prevails
144	6	1.5	Bus duct	We presume here IPBD implies SPBD	Refer Corrigendum (II), vol.IV-A.
145	6	3.9, 4.2.11	SPBD	Our SP bus duct design has a frame work made out of angles rigid enough to withstand the short circuit forces. Hence, barrier sheet of 2 mm thick shall be more than adequate	Bid specification prevails

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
146	6	4.2.9	SPBD	Standard length of bus duct shall be 3.72 mtr	confirmed.
147	6	4.2.9	Shipping length of bus duct	The shipping length shall be decided during detail engineering. Please confirm.	confirmed.
148	6	4.3.1 & 4.4.1	SPBD	We will offer SP design with epoxy insulators. Epoxy insulators are light in weight, easy for maintenance, higher in strength and gives higher creepage distance for the same height.	Bid specification prevails
149	6	4.3.4, 4.3.5	SPBD	All the contact surfaces of the bolted joints shall be plain i.e. without silver plating. Offered design is proven. Hardware shall be of High tensile steel.	Bid specification prevails
150	6	4.4.1	Bus support insulators shall be interchangeable, high creep, high strength, wet processed, and fine glazed porcelain. Alternatively, good equality cast resin insulators may be offered.	Please also consider Epoxy bus support insulators for SPBD.	Bid specification prevails
151	6	4.7.5	SPBD	Foundation pocket, building steel, inserts/embedment plates shall be in civil scope of supply, however, the location of the same shall be intimated during detailed engg. We shall supply structure for bus duct.	Bid specification prevails

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
152	Vol-IVA, Section-6	cl no 4.10.1 and 4.10.2, page no 237 of 440	Hot air blowing system or space heaters for SPBD	The 11kV and 3.3kV SPBD shall be provided with thermostatically controlled space heater instead of Hot air blowing system. Please confirm.	confirmed.
153	6	5.0	SPBD	Similar Type Test certificate shall be submitted for acceptance. No fresh type test shall be conducted. All routine tests shall be conducted at works as per IS: 8084.	Bid specification prevails
154	6	5.1	Tests	Please note that water tightness and air tightness tests are type tests and not the routine tests and shall be performed at factory only. Routine test shall be done as per IS 8084.	confirmed.
155	Vol-IVA, Section-6	Cl. No 5.2, Page no 238 of 440	Type tests on bus duct	Valid type test report on similar rating equipment shall be furnished for approval hence no type tests are considered in the offer. Please confirm.	Bid specification prevails
156	6	1.7 & 2.7 DataSheet-A	SPBD	Short time current rating shall be for 1 sec instead of 3.	Bid specification prevails
157	6	3.4 DataSheet-A	SPBD	Temperature rise limits above ambient temp. 50 °C shall be in line with IS-8084, as below- 1). Enclosure- 30 deg C 2). Conductor- 40 deg C for plain bolted	As per IS-8084.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
158	6	Data sheet - A, 3.4 (a)	Rated conductor temp. rise	We propose temp. rise shall be carried out as per IS 8084.	As per IS-8084.
159	6	3.5(b) DataSheet-A	SPBD	Material of enclosure shall be Al alloy grade-31000 & material for conductor shall be Al alloy grade-63401.	Refer Corrigendum (II), vol.IV-A.
160	7	1.1 & 1.2	Scope of Supply :- Minimum 10 number of 11kV Switchgears & Minimum 6 number of 3.3kV Switchgears	Kindly refer Sl. No. 1.0 & 3.0 above	Refer Corrigendum (II), vol.IV-A.
161	Vol-IVA, Section-7	Cl. No 3.1.1, Page no 253 of 440	The continuous rating of the 11/3.3kV switchgear buses and incomer breaker shall be based on the rated LV winding current of the transformer with 20% margin rounded off to the next higher standard rating.	15% margin already included in the transformer sizing and rounded off to the next higher standard rating hence the continuous rating of the 11/3.3kV switchgear buses and incomer breaker shall be based on the rated LV winding current of the transformer . Please confirm.	Bid Specification prevails.
162	Vol-IVA, Section-7	Cl. No 3.1.1, Page no 253 of 440	The continuous rating of the feeders shall be based on name plate current rating of the connected equipment with 20% margin rounded off.	The continuous rating of the feeders shall be based on name plate current rating of the connected equipment . Please confirm.	Bid Specification prevails.
163	7	3.9	Surge arrestor	LA will be suitable for 2.2pu.Please confirm the acceptance.	Bid specification prevails

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
164	7	3.10	A margin of 5% over the short circuit current shall be applied and rounded off to the next higher standard ratings and this value shall be adopted for the breakers and switchgears.	Bidder's understanding is that the system fault level for the medium voltage is already defined (44kA for 11kV and 40kA for 3.3kV). Based on this system fault rating the circuit breaker short circuit rating shall be selected.	Bid specification prevails, minimum rating of the selection shall be as per bid specification.
165	7	3.11	The continuous rating of the 11/3.3kV switchgear buses and incomer breaker shall be based on the rated LV winding current of the transformer with 20% margin rounded off to the next higher standard rating.	10% Margin shall be adequate and we propose to consider the same inline with that of power transformers.	Bid specification prevails
166	7	4.1.1	Forced Cooling for HT Breakers (11kV & 3.3kV) & HT Switchgear is not acceptable. The nameplate rating of the Breakers and all the switchgear components shall confirm to the rating in closed cubicle of the switchgear.	Fan cooling may be required only for Station Incoming panel where the requirement is 3150A at 50 deg C.	Bid specification prevails
167	7	4.1.3	The switchgear enclosure shall conform to the degree of protection IP- 4X. The minimum thickness of CRCA sheet steel used shall be 2 mm.	We may propose Cubicle made up of riveted sheets of Alu-Zinc instead of CRCA except for front doors and end covers. Used by leading manufacturers, AluZinc is a light weight metal with increased strength and is extremely resistant to corrosion as compared to CRCA.	Refer Corrigendum (II), vol.IV-A.
168	7	4.1.6	Circuit breakers, instrument transformers, bus bars, cable compartment etc., shall be housed in separate compartments within the cubicle.	We shall consider common compartment for Cable and CT housing in HT switchgears.	Confirmed

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
169	7	4.2.1	Temperature rise	We propose temp Rise shall be as per IEC-62271-100/200 and the busbars will be Aluminium maintaining the same temp rise as per above IEC	Bid specification prevails
170	7	4.2.2	Copper busbars shall be used for bus bar current rating above 2000A, with maximum temperature rise limits same as that for aluminium bus bar.	We propose busbar & connections shall be made of Aluminium up to current rating of 3150A. However for higher current rating Busbar shall be of either Aluminium or Copper .	Bid specification prevails
171	7	4.5.2.d 5.10.3.c & d	CT accuracy 0.2S	As per CEA amendment, accuracy class of meters shall not be inferior to 1.0S accuracy class. Also, as per original CEA notification, accuracy class of CTs and VTs shall not be inferior to that of the associated meters. Hence, as per CEA notification / amendment, Class 1.0S instrument transformers and meters shall be provided. Further, since Class 1.0S CT is not defined by IS 2705 Part 2, Class 1.0 CT shall be provided. Accordingly, Class 1.0 meter shall be provided. Also note that 0.2S class CTs for smaller ratios are not available.	Refer Corrigendum (II), vol.IV-A.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
172	7	4.7.5	Separate numerical relay shall be provided for differential protection of motors 1000kW and above and E/F protection of motor and transformers shall be achieved through CBCT.	We have considered Multifunction relay composite type. Main protection relays shall be numerical type in MV switchgear and shall be with modbus protocol. Back-up protection / auxiliary relays shall be electro-mechanical type.	Bid specification prevails
173	Vol-IVA, Section-7	Cl. No 4.8.3, Page no 263 of 440	Metering for energy auditing and accounting meters accuracy class	As per latest CEA guide lines, the meters at generator stator terminals and before tap off to the unit auxiliary transformers are 0.2S class and all other meters associated CTs and PTs are not inferior that of 1.0s class. Please confirm.	Refer Corrigendum (II), vol.IV-A.
174	7	4.9	Transducers	We will consider current transducers only for the Y phase for Motor feeders.	Refer Corrigendum (II), vol.IV-A.
175	7	4.11.1	Visible indication shall be provided on blowing of the fuse.	Visual indication shall be provided on blowing of fuses used in protective circuits such as VT secondary fuse fail, DC control supply fuse fail.	Bid specification prevails
176	7	4.21.1 (a)	AC Supply: 230V	Bidder's understanding is that the single phase supply voltage is 240V.	confirmed.

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Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
177	7	5.3	HT Switchgear :- Type Test	We will be sourcing the switchgear from reputed manufacturers/ approved vendors, who have carried out type tests on these panels. Hence we request you to accept only review of type test reports	Refer Corrigendum (II), vol.IV-A.
178	Vol-IVA, Section-7	Cl. No 5.3, Page no 278 of 440	Type tests on MV Switchgear	Valid type test report on similar rating equipment shall be furnished for approval hence no type tests are considered in the offer. Please confirm.	Refer Corrigendum (II), vol.IV-A.
179	7	5.3.9	HT Switchgear :- Tests on CTs & PTs - For each switchboard one CT of each rating shall be subjected to following routine tests in the presence of Owner's representative.....	Since CTs & PTs are bought-out items, HT Switchgear manufacturer can submit only routine test reports.	Refer Corrigendum (II), vol.IV-A.
180	7	Data Sheet-A : 1.5 & 2.2	AC Symmetrical breaking current shall be 44kA & Making current shall be 112kA for 11kV Switchgears	As per manufacturer's standard, Making current shall be 110 kA for the AC Symmetrical breaking current of 44kA	Bid specification prevails
181	Vol-IVA, Section-7(DATASHEET)	sl.no 1.5.b, Page no 284 of 440	short circuit duration 3 sec	As the 11 kV and 3.3 kV system fault clearing time is less than 1 sec hence please accept the 11KV and 3.3kV systems fault time of 1 sec similar to 415V system. Please confirm.	Bid specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
182	7		Spare feeders requirement for MV switchgears	The spare feeder philosophy for MV switchgear shall be; one no. largest motor feeder & one no. service transformer feeder of largest rating feeders per switchboard as per standard practice.	Refer Corrigendum (II), vol.IV-A.
183	8	1.0	General, NSPBD	Bidder may explore option of unit substation arrangement with dry type LV transformers closely coupled with associated LV switchgear, thus improving the reliability and reducing the space requirement.	Bid specification prevails
184	8	1.3	Set of accessories as listed below : a) Breaker lifting and handling trolley b) Test cabinet with coupling cables for testing the breaker in drawout position c) Racking in/out handle for breakers d) Racking in/out handle for drawout MCC modules	Wherever Breakers involved, following set of accessories shall be provided. 1. One no. of Breaker lifting and handling trolley shall be provided per Switchgear Room. 2. One no. of Test cabinet with coupling cables for testing the breaker in drawout position shall be provided per Switchgear Room.	Bid specification prevails
185	Sec-8	(B)-2.1	For bus rating including and above 2000 A, enclosure shall be of aluminium and for bus rating below 2000 A, enclosure shall be of sheet steel fabricated type.	For all Busbar rating enclosure will be of Aluminium.Pl.confirm	Bid specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
186	8	2.1	For bus rating including and above 2000 A, enclosure shall be of aluminium and for bus rating below 2000 A, enclosure shall be of sheet steel fabricated type.	We shall consider Enclosure of Al for ratings above 4000A as per CEA guidelines	Bid specification prevails
187	Sec-8	(B)-3.1	The conductor shall be of high conductivity aluminium /aluminium alloy sized for the same rating as associated PCC/PMCC bus. for rating above 2000A conductor shall be copper.	For LT Busduct all busbars will be of Aluminium/Aluminium alloy irrespective of ratings to have a common system.Pl.confirm	Bid specification prevails
188	8	3.1	Bus conductor	Aluminium Busbars for all ratings may be acceptable. Please confirm	Bid specification prevails
189	8	4.5	Busbars of PCCs/PMCCs shall be sized to carry continuously the associated transformer secondary current plus a 20% margin. Busbars of MCCs/DBs/SVBs/FBs shall be sized to carry continuously the total running load of the MCC/DB/SVB/FB plus a 20% margin.	The transformer itself is selected with a minimum of 10% margin, hence an additional margin of 20% is not warranted. We would select the busbar rating with a margin of 20% of the max demand on the transformer for that bus.	Bid specification prevails
190	Vol-IVA, Section-8	Cl. No 4.5, Page no 299 of 440	Bus bars of PCC/PMCC shall be sized to carry continuously the associated transformer current plus 20% margin.	Margin already included in the transformer sizing hence Bus bars of PCC/PMCC shall be sized to carry continuously the associated transformer current. Please confirm.	Bid specification prevails
191	8	4.6	LT Switchgear :- Minimum height of motor starter module shall be 400 mm & for SFU 300 mm	The module sizes shall be as per manufacturers standard as these modules are already type tested.	Bid specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
192	Vol-IVA, Section-8	Cl. No 4.6, Page no 299 of 440	Minimum height of motor starter module shall be 400mm and for SFU 300mm.	Minimum height of motor starter module shall be as per manufacturer standard however the working operating height of the boards shall be maintained as required. Please confirm.	Bid specification prevails
193	8	4.8	Incomer feeders & outgoing feeders rated upto and including 400A shall be SFU. Above 400A all incomers & outgoing feeders shall be breaker (ACB) controlled	Incomers / Bus couplers / Outgoing feeders rated up to and including 630A, shall be switch fuse controlled. Above 630A shall be breaker controlled.	Bid specification prevails
194	Sec-8	4.9 & 5.12.1	For motor rated 75kW and above shall be provided with Numerical Motor protection Relay	All breaker control for motors 90kW and Above only will be provided with Numerical relay, as motor below 90kW are Fuse protected. Pl.confirm	Bid specification prevails
195	8	4.9	All motors rated 90kW upto and including 160kW shall be breaker controlled.	Bidder's understanding is that MCCB is acceptable.	Bid specification prevails
196	8	4.12	Incomer and Bus-sections of all MCC/PMCCs shall have provisions for remote operation	Incomer and Bus-sections of all PMCCs & Breaker controlled Incomer and Bus-sections of MCCs shall have provisions for remote operation	Confirmed.
197	8	5.1.2	PCCs/ PMCCs /MCCs shall be drawout type. DBs/ FBs / SVBs shall be fixed type.	DC Starter Panel shall be non drawout type. Please confirm.	confirmed.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project Pre - Bid Queries Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A					
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
198	8	5.1.3	PCCs/DBs/SVBs shall be of single-front construction and PMCCs / MCCs shall be of double-front construction. Breaker panels of PMCCs shall be of single-front construction.	Please note that we will consider PCCs, MCCs with Double Front construction, draw-out type as per practice and for optimum utilization of space. DB's shall be fixed type and may be single front or double front type depending on the no. of ensuing feeders, size of DB, space constraints, etc.	Bid specification prevails
199	Sec-8	A) 5.1.6 & 5.1.1	Base frame of 100mm height	Base frame height will be 50mm.Pl.confirm	Bid specification prevails
200	Sec-8	(A)-5.2.2 & (B)-1.4(a)-iv	Horizontal and vertical busbars and bus connections shall be of high conductivity copper/aluminium alloy. For rating above 2000A, conductor shall be copper. The Max. temp rise for busbars shall be limited 35 deg. C over 50 deg. C.	For LT swgr. all busbars will be of Aluminium/Aluminium alloy irrespective of ratings to have a common system. The Max. tem rise will be 40 deg. C above 50 deg. C.Pl.confirm	Bid specification prevails
201	8	5.2.2 & B1.4	Temperature rise	We propose Temperature rise shall be limited as per IS:8084/IEC-60439.	Bid specification prevails
202	8	5.3	Module	We will consider the switchgear components selection with type-2 co-ordination .	Bid specification prevails
203	8	5.9.1	All indicating instruments (96 x 96 mm) shall be switchboard types, with 240 Deg. scale, anti-glare glass and accuracy class of $\pm 2\%$ full scale. Each meter shall have zero adjuster on the front.	Only 90 Deg scale is possible in LT switchgear.	confirmed.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
204	Vol-IVA, Section-8	Cl. No 5.9.4, Page no 311 of 440	Metering for energy auditing and accounting meters accuracy class	As per latest CEA guide lines, the meters at generator stator terminals and before tap off to the unit auxiliary transformers are 0.2S class and all other meters associated CTs and PTs are not inferior that of 1.0s class. Please confirm.	Refer Corrigendum (II), vol.IV-A.
205	8	5.12	PROTECTIONS: Under Voltage relay (27) with Timer (2)	We have not considered dedicated under-voltage relay for motor feeders, it shall be from the bus-under voltage relay.	confirmed.
206	8	5.12	PROTECTIONS: REF Relay (64R) & stand by E/F Relay (64 F) shall be provided for all Transformer feed Incomers.	We will not envisaged 64REF for LV service transformer as 64SEF is adequate for the same.	Bid specification prevails
207	8	5.13.2 (a)	All protective relays shall be of numerical microprocessor based multifunctional type having communication facility for connection to DCS through PC via PLC console.	We will envisage Numerical Relays for ACB based for LT Switchgears feeders only.	Bid specification prevails
208	8	5.13.2-c	Vendor shall ensure availability of spare parts and maintenance support for the equipment for at least 15 years from the date of supply.	Availability of spare parts and maintenance support for the equipment for at least 15 years not envisaged	Bid specification prevails
209	8	5.13.2-d	Any foreign relay manufacturer through his Indian partner or subsidiary company in India shall provide application, testing, commissioning and other necessary support for minimum 15 years. They shall also maintain adequate inventory of each type of relay or spares to meet the requirement arising during project execution and plant operation.	Vendors will be selected from Customer approved Vendor list	Bid specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
210	8	6.5	Seal off bushing	We propose FRP Seal-off plates in place of seal of bushing at wall frame for NSPBD.	Bid specification prevails
211	Sec-8	(B)10.1	Impulse voltage withstand test, Water tightness test and Air tightness test for LT busduct	Impulse voltage withstand test, Water tightness test and Air tightness test for LT busduct are not applicable as per IS. Pl.review and confirm.	Refer Corrigendum (II), vol.IV-A.
212	Vol-IVA, Section-8	Cl. No 10.1, Page no 329 of 440	Type tests on LV Switchgear and bus duct	Valid type test report on similar rating equipment shall be furnished for approval hence no type tests are considered in the offer. Please confirm.	Bid specification prevails
213	8	Annx A	Indicative list of 415V Switchgears	The list furnished is not binding and the number of boards will be decided based on the geographical location of the loads. The quantum of boards can decrease or increase as required during detailed engineering.	Noted. However list of switchgear will be subject to approval of owner's during DDE.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
214	8	Annx B	Module Selection, Cable Size & Module Size	It is the normal practise in the Industry that the modules are sized as per the manufacturing practise of the LT switchgear vendors. Hence we request you to accept the same. Further, the cable sizes are decided by sizing criteria specified, this will result in optimum sizes being used for particular applications. Hence we request you to leave the option of selecting the cable sizes also to the Contractor based on sizing calculations. Motor Module selection shall be as per TYPE-2 COORDINATION & Selection chart will be submitted during detail engineering as per the Switchgear manufacturer recommendation. The module sizes shall be as per manufacturers standard as these modules are already type tested.	Bid specification prevails
215	8		General	NSPBD is considered for connection of 433V end of LV service transformers to associated LV switchgear (PCC) for all service transformer rated >1000kVA, rest all PCC tie-connections, connections from primary switchgear (PCC) to secondary switchgear (PMCC / MCC) shall be allowed with adequately sized LV cables.	Bid specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
216	9	4.1.1	Local Control Panel	Local Control Panel shall be provided as per OEM's standard for elevator, hoist, mill bay cranes, sky clamber, FEGT, ASLD field cabinet panel, HEA igniters field panel in boiler area.	Bid specification prevails
217	10	4.1.6	The motor name plate rating shall have at least 10% margin over the input power requirement of the HT driven equipment & 15% for LT driven equipments at rated duty point.	HT & LT Motor name plate rating at 50°C shall have 10% margin over the input power requirement of the driven equipment at rated duty point	Refer Corrigendum (II), vol.IV-A.
218	10	5.2	Motor shall be designed for direct on line starting at full voltage. Starting current shall not exceed 6 times full load current for all auxiliaries except boiler feed pump where the starting current shall be limited to 4.5 times. No further tolerance are applicable on starting current specified above for HT Motor =s.	We propose starting current for all HT Motor shall be restricted to 6 p.u (Including positive IS tolerance) except boiler feed pump where the starting current shall be limited to 4.5 times (Including positive IS tolerance) may be accepted.	Bid specification prevails
219	10	6.1.1	All indoor motor enclosures shall conform to degree of protection IP-55 unless otherwise specified and outdoor motor enclosures shall conform to degree of IPW-55. Motor for outdoor or semi- outdoor service shall be of weather proof construction.	Bidder shall offer all indoor motor enclosures conform to degree of protection IP-55 unless otherwise specified and outdoor motor enclosures shall conform to degree of IP-55 with canopy.	confirmed.
220	10	6.8.1	The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole , GS bolt and washer.	2 Nos. Grounding pads shall be provided for HT motors and grounding studs shall be provided for LT motors on either side of Motor	Bid specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
221	10	7.4.3	Indicator / Switch : Alarm contact rating shall be minimum 0.5A at 220V DC & 5 A at 240 V AC	We understand as alarm contact rating shall be minimum 0.5A at 220V DC OR 5A at 240V AC.	confirmed.
222	Vol-IVA, Section-10	Cl. No 8.1, Page no 375 of 440	Type tests on Motors	Valid type test report on similar rating equipment shall be furnished for approval hence no type tests are considered in the offer. Please confirm.	Bid specification prevails
223	11	6.2.3	The Motor shall be capable of starting at 85% of rated voltage and running at 80% of rated voltage at rated torque and 85% of rated voltage at 33% excess rated torque for a period of 5 minutes each.	Bidder shall offer Motorized Actuator as per IS : 9334-1986 and IS : 325	Bid specification prevails
224	12		Specification for VFD	Specification of VFD for Elevator , Coal Feeder , RAPH & MRS Motor shall be as per OEM's standard.	Bid specification prevails
225	Vol-IVA, Section-13	Cl. No 5.1 and 5.2, Page no 431 of 440	Type tests on Aux transformers	Valid type test report on similar rating equipment shall be furnished for approval hence no type tests are considered in the offer. Please confirm.	Bid specification prevails
226	13	Data sheet-A, 25.0	Data Sheet-A: Aux. Supply 415V±10%, 3ph. 50Hz±3%...	We are considering Aux. Supply 415V±10%, 3ph. 50Hz±5% as per spec. mentioned in Vol IV A Section 1, page 58 of 440, Annexure A, Clause no. 3.1.b . Please confirm.	Confirmed;(refer sec IV-B, 1st point.)

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
227	General Electrical Requirement		All Electrical equipment - Routine Tests	Routine Test : During manufacture and on completion, all electrical equipment shall be routine tested at manufacturer work in accordance with relevant sections of IS / IEC / Relevant Standards. QAP will be submitted during detail engineering in line with the same & as per as per manufacturer practice.	Bid specification prevails
228	General Electrical Requirement		All Electrical equipment - Type test & Special Test	Type Test : Valid type test certificates for the tests listed in IS / IEC will be submitted for acceptance during detail engineering. Type test certificates will not be older than 5 years from the date of opening of the tender. No fresh type test / special test envisaged. Short Circuit test will not be conducted & only test certificates / calculations will be submitted.	Bid specification prevails

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

RESPONSE TO PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1

VOLUME - IV B

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
1	1	1.4 Data Sheet-A:	Rated Frequency and allowable Variation - 50Hz±3%	We shall consider 50Hz±5% as mentioned in Vol IV A Section 1, page 58 of 440, Annexure A, Clause no. 3.1.b. Please confirm.	Confirmed
2	1	Data sheet - A, 2.7	Data sheet - A Temp rise	We propose the temperature rise of resistor element shall be as per IEEE 82.	Bid Specification prevails
3	2, 6 & 13	1. 3.1.4 1.22	MVA rating of the transformer, ... Transformer offered by the bidder shall be sized according to the maximum demand considering additional running of one largest standby motor with driven equipment, ...	Stand by motor loading shall be considered only when process allows the same for normal working condition of the plant. When, standby motor will be considered for transformer sizing, maximum 70% loading of stand by motor shall be considered.	Confirmed
4	2	2.1.1	For 240V AC supply :	"CBIP Manual on Transformers" shall also be referred in addition to the standards listed in the specification & the offered transformer shall be as per manufacturer standards also.	Bid Specification prevails
5	2	3.1.4	15% margin shall be considered while calculating the total load on transformer	10% of design margin over maximum consumed power shall be considered.	Bid Specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
6	2	3.1.4	All anticipated future loads in or around the load centres shall be taken into consideration while finalising size of L.T. Transformers.	In the absence of data on future requirements, we have not sized the transformers for future load requirements. Also We confirm that, the transformer sizing calculations will be done considering the approved mechanical load list & the same will be submitted for Owner's approval during detail engineering. Hence no other additional margin shall be considered.	Design margin takes care of future loads.
7	2	3.8	REF & Standby protection CT's shall be provided on transformer.	As we have proposed that SEF is adequate for LT Service transformer and REF shall not be envisaged, Current Transformer for SEF shall be provided.	Bid Specification prevails
8	2	4.12.3	The interior surface shall be finished with..... RAL 7032	Same Interior and exterior colour shade RAL 7032 shall also be permitted. Please confirm	Confirmed
9	Vol-IVB, Section-2	Cl. No 5.2, Page no 33 of 457	Type tests on dry type transformers	Valid type test report on similar rating equipment shall be furnished for approval hence no type tests are considered in the offer. Please confirm.	Bid Specification prevails
10	3	2.1.1	Additional Battery & Battery Charger if required shall be provided	If required, DC load requirement for other areas shall be distributed thro' DCFBs & the same shall be fed from nearest DCDBs	Bid Specification prevails. However, total DC requirements of the system should be fulfilled by the bidder.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
11	3 & 10B	2.1.1 & 3.2.1	2.2.1: (a) 220V battery sets (Plante) 3.2.1: Battery shall be Lead -Acid Plante type.	We propose to use Plante or Ni Cd batteries. Firstly, the approved vendor list allows for vendors of Ni Cd. Plante would be very specific to a vendor and would defy the logic of an EPC route for project execution. Secondly, 172 cells is indicated in Battery charger diagrammatic scheme which implies the provision of NiCd battery. Thirdly, the use of mild steel racks is indicated in Vol.V, Section 10B, which is applicable for NiCd batteries. Also, NiCd batteries are being executed in running Owner projects.	Bid specification prevails, Cl.3.2.1 stands as valid.
12	3	4.1.3	Design margin	We shall consider 10% design margin as recommended by IEEE and temperature correction factor as per manufacturer's recommendation.	Bid Specification prevails. However, total DC requirements of the system should be fulfilled by the bidder.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
13	3	4.1.3	The procedure for estimating battery capacities shall be as per guidelines stipulated in latest revision of IEEE Std. 485 for Lead acid Battery. Derating factor for prolonged float charging shall be duly taken into account, as applicable, in estimating battery capacity. While estimating battery capacities, aging margin as per relevant standard, temperature correction factor as per manufacturer's standard and a design margin of 20% shall be considered.	We propose to consider the ageing factor shall be as per IEEE-485, however, temperature correction factor shall be as per manufacturer's recommendation.	Bid Specification prevails
14	3	4.2.7	If float charger fails, it will be annunciated in the control room and stand-by float charger of the float cum boost charger will have to cut into the circuit automatically by double pole double throw switch to take over the function of float charger.	As per Cl.no. 4.2.4.b of the same specification, the float-cum-boost charger will be normally in standby mode (Auto float/charge) and will cut into the circuit automatically to take over the functions of a float charger in case of its failure. Same is contradicted in Cl.4.2.7. We have considered design as per Cl. No. 4.2.4.b	Confirmed
15	Vol-IVB, Section-3	Cl. No 6.1.1, Page no 63 of 457	Type tests on Battery and charger	Valid type test report on similar rating equipment shall be furnished for approval hence no type tests are considered in the offer. Please confirm.	Bid Specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
16	3	Data Sheet - 1.0	Lead Acid 5 Sets or more if required	If required, DC load requirement for other areas shall be distributed thro' DCFBs & the same shall be fed from nearest DCDBs	Confirmed
17	3	Data Sheet - 1.4	Number of cells per Battery - 110	Number of Cells, AH Rating & Quantity mentioned in this clause are considered for tender purpose only & not considered as minimum requirements. During detail engineering, battery sizing calculation will be done as per the sizing methodology listed in IEEE 85 & the same shall be submitted for Owner's review & approval.	Bid Specification prevails
18	3	Data Sheet - 1.6	Battery Capacity - Main Plant : 2sets each 3000AH or more, AHP : 1 set 250AH or more, CHP : 1 set 250AH or more, CW System & Raw Water : 1 set 250AH or more.	Number of Cells, AH Rating & Quantity mentioned in this clause are considered for tender purpose only & not considered as minimum requirements. During detail engineering, battery sizing calculation will be done as per the sizing methodology listed in IEEE 85 & the same shall be submitted for Owner's review & approval.	Bid Specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
19	3	1.6 Data sheet-A	Battery capacity at 27°C Main Plant – 2 sets each of 3000Ah or more AHP- 1 set of 250 Ah or more CHP- 1 set of 250 Ah or more Raw water & Cooling water system- 1 set of 250 Ah or more	We understand that battery AH shall be selected as per ratings derived from calculation and 3000AH rating as mentioned shall not be considered as the minimum rating.	Bid Specification prevails
20	3	Data Sheet - 3.5	Discharge Resistor Bank : Cooling - Natural Air Cooled	Shall be Forced cooling type as per manufacturer recommendation	Bid Specification prevails
21	4 & 10B	1.2.2 & 2.1.9	Data sheet A 1.2.2: Min Temperature: 3 Deg C 2.1.9: For the purpose of estimating battery capacities, the maximum and minimum temperatures shall be considered as 50oC and 5oC respectively.	We are considering minimum temperature as 13 Deg. C in line with Vol IV-A, Section-1, Cl. No. 4.2.b.	Bidders to follow as per Data sheet A 1.2.2: Min Temperature: 3 Deg C.
22	4	3.4	Armouring	Armouring for multicore cables will be flat GS Strips and round Al wire for single core cables may also be permitted. Please confirm	Bid Specification prevails
23	4	4.6.1	i. Minimum size of LT cable to be chosen as below: Al-16 Sq.mm	We propose to consider minimum Al-10 Sq.mm for fractional motors. Please confirm.	Bid Specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
24	4	4.6.1-b	Cable : Selection Criteria - Cables from PCC to MCC/ACDB shall be sized for selected busbar rating of MCC/ACDB	Cables from PCC to MCC/ACDB shall be sized for maximum connected load of the respective MCC/ACDB	Bid Specification prevails
25	4	4.6.1 d	Cables, for circuit breaker controlled outgoing feeders for motors and transformer shall withstand the short circuit current for the fault clearing time of 0.2 Sec. and 1.0 Sec. for tie feeders & Incomers of 11kV, 3.3kV and 415 volt system.	3.3kV minimum cable size will be selected based on calculated fault level vide system study calculations.	Bid Specification prevails
26	4	4.6.1 (g)	For loads fed from local panels, the total running voltage drop in cable from 415V PCC to local panel and from local panel to individual motor shall be limited to 3% at full load motor current while the same during starting shall be limited to 15%.	Voltage drop at motor terminals is permitted at 5% during steady state and 15% during starting conditions may please be accepted as per standard engineering practice.	Bid Specification prevails
27	4	4.6.1-h	Cable : Selection Criteria - Current carrying capacity of cables should be 110% of full load current after considering the derating factors	Current carrying capacity of cables shall be 100% of full load current after considering the derating factors	Bid Specification prevails
28	4	4.6.1 (h (i))	Size of LT cable	Al cables is 4sqmm of may also be acceptable as per standard engineering practice.	Bid Specification prevails
29	4	4.6.4-a, 4.6.5, Annx A	Cable Sizes to be used	Cables sizes mentioned are not considered as the standard cable sizes to be used. Detailed cable sizing calculations furnishing the dip, drop and fault current withstand ratings, will be submitted during detailed engineering to confirm compliance with the sizing criteria for every cable selected.	Bid Specification prevails
30	4	4.6.7	Multi core control cables will generally have spare conductors in accordance with following Chart: (Table)	16C and 19C control cables shall also be considered. Please confirm	Bid Specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
31	Vol-IVB, Section-4	Cl. No 5.0, Page no 86 of 457	Type tests and additional tests on cables	Valid type test report on similar rating cables shall be furnished for approval hence no type tests are considered in the offer. Please confirm.	Bid Specification prevails
32	Sec-5	1.1.1	Control and Relay Panel for GT, UT1 & 2, ST1 & ST2--Quantity- One No. for each equipment	a) 1 No. generator Relay Panel (GRP- with different vertical sections) will be provided for Generator, GT, UT Combined and 1 no. b) Station Transformer relay panel (STRP- with different vertical sections) for ST1 and ST2 combined for each of wiring and interface. Pl.confirm	a) 1 No. generator Relay Panel (GRP- with different vertical sections) will be provided for Generator, GT, UT Combined and 1 no is acceptable. b) However for ST1 and ST2 separate panels shall be provided.
33	Sec-5	2.3 (d)	EHV substation (generator bay breakers and ST bay breakers) are not to be included in ECP for operation, Control and Monitoring	Pl. note that EHV Generator Bay breaker are to be provided on ECP for Generator synchronising, Control etc. Pl.confirm	Confirmed. Refer to Corrigendum II, Vol.IV-B, Section 5, p.114 / Cl.2.3
34	Sec-5	2.4 (f)	Operation of protection relays (including trip circuit supervision relay) for 11kV, 3.3kV and 415V breakers of Unit and Station boards except for motor breaker feeders shall be provided on ECP.	Only trip circuit supervision alarm for breakers of 11kV, 3.3kV & 415V will provided on ECP. Operation of protection relays will be provided in DDCMIS.Pl.confirm	Bid Specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
35	Sec-5	2.4 (K)	Status (ON, OFF, Auto, Manual) of GT, UT & ST cooling fans and Pums shall be provided on ECP.	These status will be provided in DDCMIS and not on ECP.Pl.confirm	Bid Specification prevails
36	Sec-5	2.4 (l)	Auto change-over status of 11-3.3kV and 415V unit and Station boards shall be provided on ECP.	Auto change-over status of 11-3.3kV and 415V unit and Station boards will not be provided on ECP. However, these can be provided in DDCMIS.Pl.confirm	Auto change over status for 11 & 3.3 KV shall be provided on ECP. For 415V should not be provided. Refer to Corrigendum-II,vol.IV-B.
37	5	8.8.1	UAT-SAT Differential protection	We shall consider 87T applicable for transformer rating greater and equal to 5 MVA	Confirmed
38	5		General, back-up/auxiliary relays	Bidder shall consider back-up/auxiliary relays as electro-mechanical type.	Only auxiliary relays shall be electro-mechanical type. Back up relays shall be of same type as main relays.
39	6	1.0	The specification for Auxiliary power transformer is specified in volume IV-A and IV-B.	Please confirm which volume is to be referred for the specification of auxiliary transformers.	Both section shall be referred for respective transformers. a) Section IV - B for : UAT - 2 Nos & SAT - 2Nos b) Section IV - A for : AHP - 2 Nos, CHP - 2 Nos & Fire/Raw Water Transformer - 2 Nos

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
40	Vol-IVB, Section-6	Cl. No 5.2, Page no 183 of 457	Type tests on Aux power transformers	Valid type test report on similar rating equipments shall be furnished for approval hence no type tests are considered in the offer. Please confirm.	Bid Specification Prevails
41	6	8.0	Auxiliary equipment REF CT	In case of REF line side CT is considered in Switchgear, the same would not be provided in transformer.	Accepted .
42	7	2.1 (b)	Lighting fixtures with lamps & LED type fixtures for main road, secondary road & Perimeter compound lighting.	We propose conventional fixture like 250W HPSV for Street lighting fixtures inplace of LED type fixtures for approach Road lighting. Please confirm.	Confirmed
43	Sec-7	5.2.3 (c)	DC lights will be ON all time-normally from station AC.	DC lights will normally OFF when AC and Emg. AC Lights are ON. For energy saving DC lights will normally OFF and it will ON only when AC and Emg. Power are not avialable.	Refer to Corrigendum-II, vol.IV-B
44	7	5.4.4	Lux level to be considered for various areas	We have considered lux level as per CEA guidelines, relevant IS / CBIP, and supporting area-wise lux calculations, fitting selection criteria shall be furnished during detail engg. stage for Purchaser's review	Bid Specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
45	Vol-IVB, Section-7 Vol-IVB, Section-13	Cl. No 6.15.6,a, Page no 222 of 457 Cl. No 3.2.1, Page no 427 of 457	Minimum 8 no's high intensity aviation lights..... Medium Intensity and Low intensity AOLs for Chimney	The Aviation lights required for the chimney was mentioned differently in two clauses as mentioned. Please clarify the type and number of AOL to be considered.	Refer to Corrigendum-II, vol.IV-B
46	7	General-	Boundary wall illumination	Bidder understand that boundary wall illumination is not in scope of Bidder.	Boundary wall illumination Included in bidder scope
47	7	General-	Watch tower illumination	Bidder has not considered watch tower illumination in its scope of work.	Watch tower illumination Included in bidder scope
48	10	1.12	Data sheet-A Fire stop mortar seal	We propose to consider fire resistance seal suitable for 2Hrs as per standard practice.	Specification prevails
49	10	2.4.4	Earthing conductors reinforcement rods. Minimum concrete cover above earthing flat shall be 50 mm.	We propose to consider earthing conductors reinforcement rods. Earthing flat shall be embedded in 50mm finish flooring.	Confirmed
50	10	4.1.1 & 4.1.5 (a)	4.1.1: "Earth resistance value shall be less than 0.5 ohm for earthing system." 4.1.5.(a) ".....The length of ground conductors below earth will be sufficient to ensure a ground resistance less than one (1) ohm.	As per IS 3043 we will consider Earth Resistance less than one (1) ohm.	Bidder should follow as per clause no 4.1.1: "Earth resistance value shall be less than 0.5 ohm for earthing system." 4.1.5.(a) ".....The length of ground conductors below earth will be sufficient to ensure a ground resistance

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
51	10	8.0	Routine & Type Tests	Routine tests shall be carried as per IS 325. Regarding type test, we confirm that, We will be sourcing the motors from reputed manufacturers / approved vendors who have vast experience in motors of similar or higher rating. Hence we request you to accept only review of type test reports.	Bid Specification prevails
52	14	2.2	Tender drawing no: 518 P0 _SLD for Chimney Elect_ system Each lighting distribution board shall be provided with an adequately rated dry type, Delta/star lighting transformer	We would like to consider one number of Dry type isolation transformer of Dyn connection for Emergency power distribution board. Lighting transformer is not considered in Main power distribution board. Kindly confirm.	Tender drawing # 518 deleted. Refer Corrigendum-II, vol.IV-B also.
53	14	4.4	Chimney Elevator machine room	We have not considered any separate Elevator machine room, However the panels shall be located at FFL. Kindly confirm.	If equipment requires room, it shall be provided.
54	12	5.1.4	Noise level of engine shall be 90 db at a distance of 1 meter from the engine and its various components.	For the rated power required for the emergency diesel generator, such noise limit of 90 dB(A) at a distance of 1 m from the engine cannot be achieved. The noise limit shall be met in accordance with MoEF guidelines as applicable for DG set.	Confirmed

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
55	12	5.1.4	Diesel Engine generator noise level	For DG sets above 1000kVA, Noise from DG set may be controlled by providing an acoustic enclosure. The acoustic enclosure shall be designed for minimum 25 dB (A) insertion loss or for meeting the ambient noise standards, whichever is on the higher side (if the actual ambient noise is on the higher side, it may not be possible to check the performance of the acoustic enclosure. Under such circumstances the performance may be checked for noise reduction up to actual ambient noise level, preferably, in the night time). The measurement for Insertion Loss may be done at different points at 0.5 m from the acoustic enclosure, and then averaged. Bidder shall offer DG set higher than 1000kVA & hence we shall follow above mentioned CBCP guide lines.	Confirmed

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
56	12	5.10.4 Data sheet A / 2.8	Insulation	1. Please note that Class F insulation alternator is manufactured only for HT DG sets 3.3 kV and Above. Alternator for any LT DG set (415V) shall have Class-H insulation with temperature rise limited to Class F. Hence Class H insulation with temp rise limit to class F shall also be considered. 2. Excitation system of Brushless alternator is Govern through Digital AVR which is inbuilt feature of Microprocessor base Controller; hence there is no separate provision for manual control is required	Bid Specification prevails
57	12		General	AVM pads as per manufacturer design shall in place of foundation bolts shall also be considered..	Bid Specification prevails, &AVM pads if required, shall be provided.
58	12		General	The electronic governor provided on the engine has built in protection against over-speed. Separately manually adjustable mechanical over speed protection is not envisaged	Bid Specification prevails
59	Vol-IVB, Section-13	Cl. No 3.2.1, Page no 427 of 457	Additional Type tests on FRLS cables	Valid type test report on similar rating cables shall be furnished for approval hence no type tests are considered in the offer. Please confirm.	Bid Specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
60	14	1.2 (b)	"Electrical system for Elevator"	No elevator is envisaged for NDCT in line with industry practices	Refer to Corrigendum II,vol.IV-B.
61	14	7.1	"The required number of 204 mm dia., 20004mm long, lead coated copper air termination rod with standard GI dome and spikes on one end and 150mm x 6mm thk."	It seems diameter shall be 20.4mm instead of 204mm.	Refer to Corrigendum II,vol.IV-B.
62			DG and Compressor building	DG building shall be located in transformer yard near to power house switchgear room to reduce voltage drop between DG and emergency MCC. Please confirm the acceptance.	Bid Specification prevails
63		DWG No. PE-189-EL-SK-5007, Issue-P1, Key Single Line Diagram for Water supply arrangement from Tapi river PH Notes - 6	110V DC supply & 240V AC supply at site. Shall be tapped from existing DC & AC system.	Please provide physical locations of the DC & AC sources from where we need to tap the supply.	ADDITIONAL WATER SOURCING as per Addendum -I is deleted from the scope , hence not appilcable.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project**Pre - Bid Queries****Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-B**

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
64		DWG No. PE-189-EL-SK-5007, Issue-P1, Key Single Line Diagram for Water supply arrangement from Tapi river PH	GA drawing	Please provide complete GA drawing indicating physical locations of all Electrical equipment including 12.5 MVA transformers, Switchgears, Motors etc.	ADDITIONAL WATER SOURCING as per Addendum -I is deleted from the scope , hence not appilcable.
65		DWG No. PE-189-EL-SK-5007, Issue-P1, Key Single Line Diagram for Water supply arrangement from Tapi river PH	connection of 12.5 MVA transformer with 6.6kV Raw water switchgear	As per key SLD, we understand that connection of 33/7 kV, 12.5 MVA transformer 1 & 2 with 6.6kV Raw water switchgear -1 & 2 is done by HT cable and shall be replaced by HT cable only. Please confirm.	ADDITIONAL WATER SOURCING as per Addendum -I is deleted from the scope , hence not appilcable.
66		DWG No. PE-189-EL-SK-5007, Issue-P1, Key Single Line Diagram for Water supply arrangement from Tapi river PH	Interfacing with protection panel of 12.5 MVA transformer	We understand that protection of 33/7 kV, 12.5 MVA transformer - 1 & 2 is covered in their protection panels and no interfacing with their protection panels is envisaged by us in our scope of work. Please confirm.	ADDITIONAL WATER SOURCING as per Addendum -I is deleted from the scope , hence not appilcable.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
67		DWG No. PE-189-EL-SK-5007, Issue-P1, Key Single Line Diagram for Water supply arrangement from Tapi river PH	Outgoing cables from 6.6kV Raw water switchgears	We understand that all the outgoing cables from 6.6kV Raw water switchgears - 1 & 2 up to Terminal box of motors and HV bushings of 6.6/433 kV transformers are in scope of replacement by us. Please confirm.	ADDITIONAL WATER SOURCING as per Addendum -I is deleted from the scope , hence not appilcable.
68		Addendum - 1, Technical Specification for additional sourcing of Raw water	Below ground earthing	We understand that complete below ground earthing of pump house including for one No. new pump is already in existence and need not to be replaced. Please confirm.	ADDITIONAL WATER SOURCING as per Addendum -I is deleted from the scope , hence not appilcable.
69		Addendum - 1, Technical Specification for additional sourcing of Raw water SCOPE OF WORK, 3.7,	The MCC for pumps providing power supply to the pumps shall be provided in the adjoining room of the raw water intake pump house.	We shall not supply or replace any MCC for Raw water PH. We understand that no MCC related works is included on bidder's scope of work. Please confirm the acceptance.	ADDITIONAL WATER SOURCING as per Addendum -I is deleted from the scope , hence not appilcable.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
70		Addendum - 1, Technical Specification for additional sourcing of Raw water 7.2.2,	Removal of these cables from Trays, trenches, underground locations & transport & storing them at suggested location.	We understand that no replacement works or any other work shall be carried out for existing trays and accessories. Please confirm.	ADDITIONAL WATER SOURCING as per Addendum -I is deleted from the scope , hence not applicable.
71		Addendum - 1, Technical Specification for additional sourcing of Raw water 7.2.2	Removal of these cables from Trays, trenches, underground locations & transport & storing them at suggested location.	We understand that existing trenches and underground locations related to cables need not to be altered if not needed to be. Please confirm.	ADDITIONAL WATER SOURCING as per Addendum -I is deleted from the scope , hence not applicable.
72		Addendum - 1, Technical Specification for additional sourcing of Raw water 7.2.3	Removal of existing switchgear panels bus section wise and transport & storing them at suggested location.	Please provide the storage location distance from RWPH. Also provide necessary drawings related to the same.	ADDITIONAL WATER SOURCING as per Addendum -I is deleted from the scope , hence not applicable.
73		Addendum - 1, Technical Specification for additional sourcing of Raw water 7.2.5	Design, engineering, manufacturing, testing at works, Insurance supply to site, unloading, checking, storage, erecting / installation at site testing & commissioning and putting into successful commercial operation of the following electrical equipment.	We shall not carry out any design calculation for the equipment to be replaced since the rating of the same remain unchanged even after replacement. Please confirm the acceptance.	ADDITIONAL WATER SOURCING as per Addendum -I is deleted from the scope , hence not applicable.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
74		Addendum - 1, Technical Specification for additional sourcing of Raw water 7.2.5	Design, engineering, manufacturing, testing at works, Insurance supply to site, unloading, checking, storage, erecting / installation at site testing & commissioning and putting into successful commercial operation of the following electrical equipment.	Please provide detailed technical specifications for all the items to be replaced. We shall not carry out any separate design calculation for the existing equipment that are to be replaced. Please confirm the acceptance.	ADDITIONAL WATER SOURCING as per Addendum -I is deleted from the scope , hence not applicable.
75		Addendum - 1, Technical Specification for additional sourcing of Raw water 7.2.7	Grounding for the entire system	We have included only above ground earthing for one No. new motor and any additional above ground and below ground earthing works is excluded by us. Please confirm the acceptance. Above ground earthing of the equipment to be replaced is included in our scope of work.	ADDITIONAL WATER SOURCING as per Addendum -I is deleted from the scope , hence not applicable.
76		Addendum - 1, Technical Specification for additional sourcing of Raw water	Trays, Trenches	We understand that for one No. new motors, the space for cables is available in present trays and trenches. Please confirm.	ADDITIONAL WATER SOURCING as per Addendum -I is deleted from the scope , hence not applicable.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
77		Addendum - 1, Technical Specification for additional sourcing of Raw water 7.3.6	LOCAL CONTROL PANEL -Height Height - panel height shall match with existing panels. Working height of panels shall be limited between 750 mm & 1800 mm.	Please provide heights of existing panels.	ADDITIONAL WATER SOURCING as per Addendum -I is deleted from the scope , hence not applicable.
78		Addendum - 1, Technical Specification for additional sourcing of Raw water 9.4, CIVIL	Providing and Laying pipe line including their supports and foundations, thrust blocks etc. wherever required including earth mat/lightening protection.	Please note that we have not considered any earth mat or lightening protection scope for RWPH and related piping. Please confirm the acceptance.	ADDITIONAL WATER SOURCING as per Addendum -I is deleted from the scope , hence not applicable.
79	-	-	General - Creepage Distance - 31 mm/kV	Creepage Distance of 25 mm/kV considered	Bid Specification prevails
80	General Electrical Requirement		All Electrical equipment - Routine Tests	Routine Test : During manufacture and on completion, all electrical equipment shall be routine tested at manufacturer work in accordance with relevant sections of IS / IEC / Relevant Standards. QAP will be submitted during detail engineering in line with the same & as per as per manufacturer practice.	Bid Specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
81	General Electrical Requirement		All Electrical equipment - Type test & Special Test	Type Test : Valid type test certificates for the tests listed in IS / IEC will be submitted for acceptance during detail engineering. Type test certificates will not be older than 5 years from the date of opening of the tender. No fresh type test / special test envisaged. Short Circuit test will not be conducted & only test certificates / calculations will be submitted.	Bid Specification prevails
82	----	7.2.5(a) and key single line diagram no. PE-189-EL-SK-5007/P1	Notes .3:- All HT cables-----, XLPE, 3 Core ----	For incomer to 6.6kV swgr. from 12.5MVA transformer, it is proposed to use 1C (single core) cable as rating of board is high. Similarly for 110V DC and 240V AC, it is proposed to use 2C (two) core cable. For motors 3C (three core) cable will be used. Please confirm.	ADDITIONAL WATER SOURCING as per Addendum -I is deleted from the scope , hence not appilcable.
83	-----	..Do...	Notes.6:- 110V DC supply & 240V AC supply at site shall be tapped from existing DC and AC system	Please furnish the distance from exsiting DC and AC system for estimation of cables.	ADDITIONAL WATER SOURCING as per Addendum -I is deleted from the scope , hence not appilcable.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-B

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Resolution
84	ADDENDUM -1	2.3	MAHAGENCO also have their own pump house on Tapi River ... dedicated pipe line...	Please furnish Geotechnical details, Longitudinal and cross sectional details along the proposed dedicated pipeline from the existing pump house on Tapi River to the plant site. Also provide the details of existing canal as well.	ADDITIONAL WATER SOURCING as per Addendum -I is deleted from the scope , hence not applicable.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

RESPONSE TO PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1

VOLUME - V

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume V

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
1	1	1.5	Bidder shall furnish a list of recommended back up control & instrument devices for Owner's approval with a write up as to how the unit shall be brought to safe shut-down condition in case of DCS black-out situation without damage to plant, equipment and ersonnel. In general, emergency protective devices like DC lube and seal oil pumps, air motors, hydraulic barring system etc, as offered, shall not depend on DCS for their autostarting.	As per requirement specified in clause Volume: III-B Section-1 , 6.8.1 Offered alternate for Steam Turbine Turning Gear is AC motor driven type , Accordingly Hydraulic barric system is not applicable (Please Confirm.)	Confirmed. However it shall not depend on DCS for their Auto starting during AC Power failure.
2	1	1.5	Complete operation and control of Steam Generator, Turbine Generator, Station, unit and electrical system including metering and auxiliary systems shall be carried out from DCS.	Steam Generator and Turbine Generator controls shall be carried out through dedicated control systems independent of station DCS. Hardwired and soft link interface is envisaged between SG, TG control system and DCS.	Agreed. However it shall be DCS based. PLC based System is not acceptable.
3	1	1.5	There shall be 150 nos. annunciation windows in the back-up panel...	There shall be 150 nos. of alarm annunciation windows in total in Back-up Panel (Electrical Control Panel and Unit Control Panel). Please Confirm.	Confirmed.
4	1	2.8	All modulating devices shall be in stay put condition during any of the above failures.	State of each individual modulating device on failure will be fail safe position which may be open, close or stay put based on process requirement. The same shall be decided during detailed engineering.	Refer the CORRIGENDUM-II TO BID SPECIFICATION VOLUME - V CONTROL & INSTRUMENTATION Sr No 1.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume V

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
5	1	3.4	Bidder shall indicate the year in which the offered models of C&I system have been introduced and how long the commercial production of the same is expected to continue. In any case, Bidder shall ensure supply of spare parts for the lifetime of the plant. In case if it is felt by the bidder that certain equipment is likely to become obsolete, Bidder shall clearly bring it to the notice of the owner and indicate step proposed to deal with obsolescence. Any part/ module not listed in recommended spares shall be deemed to have a life expectancy of 30 years.	During the first ten years of the plant operation, ALSTOM PAC commits itself to support the customer with spares and service. Beyond ten years, Spares and service can be offered "on request" basis through a separate dedicated maintenance contract.	Specification prevails
6	1	3.5	Any part/module of the C&I system which are not.....expected life of the plant i.e. 30 years	Due to continuous technology advancement, upgrades in C&I parts / modules by the manufacturer will be brought to the notice of the Owner / Consultant, in the form of recommended spares for upgradation. Owner may be required to upgrade, before these products become obsolete, even though the life expectancy of these items could be possessing a life expectancy of the plant.	Specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume V

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
10	1	4.13	In general, for temperature measurements up to 300°C, Platinum resistance temperature detectors shall be used unless the area is prone to vibration. For temperature measurement above 300°C up to 750°C, Chromel-Alumel (K) type thermocouple shall be used. For high temperature applications, noble-metal thermocouple (TC) such as Pt Rh Pt (R) type in Inconel sheathed thermowell shall be used.	For temperature measurement above 300°C only K-type T/C will be provided in Boiler and Turbine applications as per OEM's standard practice.	Specification prevails
11	1	4.15	In general, temperature transmitters shall not be used. Instead, temperature elements shall be directly connected to their respective input modules. For non-critical measurement applications (such as measurements for Boiler metal temperature and Generator winding temperature) where the measurements are not used for control/protection, Sensors may be grouped and connected to I/O modules in DCS.	Application of Temperature Transmitter in critical and non-critical temperature measurements will be as per standard & proven practice and grouping of temperature transmitters will be done in local JB's during detailed engineering.	Specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume V

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
12	1	4.15	In general, temperature transmitters shall not be used. Instead, temperature elements shall be directly connected to their respective input modules. For non-critical measurement applications (such as measurements for Boiler metal temperature and Generator winding temperature) where the measurements are not used for control/protection, Sensors may be grouped and connected to I/O modules in DCS.	Now days reliable temperature transmitters are available which can be used for monitoring and interlock function. This will eliminate requirement of special cables and cards at DCS end. Hence, temperature transmitters shall be used instead of connecting temperature elements directly to their respective input modules. However, in boiler area temperature elements will be directly connected except for some equipment like pulverizer lube oil / hydraulic oil, RAPH system etc. where temperature transmitters shall be used as per OEM's standard practice.	Specification prevails
13	1	4.16	In general, temperature switching function shall be configured by use of temperature elements and software configured limit value monitors instead of using conventional field mounted temperature switch.	In some equipment temperature switches shall be used as per OEM's standard practice.	Specification prevails

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
14	1	4.25	All Drives shall have its local control station comprising of start and emergency stop pushbutton and with a local & remote selection switch in SWGR/MCC (Refer electrical volume of the specification). Local stop pushbutton shall always be active. During the trial run of drives from local, safety permit and protection shall be ensured.	Local field operation is not a part of Bidder's standard control philosophy for safety and availability reason.	Specification prevails
15	1	4.29	KKS identification system shall be adopted consistent with the plant equipment numbering system.	Bidder's standard KKS tagging procedure will be followed.	specification prevails

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
16	1	4.30	BMS & MFT shall be tri-fold or triple redundant	As Boiler Protection system, Burner Management System, Turbine protection system, Turbine Governing System are very much critical for the safety of the Boiler and Turbine hence OEM recommendations and implementation procedures as per their proven practice are normally followed. As per OEM proven practice - 1. Stand alone PLC based system with triple redundant controllers shall be provided for implementing Boiler protection system. 2. Burner Management System (BMS) shall be implemented in DCS. These functions shall be implemented in dedicated controllers of the DCS. 3. Stand alone PLC based system with double redundant controllers shall be provided for implementing Turbine protection system in FAIL SAFE DESIGN. 4. Turbine Governing control function shall be implemented in dedicated controllers of DCS. As per OEM practice all above loops are implemented in non SIL3 configuration.	Specification Prevails

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
17	1	4.30	Soot blower control shall be also synthesized from the same family of hardware as the DCS.	Soot blowing system is a bought out item by Boiler OEM and entire system is implemented by the sub vendor including the control system. Hence it is the practice of the OEM to supply a standalone SBC control in Hot redundant configuration PLC. Same is connected to DCS for monitoring and group start /stop.	Refer the CORRIGENDUM-II TO BID SPECIFICATION VOLUME - V CONTROL & INSTRUMENTATION Sr No2.
18	1	4.30	STEAM GENERATOR (SG) INTEGRAL CONTROL AND MONITORING Steam Generator (SG) Integral Control shall be synthesized from the same family of hardware as the DCS and shall integrate seamlessly. Major Boiler controls like Burner Management System (BMS) including Master fuel Trip (MFT) shall be tri-fold or triple-modular redundant and shall be housed in a distinctly separate cabinet set. Secondary Air Damper (SADC), Soot Blower Control and other controls shall be also synthesized from the same family of hardware as the DCS.	Bidder shall offer proprietary BMS, BPS system for boiler control which may not be of the same family of hardware as station DCS. BMS CPU shall be of redundant configuration and BPS shall be of triple modular redundant configuration. BMS and BPS shall have OPC connectivity with station DCS. Soot blower control system shall be stand alone PLC based. SADC control system shall be implemented in station DCS	Refer the CORRIGENDUM-II TO BID SPECIFICATION VOLUME - V CONTROL & INSTRUMENTATION Sr No2.
19	1	4.33	ESP Controls shall have OS in CCR in addition to their local OS for O&M from ESP building	ESP is stand alone system operate from ESP control room only. Monitoring will be in DCS.	Specification prevails

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
20	1	4.33	CW & ACW pumping system & Fuel oil pressurising & heating shall be controlled & operated from DCS unit operator workstation as well as from local operator workstations. Remote processing units shall be provided at appropriate locations for the purpose.	Kindly clarify the type of control system to be used for Fuel oil pressurizing and heating system namely PLC or remote processing unit.	CW,ACW and fuel oil pressurizing & temp. control are to be implemented in DCS. However for fuel oil transfer system PLC system is envisaged as indicated in page no.156 of 223 of Vol. IIIA/Section-3
21	1	4.34 (a) - (iii), (iv), (vi)	ON feedback, OFF feedback, and Electrical Trip (Motor Protection Relay) - DI - 1 COC	As per engineering Module DI wiring will be complicated it should be all COC or NO/NC.	Specification prevails
22	1	4.34 (b) - (iii), (iv) and (c) - (iv)	ON feedback. OFF feedback, and Open limit switch feedback - DI - 1 COC	As per engineering Module DI wiring will be complicated it should be all COC or NO/NC	Specification prevails
23	1	4.34	Above I/Os used in OLCS or CLCS loops shall be redundant	Redundant I/O is not required for all OLCS and CLCS. Normally only critical Loops IOs will be redundant. Please review.	Refer the CORRIGENDUM-II TO BID SPECIFICATION VOLUME - V CONTROL & INSTRUMENTATION Sr No 3.
24	1	4.39	Machine Condition Monitoring System: Continuous monitoring and analysis and all HT motors & their driven	Vibration Anlaysis system for Turbine , generator,Exciter& BFP pumps & for all other HT motors VMs will be provided. Please confirm	Specification prevails

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
25	1	4.40	Conductor cross section for single pair or triad signal cables shall not have individual conductor cross section below 1.5 mm ² and multi-pair or multi-triad cables shall not have individual conductor cross section below 0.5 mm ² . For solenoid valves, depending on pick-up VA, individual conductor cross section shall not be below 2.5 mm ² .	Conductor cross section for single pair or triad signal cables shall not have individual conductor cross section below 0.5 mm ² considering short distance between instrument and junction box. 1.5 mm ² cross section core cables are sufficient enough to drive the solenoid valves. However, higher cross section shall be provided considering the VA requirements. Hence, 1.5 mm ² will be considered as minimum instead of 2.5 mm ² cables.	Refer the CORRIGENDUM-II TO BID SPECIFICATION VOLUME - V CONTROL & INSTRUMENTATION Sr No 4.
26	1	4.40	All spare contacts/terminals on relays, control switches, limit switches or similar devices , duplex RTDs & Duplex T/Cs shall be wired to accessible terminal blocks for Owner's future connections.	For duplex RTDs, T/Cs and control switches spare contacts shall be wired upto respective junction box. For rest of the items only used signals will be wired upto terminal box of respective junction box.	Specification prevails

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
29	1	4.40	Cable quantities included shall be specified in the offer, class wise and pairwise. Any shortfall in cable quantity observed during detailed engineering or actual laying shall be compensated by the contractor by suitable addition cable at no extra cost. The required quantities of cable accessories shall be similarly estimated on the basis of number of terminations and proposed routing of the cables and shall be included in the offer allowing a positive allowance of at least 30% for each accessory. The exact quantity of different accessories shall be specified in the offer.	As the nature of our offer shall be complete EPC on turn-key basis quantity of cables, cable accessories and proposed routing of cables will be submitted during execution. Please confirm.	Confirmed. However the required quantities of cable & cable accessories shall be similarly estimated on the basis of number of terminations and proposed routing of the cables and shall be included in the offer allowing a positive allowance of at least 30% for each accessory.
30	1	4.40/(f)	Scope of supply of cable (f) Interfacing cable (coaxial, fibre optic etc) between owner supplied PLC systems to DCS	Please list the Owner's supplied PLC systems that require interface to DCS.	Refer the CORRIGENDUM-II TO BID SPECIFICATION VOLUME - V CONTROL & INSTRUMENTATION Sr No 5.
31	1	4.40 (I)	(i) All cables shall be paired cables.	Our understanding is that Paired cables will be used only for analog signals and Overall shielded core cable for binary signals. Please clarify.	specification prevails

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
32	1	5.1	The offered model of DCS, Microprocessor based control system must have been successfully supplied, erected, tested and commissioned as complete station Control & Instrumentation system for at least two units of capacity not less than 600 MW supercritical Thermal Power Station(s) with reheat type pulverized coal fired boiler.	The Provenness criteria for DCS should be same as that of STG & SG(C&I) (Refer Vol I, Section 3, CI 2.5) Since the same control system is being supplied for all these applications..	Refer the CORRIGENDUM-I TO BID SPECIFICATION VOLUME - V CONTROL & INSTRUMENTATION Sr No 2.
33	1	5.1	Provenness of equipment	Pl refer vol. V of the specification (Section-1/ cl. 5.1/ page 37 of 718), where it has been mentioned that DCS to be offered have been proven in 2 units of 600 MW or above super critical sets. This is contradicting the clause 2.5.1 and 2.5.2 of Vol-I. Please confirm that for any equipment, the provenness / qualification criteria mentioned anywhere in the tender specification, other than Volume-1, is not to be considered.	Refer the CORRIGENDUM-I TO BID SPECIFICATION VOLUME - V CONTROL & INSTRUMENTATION Sr No 2.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
34	1	5.1	The offered model of DCS, Microprocessor based control system must have been successfully supplied, erected, tested and commissioned as complete station Control & Instrumentation system for at least two units of capacity not less than 600 MW supercritical Thermal Power Station(s) with reheat type pulverized coal fired boiler. Further, these units should be in successful operation for a minimum period of two (2) years.	We propose the requirement to be altered to 'at least one (1) unit of capacity not less than 600 MW supercritical Thermal Power Station(s) with reheat type pulverized coal fired boiler. Further, this unit should be in successful operation for a minimum period of two (2) years.'	Refer the CORRIGENDUM-I TO BID SPECIFICATION VOLUME - V CONTROL & INSTRUMENTATION Sr No 2.
35	1	6.2	Generally, the following latest edition of codes and standards prevailing at the time of award of contract shall be applicable.	Offered Instruments will be either as per mentioned Codes and Standard or as per Bidder's followed codes and standard.	Specification Prevails
36	1	7.5.2 (e)	Signals shall be verified against cable failure.	As per Bidder's standard and proprietary interlock philosophy signals are not verified against cable failure.	Specification prevails
37	1	7.5.3	a. iii. Redundant output card shall be provided for the signals from CLCS going to final drive control elements.	Redundancy in CLCS signals going to final control element will be managed by two different analog output cards located in different racks. We request to confirm that our understanding is correct.	Confirmed.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
38	1	7.9	Solid-state logic systems shall be subject to the elevated temperature test and burn-in test as complete assemblies.	The certificates for the burn-in test shall be provided to the customer.	Specification prevails
39	1	7.9	Solid-state logic systems shall be subject to the elevated temperature test and burn-in test as complete assemblies.	Burn-in tests are manufacturer standard type tests. Wherever type tests have already been conducted, only test results/ certificates shall be submitted for Owners review.	Specification prevails
40	1	9.16	Impulse pipe including taps for furnace, flue gas and coal mill application shall be provided with air purge connection. Differential instruments for such application shall have continuous and as well as intermittent purging. Whereas, pressure measurement shall have only intermittent purging	Continuous Purging shall be considered for Flue gas pressure measurements with positive	Specification prevails
41	2	1.3.18	OTDR & Splicing kit for optical fiber cable testing & maintenance	please mention the quantity	Refer the CORRIGENDUM-II TO BID SPECIFICATION VOLUME - V CONTROL & INSTRUMENTATION Sr No 6.
42	2	1.3.33	A complete microprocessor based Plant simulator unit replacing the plant exactly with the HMI.....	Please clarify we have to provide simulator for BTG or BOP area. Please note that a simulator is not normally required.	Training simulator for BTG (5 nos. operating station)

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
43	2	2.1.1	Supply of spare parts for at least 30 years after commissioning of the plant shall be provided by the bidder.	Due to continuous technology advancement, upgrades in C&I parts / modules by the manufacturer will be brought to the notice of the Owner / Consultant, in the form of recommended spares for upgradation. Owner may be required to upgrade, before these products become obsolete, even though the life expectancy of these items could be possessing a life expectancy of the plant.	Specification prevails
44	2	2.3.1	Testing / calibration / configuring / software development, loading, commissioning of instruments and systems supplied by Bidder as per the guidelines laid down in the specification.	Testing / calibration / configuring / software development etc., is provided as per manufacturer's standard and according to the requirements of the appropriate code i.e. ASME and IBR.	Specification prevails
45	3A	2.10	Bidder shall provide electrically operated retractable type furnace temperature probes at both sides of furnace complete with actuating mechanism, temperature element, position transmitter, limit switches etc. for measuring flue gas temperature.	FEGT probe with duplex K-type thermocouple shall be offered by Bidder.	Specification Prevails

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
46	3A	2.11	Acoustic pyrometer type flue gas temperature measurement shall be provided to determine the average and complete temperature profile at different sections of furnace such as economizer, furnace exit zone etc. System shall be complete with required transmitters & receivers located in different zones, air purging system, monitoring terminal with required hardware, software & colour 24" TFT monitor and colour laser printer etc. The system shall be able to eliminate the effect of varying noise to obtain a high accuracy of measurement. Range shall be adequate to cover boiler operation during all regimes. Accuracy of measurement shall be better than 2%.	As per OEM standard, acoustic pyrometer shall not be provided. FEGT probe shall be used.	Specification Prevails
47	3A	2.22	Continuous air purge connections shall be provided for pressure, differential pressure and flow instruments on flue gas, flue gas/air and coal /air lines to avoid clogging.	Continuous Purging shall be considered for Flue gas pressure measurements with positive pressure where applicable and coal mill applications,. For other instruments in dusty medium, intermittent purging shall be provided.	Specification Prevails
48	3A	3.7	Complete BMS logic configuration, loading and documentation shall be permissible from common DCS engineering station.	BMS shall be proprietary control system provided by OEM, hence complete BMS logic configuration, loading and documentation permissible from common DCS shall not be recommended by OEM.	Specification Prevails

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
49	3A	3.10.1(ix)	FMS/Flame detector testing kit.	No FMS/Flame detector testing kit is envisaged by OEM.	specification prevails
50	3A	6.4.1	O2 in Flue gas path....	O2 analyzer is the integral part of boiler. Same shall be supplied as per Boiler OEM standard practice	specification prevails
51	3A	9	Flue gas velocity measurement & Ultrasonic mass flow meter.	Please clarify, whether flue gas velocity and mass flow meter shall be two separate instruments. We understand that there shall be one instrument to measure the flue gas flow through stack. Owner to confirm our understanding.	Velocity as well as Mass Flow Measurement is required
52	3A	9	Bidder may include an air-conditioned analyzer shelter to accommodate all above analyzers and accessories & the Data acquisition station with an UPS. The optical fibre cables to the control room shall be included.	We will consider in-situ type CEMS analyzers. Hence, we understand that an air-conditioned shelter is not required and the CEMS data acquisition station may be located in the unit control room. Please Confirm.	Specification prevails.
53	3A	10	Ambient Air Quality Monitoring System	Bidder will provide AAQMS having the continuous sensor for Sox, Nox, PM10, PM2.5, CO, CO2, Ozone & Benzene only. No online measuring sensors available for the Lead (Pb), Benzo (a) Pyrene, Arsenic (As) & Nickel (Ni). These can be measured by digesting filter paper of HVS and analysis by AAS/ GC	Refer the CORRIGENDUM-II TO BID SPECIFICATION VOLUME - V CONTROL & INSTRUMENTATION Sr No 8.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
54	3A	10.4	AAQMS shall include monitoring of the following pollutant gases/parameters. (h) Lead (Pb) (i) Ammonia (NH ₃) (j) Benzene (C ₆ H ₆) (k) Benzo (a) pyrene (l) Arsenic (As) (m) Nickel (Ni)	We will not consider monitoring of these parameters in AAQMS package as their concentration in power plant surroundings is negligible. Also, we understand that online measurement of these parameters is not possible. Please review the requirement.	Specification Prevails
55	3A	10.5	AAQMS Total three (3) no's such stations shall be provided at the minimum	Please specify the exact quantity required.	Three (3) nos.
56	3A	10.5	However, during the contract implementation stage, if additional number of such monitoring locations and hence AAQMS Stations are required as per regulatory agencies requirement then the same shall be provided by the Vendor at no extra cost implication to Owner.	We have considered three (3) set of AAQMS stations and one (1) set of Meteorological Monitoring System (MMS) as specified in Tender specification. Any increase in the no. of stations will have cost implications.	Meteorological Monitoring System (MMS) not in bidder scope. Details of existing Meteorological Monitoring System shall be provided.
57	3A	10.8 (k)	Facility to interface existing plant AAQMS shall be envisaged.	Please elaborate the type of interfacing to be envisaged.	Existing AAQMS Central Monitoring system to be interfaced with the new system.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
58	3A	10.9	Technical Specification of AAQMS Equipment & Metrological sensors	We presume that one (1) set of Meteorological Monitoring System (MMS) is to be provided for monitoring of wind speed, wind direction, ambient temperature, ambient pressure, relative humidity and rain gauge. Please confirm.	Refer the CORRIGENDUM-II TO BID SPECIFICATION VOLUME - V CONTROL & INSTRUMENTATION Sr No 10.
59	3B		CONTROL & INSTRUMENTATION FOR STEAM TURBINE GENERATOR, AUXILIARIES & FEED CYCLE EQUIPMENTS	1. TG integral control system like Electro Hydraulic Governor (EHG) control, Automatic Turbine Run up System, Turbine Testing, Turbine Stress Evaluator, turning gear, Turbine Protective Trip System, Turbine Supervisory Instruments etc. shall be as per OEM's standard. Controller family of these control systems may be different from plant DCS. 2. Controls in regenerative cycle such as HP-LP bypass steam system, feed water system, condensate system, drain & vent system, heater drain system, cooling water system, pressure reducing & de-superheating system, generator auxiliaries etc. including their protection & control shall be configured in DCS Owner to note and confirm.	1) TG Integral Control System shall be DCS based. 2) Confirmed.

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
60	3B	2.1	Turbine protection shall be based on triple modular redundant configuration in hardware & software meeting NFPA requirement. Configuration shall be realized with three independent trip channels.	Offered Turbine Protection is 2oo3 configuration, FireProtection is part of Turbine Protection scheme as per Bidder's standard and proven practice.	Refer the CORRIGENDUM-II TO BID SPECIFICATION VOLUME - V CONTROL & INSTRUMENTATION Sr No 11.
61	3B	2.1	Control system shall be designed meeting the criteria of high reliability and maintainability by incorporating fault tolerant hardware and software. Duplex control configuration is envisaged for Turbine EHG control and Generator mechanical protection. Duplex control configuration shall include redundant EHG valves position control modules for EHG. Two channels shall be installed in separate cabinets to avoid common failure.	Redundant Closed Loop Control for Steam Turbine will be provided as part of Integral Turbine Governing and Control System as per standard and proven practice. Accordingly separate cabinet for EHG valves position control modules in not applicable.	Specification Prevails
62	3B	2.1	Redundant EHG valve position control modules	EHG valve position control modules will be as per ALSTOM's standard proven validated practice for all the power plants globally. As per standard OEM practice, the control valve positioning module are distributed in such a way that failure of one module will result in only partial load reduction.Hence redundant EHG valve postion control modules are not envisaged.	Specification Prevails

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
63	3B	2.1	Turbine Protection shall be based on Triple modular configuration.....	As Boiler Protection system, Burner Management System, Turbine protection system, Turbine Governing System are very much critical for the safety of the Boiler and Turbine hence OEM recommendations and implementation procedures as per their proven practice are normally followed. As per OEM proven practice - 1. Stand alone PLC based system with triple redundant controllers shall be provided for implementing Boiler protection system. 2. Burner Management System (BMS) shall be implemented in DCS. These functions shall be implemented in dedicated controllers of the DCS. 3. Stand alone PLC based system with double redundant controllers shall be provided for implementing Turbine protection system in FAIL SAFE DESIGN. 4. Turbine Governing control function shall be implemented in dedicated controllers of DCS. As per OEM practice all above loops are implemented in non SIL3 configuration.	Specification Prevails

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
64	3B	3.6.1	Emergency Over-speed Protection A quick acting emergency over-speed protection system (including emergency governor) shall be provided to close instantly the emergency stop valves, control valves, reheat interceptor stop valves and also the non-return valves in the extraction lines at about 111% of the rated speed in case the speed governor fails to limit over-speed.	Emergency Overspeed Protection act at 110% of the rated speed. Please confirm the acceptance	Refer the CORRIGENDUM-II TO BID SPECIFICATION VOLUME - V CONTROL & INSTRUMENTATION Sr No 12.
65	3B	3.7	SPEED REGULATION The turbine shall be provided with remotely operable speed changer (Speed governor) to control its speed or power output within limits.	Electrohydraulic governor is provided to control speed and power output within limits. Accordingly speed changers are not applicable. Please confirm	Specification prevails
66	3B	3.13.1(b)	Frequency compensation adjustment shall be within 2 to 8%.	As per IEC-45-1 guideline, speed regulation i.e. Frequency compensation adjustment shall be adjustable within 3 to 8% rated speed.	Specification prevails
67	3B	6	BOILER FEED PUMPS 6.1 Control logic & protection for motor driven and steam driven Boiler Feed Pumps shall be configured in DCS and pumps shall be operated from the central control room.	Offered TDBFPs control and protection will be Proprietary Integral Controller and necessary interfaces will be provided by DCS and BFPs PLC for its safe operation and Plant's availability. MDBFP will be controlled from DCS.	Specification prevails

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
68	3C	1.1	Plant auxiliary system (v) Condensate tube cleaning system	Instead of Condensate tube cleaning system it should be read as condenser tube cleaning system.	Confirmed.
69	4	2.3	PLC based local control panel shall be provided for Pre- Treatment plant which will be located in the pre- treatment area.	Separate PLC for PT plant is not considered. Please confirm whether the controlling & monitoring of the same can be done through DM plant PLC. RIO with Push Buttons, annunciation & mimic shall be provided at PT plant.	Specification prevails
70	4	3.9.4	Protection switches shall be connected to a separate indicator panel to be located in the CHP control room.	Protection switch will be connected to separate indicator panel for conveyers. For BF & RBF switches quantity is very less ,it will be easily identified from field as well as control room.	Specification prevails
71	4	4.1 (b)	The drives, valves & field instruments of the four areas are controlled by the PLC (Hot stand by configuration) along with the OWS in the central main control panel(MCP) as well as from respective LCPs.	our under standing is that all operation will be from AHP control room only not from main CCR. Only monitoring in CCR.	All operations will be from AHP Main Control Room and as well as from respective LCPs. Only monitoring from CCR is envisaged.
72	4	4.1 (d)	Necessary Training to owner's representative as prescribed by AERB as precondition of NOC for procurement of nucleonic type density meter is in the scope of the bidder.	We request owner to provide NOC certificate from AERB.	MAHAGENCO will cooperate for obtaining NOC from AERB

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Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
73	4	TABLE 1.0	All PLC shall be of same make.	It is difficult to adhere to this requirement, as manufacturers of various equipments and plants have their own standard makes for PLCs. However the PLCs shall be as per the approved vendor list. Please confirm.	specification prevails
74	4	TABLE 1.0, 6.11	Laptops for PLC based systems shall be provided inline with requirements mentioned in Vol-V/ Sec-5 in this document. In addition 3 no. (three) laptop unit loaded with all PLC system software shall be furnished.	The quantity of laptop is not clear. We understand one common Laptop loaded with engineering software is to be provided for all offsite plant control system.	Three (3) nos. All 3 loaded with all PLC software
75	4	TABLE 1.0	Control system for Air conditioning system shall be PLC based.	Separate PLC for Air Conditioning system is not considered. We will be considering control through microprocessor based local control panel.	Specification prevails
76	5	1.9.2	Wire gauge: 16 AWG for Type-K, 24 AWG for Type-R.	As per bidder's standard practice 0.5 mm ² (20 AWG) cable shall be used for thermocouple cables.	Specification prevails
77	5	1.24	CO, NOX, and Moisture Analyser - Combined Insitu analyser	To clarify the specific requirement of such a combination of insitu gas analysers, including its approved vendors.	This is for monitoring & PADO application
78	5	1.35	I/P converter	Kindly clarify the type of positioner for control valves & RPC's.	Smart electro-pneumatic positioner

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume V

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
79	5	1.37.5	Solenoid Valve Body: SS bar stock.	Solenoid Valve Body shall be of Brass or Aluminium body.	Specification prevails
80	5	3.7.2	Diaphragms shall be designed for 200% maximum operating pressure.	Diaphragms shall be designed for 150% maximum operating pressure normally, because actuator size will increase in proportion to maximum operating pressure. Diaphragms will be designed 150% and it will be enough for operating.	specification prevails
81	5	3.8.1	Regulating duty valves shall be offered with smart electro pneumatic positioners to ensure accuracy and repeatability of response.	Kindly clarify the type of positioner for control valves & RPC's.	Smart electro-pneumatic positioner
82	5	4.2.3 (b)	Thickness of Sheet: (i) 2.0 mm for faces supporting instruments / terminals.	We proposes sheet thickness shall be of 1.5 mm. Please confirm	Specification prevails
83	5	4.2.3 (d)	Cabinets/Enclosure/Panels:- Panel height : 2300 mm. (approx)	Height shall be 2100mm.Please confirm.	Specification Prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume V

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
84	5	4.2.3 (f)	Doors : Double, recessed, turned back edges. (i) Thickness of Sheet : 2 mm. (ii) Hinges : Stainless steel. (iii) Door latches : Three point type. (iv) Door gaskets : Neoprene rubber on fixed frame to result dust proof/weather-proof enclosure. (v) Opening of the doors : Outward. (vi) Louvers : With removable wire mesh to ensure dust and vermin proof.	We proposes sheet thickness shall be of 1.5 mm. Please confirm	specification prevails
85	5	4.3.1(h)	Service air connection shall be provided for continuous and intermittent purging of impulse pipe in dusty medium. Continuous purging shall be adopted for differential pressure measurement such as flue gas and coal air mixture application. Pressure measurement shall have only intermittent purging whenever required....	Continuous Purging shall be considered for Flue gas pressure measurements with positive pressure where applicable and coal mill applications,. For other instruments in dusty medium, intermittent purging shall be provided.	specification prevails
86	5	4.3.1 (i)	Gate or ball type (full ported) instrument isolation valve and globe type blow down drain valve adequate for duty requirement and for withstanding continuous design pressure and temperature of main process medium shall be provided in the hook up plumbing.	Please note that Globe or needle type instrument isolation valve may also be used.	specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume V

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
87	5	5.1.14	Additional operator's stations of unit ESP controls shall be installed in the central control room in addition to local control room.	Kindly provide the quantity for the same.	Refer the CORRIGENDUM-II TO BID SPECIFICATION VOLUME - V CONTROL & INSTRUMENTATION Sr No 16.
88	5	5.3.24	Redundancy in input / output modules	At IO level - redundancy is considered only in the output module for HT drives, and few critical LT drives and modulating control drives.	Specification prevails
89	5	5.3.7 (f)	Refresh real time data on screen - 1 sec.	As per OEM design refresh & command execution time will be 2-3 secs.	Specification prevails
90	5	5.3.8	Input/output sub systems shall have features.. (a) Interface with field sensors, Signal conditioning, A/D conversion, Signal validation, Diagnostic, Engineering conversion, Time stamping, Limit value monitor etc. (b) Interface with SMART transmitter through smart interface module with optical and galvanic isolation. (c) Channels individually addressable during routine diagnostic check. (f) I/O bus and I/O communication processor shall be redundant.	(a) Time stamping, limit value monitoring etc. are done in controllers, (b) Stand alone HART management system is being proposed, i.e. transmitters will be connected to analog input modules for control functions and to HART management system for calibration. (c) Continuous diagnosis is done for all modules. For individual channel diagnosis, manual intervention is required. (f) I/O bus will be non-redundant and backplane mounted.	specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume V

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
91	5	5.13.17	The load shall be reduced by the automatic run back system which reduces or holds the unit load according to the capacity of main auxiliary systems.	The failure of the following systems (e) Boiler circulation water pumps (g) HP Feed Heaters (h) LP Feed Heaters shall not be considered for automatic run back. The reasons are circulation water pumps are used during start up conditions up to 30% load and the heaters can be bypassed during any malfunction.	Refer the CORRIGENDUM-II TO BID SPECIFICATION VOLUME - V CONTROL & INSTRUMENTATION Sr No 17.
92	5	5.3.27	Controller assignment/partitioning shall be judiciously decided considering minimum manageable outage of the equipment /system in case of failure of a functional group. Bidder shall refer to the following functional grouping as a guideline for Bidding purpose. Bidder shall furnish his partitioning scheme based without changing the intent of grouping delineated below, for Owner's approval during detailed engineering.	Controller assignment/partioning shall be as per ALSTOM's standard proven validated practice for all the power plants globally. Please confirm the acceptance.	Specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume V

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
93	5	5.3.27	Controller assignment/partitioning shall be judiciously decided considering minimum manageable outage of the equipment /system in case of failure of a functional group. Bidder shall refer to the following functional grouping as a guideline for Bidding purpose. Bidder shall furnish his partitioning scheme based without changing the intent of grouping delineated below, for Owner's approval during detailed engineering.	Controller assignment/partitioning shall be as per OEM's standard proprietary architecture. (1) MFT 1, 2, 3 Channel : 3 nos.of redundant BPS controller (2) Purge & other common logic, Pair Elevations Oil & Coal, mills, feeders : 2 sets of redundant controller (BMS-1 and 2). For other systems controller grouping shall be decided during detail engineering.	Specification prevails
94	5	6.11	In addition 3 no. (three) laptop unit loaded with all PLC system software shall be furnished.	The quantity of laptop is not clear. We understand one common Laptop loaded with engineering software is to be provided for all offsite plant control system.	Three (3) nos. All 3 loaded with all PLC software
95	5	7.3.3(g)	All Printed Circuit card connectors shall be gold plated.	Offered control system electronic modules does not have gold plated connectors. Please confirm	Specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume V

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
96	5	7.3.5 (c)	Bidder shall provide atleast 20% or minimum 2 number whichever is higher and 10% or minimum 1 number, whichever is higher complete spare IO module in each control group.	Please clarify, how much spare IO's we have to consider minimum as 10% or 20% or 30%?	Bidder shall provide at least 20% or minimum two numbers, whichever is higher, spare channels as hot on rail spares in each configured IO modules. In addition to this 10% or minimum one number, whichever is higher, extra assigned complete spare IO modules mounted on rails in sub racks as hot on rail spare for each category of installed IO modules shall also be provided
97	5	7.3.6	Controller (l) Configuration: From hand-held station through front plug and from Engineering Terminal	Please note that configuration of controllers is possible only from engineering terminals	Specification prevails
98	5	7.3.7	Engineering Station:-2nd generation core i5 or better	The offered DCS HMI (core 2 duo processor) is as per ALSTOM's standard proven validated practice for all the power plants globally . Please confirm.	Specification prevails
99	5	7.3.7 (c)	Keyboard Type : Flat spill proof membrane type or Positive depression type	We have considered standard QWERTY based keyboard in our offer. Please confirm	Flat spill proof membrane type

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume V

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
100	5	7.3.7 (d) iv	Resolution 1200 x 1200 DPI in color.	Printer resolution of 600 x 600 DPI in color is sufficient for the purpose of alarm, trend, graphics and log prints.	Specification prevails
101	5	8	ROTATING MACHINE CONDITION MONITORING SYSTEM (RMCMS)	Please provide the number of sub systems/locations and the type of transducers at respective location.	Specification is self explanatory.
102	5	11.1.1 (b)	Electrical Junction Box Material : 3 mm sheet steel	We proposes sheet thickness shall be of 1.5 mm. Please confirm	Refer the CORRIGENDUM-II TO BID SPECIFICATION VOLUME - V CONTROL & INSTRUMENTATION Sr No 18.
103	6	2.16	A microprocessor based system with PC, 24" SVGA 256 colour TFT monitor and printer shall be provided in the SWAS dry room for display of parameters and alarm condition of SWAS analyzers / systems.	SWAS room will remain unmanned, all necessary parameters, alarms and historisation will be made available in Central Control Room (CCR). Hence, we do not envisage the requirement of an operator station in the SWAS room.	specification prevails
104	Sec-7A	2.1.1 (a)	 The exchange will be located at ground floor of service building and also interface with Plant PA system	PA system specification are not available in the tender specification, hence it is presumed that PA system is not included in bidders scope.Pl.confirm.	PA system is not in bidder scope. Refer the CORRIGENDUM-II TO BID SPECIFICATION VOLUME - V CONTROL & INSTRUMENTATION Sr No 20.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume V

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
105	7A	2.1.1	The Exchange will be located at ground floor of service building and also interface with Plant PA System.	Please, clarify requirement. We understand that Public Address (PA) System is not in our scope.	PA system is not in bidder scope. Refer the CORRIGENDUM-II TO BID SPECIFICATION VOLUME - V CONTROL & INSTRUMENTATION Sr No 20.
106	Sec-7A	4.11	The EPBAX system shall have the interfacing capability with Plant Intercommunication System	PA system and/or Plant Intercommunication System specification are not available in any of the tender specification, hence PA system and /or Plant Intercommunication System are presumed to be excluded from bidders scope. Pl.confirm.	PA system is not in bidder scope. Refer the CORRIGENDUM-II TO BID SPECIFICATION VOLUME - V CONTROL & INSTRUMENTATION Sr No 21.
107	7A	5.7	The contractor shall provide facility for connection to PLCC (power line carrier communication) system.	We understand that PLCC at switchyard end is in switchyard vendors scope. Please confirm.	Confirmed. However interfacing software & hardware to be provided by the bidder. Refer the CORRIGENDUM-II TO BID SPECIFICATION VOLUME - V CONTROL & INSTRUMENTATION Sr No 22.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume V

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
108	7A	10.1.2	TELEPHONE SYSTEM Bill of Materials.	BOM for Plant Communication System shall be provided during execution.	Confirmed
109	7B	1.1.7	Bidder shall furnish unit rate of each camera system.	Since this is an EPC offer, Unit rates are not applicable and hence need not be submitted.	specification prevails. Unit Rate is for information only.
110	7B	1.1.13, Page 527 of 718	Perimeter Intruder Detection System	We do not have any reference of this equipment supplied anywhere and have no information of any vendor who can supply this equipment in totallity. Also separate CCTV camera systems are to be provided for the complete plant. In view of this Mahageco is requested to delete this euipment from the scope of supply of the bidders.	Specification Prevails
111	8	2.4.1	Extension & Compensating Cables	We are considering compensating cables for all types of thermocouple as per specification. Kindly confirm whether the same is acceptable.	Specification Prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume V

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
112	8	3	CONSUMABLE, TOOLS AND TACKLE, CALIBRATION AND TEST, INSTRUMENTS AND ERECTION MATERIALS The items listed below are indicative in nature. Any other items that may be required shall also be arranged by Contractor at his own cost iv) Dead weight testers of accuracy $\pm 0.05\%$ of measured pressure.	Some of the items listed in 3.0 of section-8, are getting repeated in the Laboratory equipments 3.1 of section-9. Kindly clarify whether we have to consider both the items in our scope.	Specification prevails
113	8	8.10	COMMISSIONING Contractor shall state in his proposal the unit price and quantity of each spare part which will be required at site during the availability test run.	The offer price will include the mandatory spares price. Any usage of spares after commissioning may be sourced from the mandatory spares.	Specification prevails
114	8	9.2	Training of Personnel Maintenance Engineers in CMMS system functioning & maintenance	We do not find CMMS requirement anywhere else in the tender specification. Please confirm if CMMS is in bidders scope. Also, in case it is to be provided please furnish the technical specifications for the same.	Refer the CORRIGENDUM-II TO BID SPECIFICATION VOLUME - V CONTROL & INSTRUMENTATION Sr No 26.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume V

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
115	9	1.12	Bidder shall submit with the proposal a full list of testing/laboratory instruments/tools offered along with detailed specification of the items. Catalogues, drawings and manuals as required shall be submitted with the proposal to provide necessary information pertaining to the items offered. Information for the items offered shall include (as applicable) but not limited to the following:	Catalogues, drawings and manuals for lab instruments and other information required under this clause are vendor specific and hence shall be provided during execution.	Specification prevails
116	9	3.1	LABORATORY INSTRUMENTS DEAD WEIGHT TESTER - (1 NO.)	Some of the items listed in 3.0 of section-8, are getting repeated in the Laboratory equipments 3.1 of section-9. Kindly clarify whether we have to consider both the items in our scope.	Both are to be provided
117	10A	1.1	UPS System shall comprise the following : (d) Manual bypass switch/breaker : 2	One(1) No. manual bypass switch/breaker shall please be accepted.	Specification prevails
118	10A	2.6.1	(j) For selecting Battery capacity following data to be considered : (iv) Ageing compensation factor: 1.25	Aging factor as 1 for plante battery as per IEEE and Manufacturer's recommendation may please be accepted.	Refer the CORRIGENDUM-II TO BID SPECIFICATION VOLUME - V CONTROL & INSTRUMENTATION Sr No 27.
119	10A	2.6.2. (a)	The UPS will consist of two physically separate sets of equipment streams each consisting of the following : (vi) One no. manual bypass switch	The manual bypass switch shall be provided in common bypass stream. Please confirm	Specification prevails

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume V

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
120	10A	3.9	(a) The UPS system components shall be housed in a sheet steel freestanding IP-52 enclosure with all access from the front.....	We are considering UPS enclosure with IP 41 and UPS DB with IP 52.	Specification prevails
121	10A	5.1.3	UPS Bill of Materials.	Since this is an EPC offer, BOM will not be applicable and hence need not be submitted.	Specification prevails
122	10A	Datasheet A (1.8)	Over load capacity	Please note that 300% for 4 msec shall be on Static Bypass mode as per manufacturer standard.	Specification prevails
123	10B	1.1, 5.1.4	24 V DC BATTERY & BATTERY CHARGER	Separate 24V DC system is not envisaged. 230 V AC UPS supply will be provided at one point at the panel for deriving of 24 V DC supply.	Specification prevails
124			General	We do not find any requirement of Attendance Monitoring System, we understand it is not in bidder's scope.	Attendance Monitoring System is not in bidder's scope.
125			General	We do not find any requirement of Wireless System, we understand it is not in bidder's scope. Please Confirm.	Wireless System is not in bidder's scope.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume V

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
7	1	4.2	Uniformity of make and type of instruments and control components shall be followed throughout for rationalization of spares inventory, except for certain proprietary items where this requirement can not be met.	We shall try to maintain uniformity of hardware to the extent possible. However make of instruments and control systems shall be as per approved vendor list.	Confirmed.
8	1	4.4	Transmitters and electro-pneumatic positioners shall be SMART type. Each SMART equipment shall communicate in the form of analog signal 4-20 mA DC with superimposed digital signal having proven HART protocol to facilitate configuration, zero adjustment, calibration and diagnostic from remote location. All microprocessor based transmitters/analyser shall have the same type of protocol. Bidder shall provide separate HART management system along with PC and necessary software and hardware for remote calibration and diagnostic.	Transmitters supplied for Steam Turbine are HART compatible. Most of these transmitters are associated with the Protection of turbine. In view of safety and availability concern the feature of online monitoring by HART management is not allowed. Hand held HART calibrators can be used for local calibration and use of it shall be as per O&M manual.	Specification prevails
9	1	4.4	Bidder shall provide separate HART Management system alongwith PC and necessary software and hardware for remote calibration and diagnostic.	Hart management system can be integral part of DCS.	Specification prevails

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

RESPONSE TO PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1

VOLUME - VI A

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - VI A

SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
1	1	2.1	2.1 Codes and Standards &	IS: 800 - 1984 version will be used for Steel structure design. All other codes shall be per latest versions. Please confirm acceptance.	Accepted
	2	3.0	3.0 Design Loads		
2	1	3.1 (a)	Area grading and levelling	We understand that area grading works are under the scope of EPC contractor and a drawing is provided along with the bid (Drawing no: PE-189-CV-SK-4003) which indicates the extent of grading and levelling. We request you to kindly confirm whether the bidder has the liberty to modify the the levels (Except of railway line) as required or the bid drawing has to be followed for grading and levelling.	Bidder has liberty to modify area grading levels considering Bid specifications & notes on the Bid area grading drawing (note no. 4.)
3	1,	3.1 (b)	It should be noted that nothing extra whatsoever on account of variation between soil data annexed in this specification and that found by detailed geotechnical investigation to be carried out by bidder shall be payable.	If there is "significant" variation between soil data annexed in the tender specification and that found by detailed geotechnical investigation carried out by the bidder, then the extra whatsoever on account of the "significant" variation shall be payable to the bidder.	Bid specification prevails

BHUSAVAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - VI A

SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
4	1	3.1.c	Demolition of existing over ground structures (including foundation)/facilities, if any, and site clearance.	Drawings /detail pertaining to existing structures / services to be dismantled may please be furnished.	Bidder has to visit the site & assess the quantum of work
5	Section-1	3.1 (c)	Demolition of existing over ground structures	kindly provide the list / drawings of existing facilities for us to understand the scope of work under this head	Bidder has to visit the site & assess the quantum of work
6	1	3.1 (f)	UCR Compound wall	The area available near the ash silos are very low level when compared to the existing railway line. Kindly confirm that construction of compound wall shall be on the existing ground level or the entire area has to be filled and then the compound wall has to be constructed. It is not possible to elevate the entire proposed area as there will be ash disposal truck movement.	The entire area need not be filled, however the road leading to existing ash silo area is passing along outside of the proposed compound wall and this road will be in filling laid in sloping from ash silo, road top shall be sloping from RL 208.50 m to RL 200.5 m. Considering above aspect bidder has to provide this compound wall in this portion as Retaining wall.
7	Section-1	3.1 (f) ii	Providing new UCR compound wall with anti-climbing arrangement as per drawing and /or as directed by Engineering-charge	Kindly provide a drawing / sketch showing details and elevation of the existing UCR compound wall with anti-climbing arrangement	Please refer drawing no. PE-189-CV-SK-4006 already provided.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - VI A

SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
8	1	3.1 (j)	Road over (ROB)	We request you to kindly elaborate on the minimum requirement of ROB, approach required on both ends, width and length required etc.,	Minimum requirement has been specified in corrigendum no. II however for railway portion railway norms to be followed and for non railway portion approval from Govt. / local authorities shall be obtained by bidder
9	1	3.1 (j)	Road over bridge (ROB) for Railway siding including approaches on both sides up to existing roads as shown in bid drawing shall be provided as per railway norms. The engineering of bridge, clearances and permission of railway authorities, construction, erection of bridge & approaches etc are included in the scope of bid.	Obtaining all necessary clearances & permissions shall be excluded from bidder's scope. Please confirm.	Bid specification prevails
10	1	3.1 (K) (ii)	Railway siding facilities	We request you to kindly provide with the minimum size requirement of the building indicated in the specification like TNC building , central panel building etc.,	Minimum sizes of the building shall be considered as below:-- 1) TNC building -750 Sq. m. (G+1) Floor Building 2) Control Panel Building - 1000 Sq. m. (G+2) Floor building. However, bidder have to provide sizes of the buildings as per railway norms/requirements.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - VI A

SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
11	1	3.1 (k)	Scope of Works	Kindly furnish us ESP's for existing railway siding.	Bid specification prevails.
12	1	3.1 (k)	Scope of Works	Kindly let us know the speed potential requirement for siding.	Railway norms shall be followed
13	1	3.1 (k)	Scope of Works - S&T Works	We request you to kindly furnish us the following details for the existing siding : a) PI / SSI System b) Block Working c) Communication facility	Railway norms shall be followed.
14	1	3.1(k)(ii)	Scope also includes coordination with Railway department & preparation of design & drawings for construction of all buildings such as TNC building, Central Panel Building etc. station works such as cabins, relay rack, battery rooms, DG room, Signalling and telecommunication room	Kindly furnish us the GAD for all the types of buildings for existing and Proposed Railway Siding in AutoCAD format. Kindly let us know the specific requirements of buildings if any.	GAD will be furnished during detailed engineering to the successful bidder. Other details shall be as per railway norms
15	1	3.1 (k) (vi-vii)	Obtaining necessary approvals / permission / clearances of railway authorities before and during execution as well as after completion of railway works as per requirements of Railway department and/or Mahagenco required for commissioning well in advance so as to start the railway traffic in schedule time frame. However delay on this account shall be to the contractor's account. Obtaining permission for block on running traffic including necessary charges of railway department.	Obtaining all necessary clearances & permissions shall be excluded from bidder's scope. Please confirm.	Bid specification prevails

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - VI A

SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
16	1	3.1 (I)	Extension of existing 02 nos RCC culverts	We request you to kindly provide the drawings of the existing RCC culverts to enable us the understand the extent of scope of extension of the same culverts. Please also confirm that the existing culvert (Between coordinate E'2200 & E'2700) near the tapping point railway line can be utilised for the proposed railway line.	Drawings will be furnished during detailed engineering to the successful bidder.
17	1	3.2 b	Vibration isolation system: Steel spring/viscous dampers for Steam Turbine Generator (STG), Boiler Feed Pumps, ID, FD, PA fans and Coal mills.	Vibration isolation system shall be considered as per OEM requirements for TG foundations, BFP, Fan foundations, Mill foundation. Please confirm acceptance.	Refer Vol VI A section 2 Annexure I clause 7.0 (special attention)
18	1	3.2 (b)	Vibration isolation system: Steel spring/viscous dampers for Steam Turbine Generator (STG), Boiler Feed Pumps, ID, FD, PA fans and Coal mills.	Requirement of Vibration Isolation System shall be as per OEM recommendation. Please confirm.	Refer Vol VI A section 2 Annexure I clause 7.0 (special attention)
19	1	3.2 9b)	VIS	Except for ID fans, all other machine foundations (STG, BFP, FD, PA, mills) can be on block foundation. Pl review	Refer Vol VI A section 2 Annexure I clause 7.0 (special attention)

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT**PRE -BID QUERIES from Prospective Bidders****Bid Specification No. DG/BSL U-6/2011/T-1, Volume - VI A**

SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
20	1	3.2 (g) & 4.16.2	Transformer Yard	As per Clause no: 3.2 (g) , it is mentioned that the transformer yard shall be paved with gravel filling but as per clause no: 4.16.2 , it is mentioned as RCC paving . Kindly confirm on the type of pavement to be followed in tranformer yard.	Bid specification prevails
21	1	3.2 (n)	Ash disposal pipe line route	We request you to kindly provide the countour survey of the proposed ash pipeline corridor along with details of water stream crossings. We understand from the site visit that the pipe route has to cross village roads, Nagpur mail railway line, 03 water bodies etc., Please confirm that the existing culverts and bridges where space is available can be utilised for proposed pipeline routing.	Refer addendum II to the Bid specification

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
22	1	3.2 (n)	Ash disposal pipe line route	We understand from site visit that for 2 x 500 MW Power plant , 02 nos. precast culverts (Push Back Method) are being launched for ash pipe line routing beneath the main Nagpur -Delhi railway track . Kindly confirm whether the same culverts can be utilised for routing the proposed 660 MW ash disposal pipe line.	Refer addendum II to the Bid specification
23	1	3.2 (n)	Ash disposal pipe line route - Road of 5.00 m width - Where required	Please elobrate on the requirement of 5.00 m wide road along the ash disposal pipe line because at present there is a 3.00 m wide WBM road available along the existing pipe line route. Please also provide us with the tentative routing of the proposed ash disposal pipe line along with the road layout upto the ash dyke.	Refer addendum II to the Bid specification

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
24	1	3.3 (n)	Slag ash/fly ash disposal system, all structure and Ash handling building, foundations for all auxiliaries along with earth mat as necessary including ash disposal pipeline up to VELHALA. The existing ash bund is about 10 Kms from the proposed power station. Ash slurry disposal pipe lines shall be routed above overhead trestles within Plant area. Pipe lines shall be routed supporting on pedestals up to ash disposal area. A 5.0 m wide WBM service road along with drains wherever required shall also be provided for maintenance purpose of these Ash slurry disposal pipe lines. The required cross drainage works for crossing these pipe lines & service roads are also to be provided.	For laying of ash disposal pipeline and all associated civil works request you to kindly provide us the survey report & bore log details of the ash disposal route. In absence of the above reports the same would be excluded from our scope of work. Please confirm. Further for ash disposal, it's right of way & all statutory permissions & clearances shall be in Owner's scope. Please confirm.	Bid specification prevails refer Volume VI A section I clause 4.4
25	1	3.3 (p)	Slag ash/fly ash disposal system, all structure and Ash handling building, foundations for all auxiliaries along with earth mat as necessary including ash disposal pipeline up to VELHALA. The existing ash bund is about 10 Kms from the proposed power station. Ash slurry disposal pipe lines shall be routed above overhead trestles within Plant area. Pipe lines shall be routed supporting on pedestals up to ash disposal area. A 5.0 m wide WBM service road along with drains wherever required shall also be provided for maintenance purpose of these Ash slurry disposal pipe lines. The required cross drainage works for crossing these pipe lines & service roads are also to be provided.	For laying of ash disposal pipeline and all associated civil works request you to kindly provide us the survey report & bore log details of the ash disposal route. In absence of the above reports the same would be excluded from our scope of work. Please confirm. Further for ash disposal, it's right of way & all statutory permissions & clearances shall be in Owner's scope. Please confirm.	Bid specification prevails refer Volume VI A section I clause 4.4

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
26	1	3.3p	Service road along ash line	The drains along this service road will be earthen construction. Please confirm.	Refer Addendum II
27	1	3.3 (z)	HFO and LDO	As there is an interface with existing fuel oil pump house and fuel oil dyke , we request you to kindly provide with layout of fuel oil pump house and fuel oil dyke.	As there is no space available in existing pump house, new pump house shall be provided.
28	1	3.4	Scope of Work Watch tower	The number of watch towers which would be considered for this plant is five(5) in nos. Please confirm acceptance or please state the basis for deciding the number.	Watch towers to be placed at spacing of 250 mtrs (max) and at locations where the boundary wall changes direction and shall be placed around the periphery of the boundary wall.
29	1	3.4	Non plant buildings	Gate office with parking facilities & check post location are not shown in the plot plan, please provide the location & number of check post required.	Already shown in the Bid plot plan drawing (Rev P3) No. & location of check post will be decided as per functional requirement during detail engineering.

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
30	1	3.4	Non plant buildings	Please clarify area required for service building, canteen, gate office, security office cum time office. Also please clarify number of watch towers required (or spacing along boundary).	For Service building refer Volume VI A section 4 clause no. 4.1 for other buildings refer plot plan & Bid specification Watch towers to be placed at spacing of 250 mtrs (max) and at locations where the boundary wall changes direction and shall be placed around the periphery of the boundary wall.
31	1	3.4	Watch tower	Please provide the no. of watch towers to be provided.	Watch towers to be placed at spacing of 250 mtrs (max) and at locations where the boundary wall changes direction and shall be placed around the periphery of the boundary wall.
32	1	3.4b	Contruction/fabrication yard	Please clarify if any permanent yard is required.	Self explanatory
33	1	3.4i	check post	Please clarify if this is part of the security office area.	No, however the number & location of check post will be decided as per functional requirement during detail engineering.
34	1	3.4m	Unloading platform	Please clarify location and specification for the same.	The no. & locations shall be as per functional requirement
35	1	3.10	"If space permits, slope (1:3) shall be provided between two different grade levels"	For better utilization of plot space and based on the soil type encountered (mostly rock), stable slope 1:2 or 1:1 may also be accepted. Under such circumstances, retaining wall shall not be provided. Please confirm.	Bid specification prevails

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
36	1	4.1	Power House building All floors except roofs of Turbine Hall will be cast-in-situ RCC over removable shuttering with hatchways as required.	Operating Floor and other floors may be concrete on metal deck. The slab design will be done without taking advantage of the decking sheet. Please confirm.	Bid specification prevails
	1	4.1	Power House building All floors except roofs of Turbine Hall will be cast-in-situ RCC over removable shuttering with hatchways as required.	Grating may be provided in mezzanine and other areas as required. Please confirm.	Bid specification prevails
38	1	4.1	CW channel Covered R.C.C. channel from Cooling Tower basin to CW Pump House shall be minimum 500 mm above F.G.L. and road-crossing portion shall be designed for Class 'AA' traffic.	Since trash rack, debris filter and OLTCs already in the CW system, thus we propose CW channel to be open at top. Please confirm.	Bid specification prevails
39	1	4.1	Two (2) E.O.T. Cranes (capacity shall be as specified elsewhere in this specification) will operate in the Turbine Hall for handling equipments. For rigging and positioning of the Turbo-Generator and condensers, building frame shall not be of any hindrance and temporary openings in the building claddings and cladding supporting structures shall be maintained till completion of the rigging and positioning of the condensers and TG.	Stand jack arrangement for stator lifting shall be provided. Tandem operation for stator lifting with 2 E.O.T cranes has not been envisaged. Please confirm.	Refer clarifications to queries in Volume II
40	1	4.2	Mill Buildings Floors shall be of cast-in-situ RCC over removable shuttering.	Concrete floors may be on metal deck. Please confirm.	Bid specification prevails

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
	1	4.2.2	Mill and bunker building	Side mill has been specified for the boiler. Typically in this arrangement, for similar boilers in the country separate staircase is not provided, access is from the boiler staircase. Please review.	Bid specification prevails
42	1	4.5a	Transfer houses/ drive houses	In the transfer house or drive house cladding will be provided in areas where equipment is located and not for the entire height. Please review and confirm.	Bid specification prevails
43	1	4.5 (a)	Cladding for Transfer Points / Junction Towers	The side cladding will be provided for the junction tower upto floors where equipment is located from roof top. Remaining portion will not be cladded.	Bid specification prevails
44	1	4.5 (f)	Over boulder soling, 75 mm thick lean concrete (1:4:8) shall be spread. Final layer shall be minimum 150 mm thick RCC slab M20 with double layer reinforcement.	In our opinion the 75 mm lean concrete over the boulder soling is more than adequate. The additional 150 mm thick RCC slab of M-20 grade can be eliminated. Since the area of the stock pile is huge the cost of the RCC is very much on the higher side. Please confirm.	Bid specification prevails

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
45	1	4.5 (f)	Over boulder soling, 75 mm thick lean concrete (1:4:8) shall be spread. Final layer shall be minimum 150 mm thick RCC slab M20 with double layer reinforcement.	Please review the requirement for 150 mm thick RCC slab of M-20 grade in coal stockpile area.	Bid specification prevails
46	1	4.5 (h)	Design of Steel Structures	Steel structures shall be designed by working stress method as per the provisions of IS 800:1984.	Accepted
47	1	4.5 (k)	For design purpose the ground water table shall be considered at 1.00m depth below F.G.L.	As seen from the preliminary geotechnical investigation report water table varies from 4 m to 5.4 m. Hence for design purpose the ground water table shall be considered accordingly satisfying all design criteria. Please confirm.	Bid specification prevails
48	1	4.6.1 (a)	Flue shall be of M.S conforming to IS:2062,Gr -A.	As Grade-A material for plates is outdated, please confirm whether we can use Grade-Br, killed quality (E250) as per latest IS:2062-2006.	Bid specification prevails
49	1	4.6.1 (b)	Inside and outside surfaces of minishell	This clause is not applicable as we are considering stainless steel liner as per clause 4.6.1 b -vi.	Accepted
50	1	4.6.1 b, vii	Internal platforms/staircase	a) All structural steel of internal platforms and staircase will be coated with two coats of synthetic Enamel Paint.b) Handrails and gratings of platforms and staircase will be hot dip galvanized. Kindly confirm.	Bid specification prevails

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
51	1	4.6.1 b, xi, b	The concrete shell shall support all platforms, which in turn provide support for three independent liners.	This clause will be read as " The concrete shell shall support all platforms, which in turn provide support for one independent liner."	Accepted
52	1	4.6.1 b, xii	Thermal insulation	We are considering Rockwool insulation of density 100kg/cu.m for the thermal insulation of steel liners. Kindly confirm.	Bid specification prevails
53	1	4.6.1 ii & xi	Permissible stresses shall be as per IS:4998(part-1)-1975.	Please confirm whether allowable compressive stress in concrete shall be limited to 0.38 Fc or 0.32 Fc under DL+WL condition	Allowable compressive stress in concrete shall be limited to 0.32 Fc under DL+WL condition.

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
54	1	4.6.1.8	Chimney Painting All structural steel works inside chimney such as internal platforms, stair case, ladders etc. excluding grating, flue, treads of stair shall be painted with 2 coats of zinc phosphate 2 pack epoxy primer, DFT 50 microns per coat, applied on dry surface cleaned by sand blasting & two coats of two pack Epoxy finish with micaceous iron oxide pigments having DFT 75 microns for each coat.	Generally sand blasting/shot blasting has to be done for the heavy corrosion area. The Project location/area is not coming under the heavy corrosion area category. Therefore, the surface preparation will be done by manual wire brush cleaning or any other suitable method as per Indian Standards. Pls. confirm.	All structural steel works inside chimney such as internal platforms, stair case, ladders etc. excluding grating, flue, treads of stair shall be painted with 2 coats of zinc phosphate 2 pack epoxy primer, DFT 50 microns per coat, applied on dry surface cleaned by shot blasting & two coats of two pack Epoxy finish with micaceous iron oxide pigments having DFT 75 microns for each coat.
55	1	4.6.2 (g)	Steel structures shall be designed as per IS-800	We are considering the structural steel designs as per IS:800-1984. Please confirm	Accepted
56	1	4.6.3	chimney foundation shall be in concrete grade M-25.	We would like to consider the minimum concrete grade for chimney foundation as M-25.	Accepted
57	1	4.6.3	Reinforcement shall be Fe-500 steel.	We would like to consider reinforcement steel as Fe-500 or Fe-500D depending upon market availability.	Bid specification prevails

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
58	1	4.6.3	Materials to be used	We are considering PPC for raft and OPC for shell. Kindly confirm.	PPC can be used for chimney raft however fly ash content shall not exceed 35% by volume
59	1	4.6.1.iX	Internal staircase shall be supported on steel frame independent of shell...	Staircase provided directly on platform, would result in large platform girders, consequently large openings in windshield, which would be zone of weaknesses in the windshield. Further platforms are placed with sliding connections in windshield, placing staircase of around 40m on platform would result in stability issues under earthquake and other dynamic conditions. Therefore it is advised that standard practice of staircase erected on brackets, supported from windshield may be followed.Pl.confirm.	Bid specification prevails
	1		Max permissible stress in "DEAD+WIND" Load case shall be $0.32 F_{ck}$, where F_{ck} is the characteristic strength of concrete.	As per the latest recommendation of Central Electricity Authority(CEA), and also as adopted by leading players in the industry , max permissible stress in "DEAD+WIND" Load case shall be taken as $0.280 F_{ck}$,where F_{ck} is the characteristic strength of concrete.Pl.confirm.	Allowable compressive stress in concrete shall be limited to $0.32 F_c$ under DL+WL condition

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
62	1	4.7.2	Surface Protection to be provided for the entire inner face of hyperboloid shell	Since the inner surface of shell upto drift eliminator is exposed to water surface, protection will be provided upto level of drift eliminator. Please confirm acceptance.	Bid specification prevails
63	1	4.7.3.5	Bypass arrangement along with isolation valve for approximately 20% of total CW flow shall be provided.....	We have not provided any such arrangement in our past projects and also could not understand the requirement. Please clarify the purpose of CW Bypass arrangement. Also, purpose of providing horizontal base plate at the bottom of Cold water channel is not clear.	Bid specification prevails
64	1	4.7.3.5 & 4.7.3.6	By pass arrangement along with isolation valve for approx. 20% of total circulating water flow shall be provided.....	Please note that specified bypass arrangements are not required nor provided in any of the previous projects by BHEL, accordingly it is not envisaged in this project too. Please confirm	Bid specification prevails
65	1	4.7.3.5 & 4.7.3.6	By pass arrangement along with isolation valve for approx. 20% of total circulating water flow shall be provided.....	Please note that specified bypass arrangements are not required nor it is a general practice to provided the same. It is requested to delete this requirement.	Bid specification prevails

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
66	1	4.7.3.6	Bypass arrangement along with isolation valve for approximately 50% of total ACW pipeline to cold water basin shall be provided.....	We have not provided any such arrangement in our past projects and also could not understand the purpose. Please clarify the purpose of ACW Bypass arrangement	Bid specification prevails
67	1	4.7.4	The basin shall be designed..... The basin holding capacity shall be minimum 16 minutes between maximum and minimum water level.	Please note that as per our standard practice basin holding capacity shall be 6 minutes between maximum and minimum water level. Pl.confirm.	Bid specification prevails
68	1	4.7.4	The basin shall be designed..... The basin holding capacity shall be minimum 16 minutes between maximum and minimum water level.	Please note that as per standard practice basin holding capacity shall be 6 minutes between maximum and minimum water level. Increasing the basin holding capacity will unnecessary increase the basin size ,leading to higher cost. Pl.review and confirm.	Bid specification prevails
69	1	4.7.4	Minimum 500 mm dead storage shall be considered above invert level of basin.... The basin holding capacity shall be minimum 16 minutes between maximum and minimum water level.	A dead storage of 300mm will be provided and 12 minutes basin holding capacity as Basin holding capacity shall be adequate. Please recheck and confirm.	Bid specification prevails

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
70	1	4.7.10.2	Drift losses At the design point, the total water mass flow entrained in the air shall not exceed 0.01% of the mass of water circulating. In case the drift eliminator packing is to be used for achieving the specified drift loss then, the same shall be provided by the bidder. If drift eliminators are provided then the drift shall be measured at the top of the drift eliminators.	Drift eliminator is not considered in the cooling tower design thus drift testing is not applicable. Kindly confirm acceptance.	Bid specification prevails
71	1	4.7.12	Acceptance test code for water cooling towers: DIN 1947 - VDI	Please note that Performance test of Cooling Tower will be carried out as per BS 4485 or CTI ATC - 105.	Refer Corrigendum II to bid Specification
72	1	4.7.15 & 4.7.20.8	Material of Construction of Screens	There is discrepancy between the two referred Clauses about the MOC of Screens. We are considering the Screens MOC in-line with Cl. No. 4.7.15. Screens Mesh Material considered is SS 304 instead of SS 304L. Kindly confirm.	clause no. 4.7.20.18 (i) shall prevail

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
73	1	4.7.17.5	Enhancement factor 1.43 is considered to take the interference effect of adjacent structures of significant dimensions into account. 10% increment shall be considered for imperfection in construction as per IS: 11504. This factor shall be increased further by 10% during foundation design in absence of model test results.	As per specification the wind enhancement factor of 1.43 shall be increase by 10% for geometric imperfections and this factor shall be increased further by 10% during foundation design in absence of model test results. We presume that for design of foundation a wind enhancement factor of 1.73 (i.e. 1.43 x 1.1 x 1.1) shall be considered. Please confirm.	Confirmed
74	1	4.7.20.7	All reinforcement steel shall be corrosion resistant steel/HCRM. The minimum reinforcement to be provided shall be as follows: HYSD bars shall be provided at a maximum spacing of 200mm in top and bottom layer along both directions.	We presume that Corrosion resistant steel shall be used only in cooling towers. Please confirm.	Accepted
75	1	4.7.2 & 4.7.20.18 9 (L)	Handling facilities at tower top	Handling facility at the tower top is not applicable for NDCT. Kindly confirm.	Bid specification prevails
76	1	4.7.20.18 (dd)	Minimum eight nos. of high intensity white flashing type aviation obstruction light at each level	We shall be considering combination of Medium Intensity and Low Intensity Aviation Warning Lights only at the top of the tower as per ICAO.	Bid specification prevails
77	1,	4.7.20.3 (E) 4.7.20.7 4.16.1	All reinforcement steel shall be corrosion resistant steel/HCRM. The minimum reinforcement to be provided shall be as follows: HYSD bars shall be provided at a maximum spacing of 200mm in top and bottom layer along both directions.	We understand that mild steel / HYSD bars shall be used for all structures and Corrosion resistant steel shall be used in cooling towers . Please confirm.	Accepted

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78	1	4.7.20.3 (E)	All reinforcement steel shall be corrosion resistant steel/HCRM. The minimum reinforcement to be provided shall be as follows: HYSD bars shall be provided at a maximum spacing of 200mm in top and bottom layer along both directions.	We presume that Corrosion resistant steel shall be used only in cooling towers. Please confirm.	Accepted
79	1	4.7.20.7 (f)	NDCT - CW Basin design	We propose to use pressure release valves (PRV) upto 50% to counter the uplift pressure.	Bid specification prevails
80	1	4.7.22 (e)	The performance of Cooling tower shall be compared with the performance required on the basis of Performance curve for 80%, 90%, 100% & 120% of design water flow.	Please note that as per Cl. No. 7.2 of CTI Code ATC-105, NDCT performance curves applicable to 90%, 100% & 110% of design water flow shall only be required to furnish for Performance test. Hence, Performance test shall not be conducted cooling water flow of 80% & 120%. Please confirm.	Bid specification prevails
81	1	4.8.1.3	Electrical swgr room	The provision of electrical switchgear room in a particular building depends on the distribution system envisaged. It is not mandatory to provide swgr room in each pump house, for some pump house the drives can be fed from the nearby swgr rooms also. The details will be decided during detailed engineering. Please confirm.	Bid specification prevails. Please refer SLD for SWGR.

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
82	1 & 2	4.9.1 (e) & 4.9	Liquid retaining structures	As per Cl. No. 4.9, Section 2, " the crack width for liquid retaining structures shall be limited to 0.1mm". All liquid retaining structures except filter water reservoir will be designed as per this clause.	All water retaining structures and other under ground structures except filtered water shall be designed with limiting crack width to 0.1 mm.
83	1	4.9.1 (e)	Filtered water reservoir shall be designed as uncracked section.	All water retaining structures and other under ground structures shall be designed with limiting crack width of 0.1 mm. Please confirm.	All water retaining structures and other under ground structures except filtered water shall be designed with limiting crack width to 0.1 mm.
84	1	4.9.4/ 4.14	Pipe/Cable Trestles And Foundations Cl. No. 4.9.4, the min clear headroom shall be 8.5 m. CL no. 4.9.4, the min clear headroom shall be 8.5 m. CL. No, 4.14 headroom clearances shall be 8.0m.	Please confirm minimum clear headroom requirement in cross-over locations.	Refer sr. No. 8 of Corrigendum no. 1 of Master specification Volume II
85	1	4.9.4	All trestles shall be provided with continuous walkway of minimum 750mm width with handrail and toe guards all along the length of the trestle along with approach ladder near roads, passageways etc.	Please review the requirement for continuous walkway of minimum 750mm width all along the length of the trestle along with approach ladder near roads, passageways etc.	Bid specification prevails

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
86	1 2 2	4.9.5 3.2.3/3.4 4.9	Raw water reservoir / Liquid retaining structures Storage tank structure shall be designed as per IS-3370 & considering water level at GL. No pressure relief valve arrangement shall be considered to counter uplift pressure.	For design purpose, the ground water table shall be considered as per final geotechnical report. Pressure relief valves will be provided, if required. Please confirm.	Bid specification prevails
87	1 1	4.9.5, Pg 144 of 639 2.14, Pg 241 of 639	Raw water reservoir.....storage tank will be in RCC construction Reservoir lining	Since water reservoir is of RCC construction, please clarify whether HDPE liner is required for reservoir.	HDPE lining to raw water reservoir is not required being of R.C.C construction.
88	1	4.11/4.13	CW and ACW Pump house	Based on Cl. 4.11, the said building can be both RCC and Steel framed. However, cl. No.4.13 indicates that this building shall be RCC. The CW building can be of RCC framed or combination of RCC and Steel.	Bid specification prevails
89	1	4.11	CW Forebay and Channel	We propose to use pressure release valves (PRV) upto 50% to counter the uplift pressure.	Bid specification prevails
90	1	4.16.1	All reinforcement steel shall be corrosion resistant steel/HCRM. The minimum reinforcement to be provided shall be as follows: HYSD bars shall be provided at a maximum spacing of 200mm in top and bottom layer along both directions.	We presume that Corrosion resistant steel shall be used only in cooling towers. Please confirm.	Accepted

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
91	1	4.17	Yard Drainage System Interconnection of drains with the existing/ plant water drainage system/ main outfall location	Please furnish the interfacing invert levels & coordinates of existing plant drainage system including outfall.	Required details will be provided to the successful bidder during detail engineering
92	1	4.17	DRAINAGE SYSTEM	Kindly provide the max. hourly rainfall to be considered for drain design. Also kindly provide the HFL of the area.	Bid specification prevails . For HFL refer note no. 6 of Bid Plot plan.
93	1	4.17	Yard Drainage System	It is proposed to provide brick masonry drains for depth upto 750 mm including building plinth protection drains. Drains with depth higher than 750 mm will be made of RCC. Please confirm.	Bid specification prevails
94	1	4.17	Discharge coordinate for storm water drain	Please provide the final discharge coordinates for drains.	Required details will be provided to the successful bidder during detail engineering
95	1	4.17	Drainage System: The drainage system shall be designed taking into account runoff resulting from 1 hr rainfall with a return period of 100 yrs. These values are based on the recommendations of the Indian meteorological department.	We propose to consider the rainfall intensity, derived from 50 years return period, for storm water network design as per standard industrial practice.	One hour rainfall intensity, derived from 50 years return period, as per recommendations of Indian meteorological department shall be considered for the design of storm water drainage system.

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
96	1	4.18	Sewage system	In remote areas inside the plant boundary where it is far away from the central treatment plant, it is proposed to use septic tank and upflow filter similar to the scheme mentioned in 4.18(2) of the specification. Please confirm.	Bid specification prevails
97	1	4.18	Sewage system	Where possible the gravity will be used for sewers, for long distances, sewage pumping will be adopted because the depth of sewage pipe becomes very high in case gravity only is adopted. Please confirm	Bid specification prevails
98	1	4.18	Septic tank in ash dyke area outside Plant boundary	The present scope of work outside plant boundary is limited to ash piping corridor from the plant to the ash dyke. Hence any Septic tank outside plant premises is not considered in scope. Please confirm.	Not envisaged in the Bid
99	1	4.18	Sanitary Sewerage system	Septic tank along with soak pit will be considered. Please confirm	Bid specification prevails

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
100	1	4.18.1	Sewerage Transfer/Treatment System Cl. No. 4.18.1: manhole spacing shall not exceed 20m Cl. No. 3.14 (Vol. VI-B Section 7/ A), the maximum distance between manholes shall be 30m.	We shall consider maximum distance between manholes as 30 m as per Cl. No. 3.14 (Vol VI-B-Section 7/ A).	Clause no. 4.18.1 shall prevail for distance between manholes
101	1	4.18.2	Sewage Treatment Plant Cl. No. 4.18.2: Anticipated number of user may be considered as 650 for design purpose Annexure-I (Vol. VI-B Section 22): The anticipated no. user may be considered as 1500 for design purpose.	For design purpose, number of users will be considered as 200 (per day) for this proposed 1X660MW unit. Please confirm.	Clause no. 4.18.2 shall prevail for no. of users for design purpose.
102	1	clause number 4.18.2, page 163 of 639	The contractor shall make the arrangement for utilizing the treated water for gardening and plantation----	PL. clarify the location where treated water from sewage treatment plant is required to be terminated for Gardening / plantaion.	Treated sewage water is to be used for gardening and terminal points of the pipes shall be upto the farthest point of green belt within periphery of the plot.
103	1	4.18(2)	Sewage treatment for ash dyke area	Please review this requirement because in ash dyke there are no buildings in Bidder scope.	Not envisaged in the Bid
104	1	clause number 4.18.2, page 163 of 639	The contractor shall make the arrangement for utilizing the treated water for gardening and plantation----	PL. clarify the location where treated water from sewage treatment plant is required to be terminated for Gardening / plantaion.	Treated sewage water is to be used for gardening and terminal points of the pipes shall be upto the farthest point of green belt within periphery of the plot.

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
105	1	4.2	5 mm stainless steel liner plates conforming to 304M Grade, fitted without allowing any projections in coal flow path shall be provided for conical hopper portion only.	As per standard engineering practice, Coal bunkers shall be provided with 3.15 mm thick stainless steel liner in the hopper portion only. Please confirm.	Bid specification prevails
106	1	5.00	Design Documents	The Civil / Structural Analysis, Design and calculation documentations will be performed using standard software like MS-Office, MathCAD, STAADPro, SAFE, SAP, ETABS, Dyna, in-house developed templates etc.	Accepted however Dyna, in-house developed templates etc. subject to validation.
107	1		Worskhop	Please clarify capacity of crane required in workshop.	Capacity of EOT Crane shall be 10 T .
108	1		Stores	We understand that for stores separate crane is not required. Please confirm. If crane is required please indicate capacity required.	Crane not required.
109	2	3.1.a)	Area grading, Levelling & dressing (Finished ground levels shall be as mentioned in Plot Plan & area grading drawings)	Please provide contour drawing and RL of bore holes. Please provide previous grading drawing if any.	Drawings & bore holes data already provided alongwith Bid documents.

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
110	2	3.1 (h)	Drain Network	We presume the terminal point of storm water drain shall be at plant boundary. Please confirm. In case it is to be drained of to near by nallah please provide us the invert level of the same. Further all necessary clearances and right of way for the same shall be in scope of Owner. Please confirm.	There will be 2 nos. of disposal points for storm water drains. The locations of the same is at bridge no. 17 & 18 of railway siding for 2 X 500 MW unit. The required data will be provided to successful bidder during detail engineering. Necessary clearances for the same shall be in scope of Bidder.
111	2	3.1.2	Live Loads	Live load considerations for CW / ACW sump and Pump house will be as per IS codal provisions.	Bid specification prevails. Refer clause no. 3.1.2.5 of volume VI A Section 2.
112	2	3.1.2.1	Live Load on roofs Cl 3.1.2.1. (a (iii)) For accessible roofs, live loads shall be considered as 1.5 KN/ m ²	However, for inaccessible roof, we propose to use live load of 0.75kN/m ² as per IS-875.	Bid specification prevails
113	2	3.1.3 (h)	Laydown area loads Lay down areas in the Turbine Hall shall be investigated for concentrated loads resulting from equipment components to be stored during erection and maintenance operation	The structure shall be designed considering laydown loads as per the actual scheme and loading data provided by equipment vendors. Please confirm.	Bid specification prevails

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
114	2	3.1.4 4.6.4 & 4.6.6.2	Wind loading Risk coefficient (k1) shall be considered as 1.07 for all structures. 3.1.5 Seismic	The risk coefficient as per IS875 (III) is 1.06. This shall be used for all structures other than Non plant buildings. K1 shall be 1.0 for all non-plant buildings. Please confirm.	The risk coefficient k1 shall be 1.06 as per IS: 875 (III) for all plant & non plant buildings.
115	2	3.1.7	Steam piping load Minimum intensity of steam piping load shall be 6.0 kN/Sqm for the areas at different levels through which steam piping is routed.	Steam piping loads will be considered as per actual pipe stress analysis results. Please confirm.	Bid specification prevails
116	2	3.1.11	Other loads All Power House columns adjacent to first row of Boiler columns shall be designed for an additional load of 500 kN to account for piping/cable rack loads.	No additional loads or blanket load shall be considered in addition to the actual loads based on the layout. Please confirm.	Bid specification prevails
117	2	3.40	" Whenever any structure under this contract will carry or receive additional load from the work of any other contract, the structures under this contract shall be provided with sufficient margin to carry the above load (like Mill Bay structure, Trestles etc.) details of which shall be finalized during detail engineering."	Since this is a BTG + BOP contract (full EPC), no additional loads are considered for others. However, suitable margins shall be considered during design phase to take care of engineering uncertainties.	Accepted
118	2	3.40	Design concepts 'Lifted Load' of crane shall not be considered during seismic condition.	For wind calculation, 50 % of the lifted load of Crane will be considered. Please confirm acceptance.	Bid specification prevails

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
119	2	3.40	Design concepts In Turbine Bay, horizontal wind girders between A-row and B-row columns must be provided below Mezzanine and Operating floor at gable ends to transmit wind load from gable columns.	The turbine building shall be designed without wind girders at gable ends.	Bid specification prevails
120	2	4.1	Power House building The roofing will be done by cast-in-situ RCC slab over permanently color coated (on exposed face) galvanized M.S. troughed metal decking of approved profile supported by steel purlins which are spanning between two adjacent roof trusses.	Insulated sandwich panel sheet shall be used in roof instead of RCC over metal deck. Please confirm.	Bid specification prevails
121	2	4.9	Liquid retaining structures All water retaining/storage structures and all underground structure requiring dry working condition shall be designed assuming liquid up to the height of wall irrespective of provision of any over flow arrangement. Use of PRV to counter uplift shall not be allowed.	Pressure relief valves may be used for liquid retaining structures. Please confirm.	Bid specification prevails
122	2	4.9	Liquid retaining structures All water retaining/storage structures and all underground structure requiring dry working condition shall be designed assuming liquid up to the height of wall irrespective of provision of any over flow arrangement. Use of PRV to counter uplift shall not be allowed.	We propose to use pressure relief valves, as required, for all liquid retaining structures.	Bid specification prevails

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
123	1 & 2	4.9.1 (e) & 4.9	Liquid retaining structures	As per Cl. No. 4.9, Section 2, " the crack width for liquid retaining structures shall be limited to 0.1mm". All liquid retaining structures except filter water reservoir will be designed as per this clause.	Accepted
124	2	4.10	Power House building The roofing will be done by cast-in-situ RCC slab over permanently colour coated (on exposed face) galvanized M.S. troughed metal decking of approved profile supported by steel purlins which are spanning between two adjacent roof trusses.	As specification stipulates use of insulated metal side cladding, we would propose use of the same insulated sandwich panel in roof instead of RCC over metal deck. Any mechanical or other utilities can be placed on roof cutouts, supported on separate structural framing. ~~Please confirm.~~	Bid specification prevails
125	2	4.30	Fly ash	Sufficient amount of fly ash shall be provided free of charges by the Owner. Please confirm.	Arranging fly ash conforming to IS: 3812 is the responsibility of the bidder. However if the required quality & quantity of fly ash is available with Mahagenco the same will be supplied to bidder on chargeable basis as per Mahagenco's prevailing

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
126	2	5.5.7	"After the tanks have been erected, hydro testing shall be done. Subsequent upon hydro testing of tank, the differential settlement"	The statement appears to be incomplete. Kindly state the requirements under this clause.	The sentence shall be read as "After the tanks have been erected, hydro testing shall be done. Subsequent upon hydro testing of tank, the differential settlement noticed if any shall be rectified to the satisfaction of Engineer Incharge"
127	3	1.3	Structural steel shall conform to Grade A of IS:2062 for rolled steel members or plates up to 20 mm thickness. For plates above 20 mm thickness and welded construction, steel conforming to Grade B (Killed and normalized) of IS: 2062 shall be used except for crane girders where Grade C (Killed and normalized) (IS: 2062) steel shall be used. All structural steel plates and sections shall be of main producer of such as "SAIL" or "TATA STEEL" or "RINL" or "JINDAL" make or vendor approved by MAHAGENCO.	Structural steel of grade Q235 / Q345 as per Chinese code shall be used in addition to Indian steel. Please confirm.	Bid specification prevails
128	3	1.4/1.11	Structural steel connections Shop connections will be all welded and field connections will generally be bolted unless specified otherwise.	Welded or Bolted type of connections will be used based on requirement.	Bid specification prevails
129	3	2.44	Boundary Wall As per Clause No.3.1 of Section 1; the boundary wall shall be made of uncoursed rubble masonry. However, as per cl. 2.44(Section 4), the boundary wall is made of masonry, painted with cement -based paint over plaster.	We understand that the existing boundary wall is made of UCR and hence we propose to follow Clause No.3.1 of Section 1 for the new boundary wall.	The boundary wall shall be of UCR masonry as per clause no. 3.1 of section 1. The anticlimbing fencing, finishing of wall etc. shall be as per clause no. 2-44 of section 4 & Bid drawing.

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
130	3	4.00	" it is envisaged that pipe/cable rack under this Package will have to accommodate some additional pipes and cables (such as Plant Water System etc.), which are not in the scope of the this Package. The Contractor shall in his offer keep reasonable margin for accommodating such additional pipes/ cables in the rack structure, details of which will be furnished to him during the detailed engineering stage. "	Since this is a BTG + BOP contract (full EPC), no additional trays/piping are considered for others. However, suitable margins shall be considered during design phase to take care of engineering uncertainties.	Accepted
131	3	5.00	Other specific requirements Interaction ratio shall be restricted to 0.9	The member design will be generally performed to reach allowable stresses. Wherever anticipated loads are not furnished, contingency loads will be provided.	Bid specification prevails
132	3	5.3	Horizontal deflection	Horizontal deflection for conveyor entry/exit of building & conveyor trestle will be H/325 (along gallery) and H/500 (across gallery)will be considered. Please confirm	Accepted
133	4	Item i	Stores	Please inform the number of stores building required.	During detail Engineering.

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
134	4	2.4 (a)/ 2.16	Cl. 2.4: handrails and ladder pipes shall be 50 mm nominal bore MS pipes... Cl. 2.16 (a) handrails and ladder pipes shall be 50 mm nominal bore MS pipes Cl. 2.16 (h) For any other floor of powerhouse building, plant & non-plant buildings, unless otherwise indicated in the specification the post and handrails of stairs, railings, etc. shall be of 32 mm dia G.I. pipes as per IS-1239-part (I) Cl. 2.4 (b) For stairs and around all floor openings at operating floors, 1000 mm high hand railing with 32 NB (polished) stainless steel pipe shall be provided. Cl. 2.16 (d) For RCC stairs and around all floor openings at operating floors, 1000 mm high hand railing with 32 NB (polished) stainless steel pipe shall be provided. Cl. 5.1.16 (c) 40ø NB stainless steel pipe handrail for Stair in T.G. Hall area and 32ø NB medium class G.I pipe Handrail for stairs in other areas,	Kindly clarify the handrail requirements in various areas/buildings in view of the contradictions in the referred clauses.	Clause no. 2.16 of section 4 prevails for handrailing in various areas & buildings.

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
135	4	2.26	Minimum 110mm thick R.C. concrete parapet Cl. No. 2.6, 110 mm thk parapet is to be provided. Cl. No. 2.28(o): 100 mm thick concrete parapet is to be provided, Section 2; Cl. No. 6.1, 125 mm thk parapet is to be provided.	We will consider 100 mm thick, 1000 mm high RCC parapet for accessible roofs and 400 mm high 230 thk masonry parapet for non accessible roof. Please confirm.	Clause no. 2.28 (o) shall prevail for parapets.
136	4	2.37	1) PCC paving of grade M-20, 100 mm thick laid over 75 mm thick bed of dry brick aggregate shall be provided for following areas: (i) 2.0 m wide pathway all along pipe/ cable corridor	We propose to provide local paving around the pipe/ cable corridor for the accessibility to the cage ladders. Please confirm.	2.0 m wide pathway all along the pipe/cable corridor consists of 150mm thick P.C.C. of grade M-20 overlaid on 230 mm thick stone soling with interstices filled with sand by water flooding. For paving around cooling tower, volume VI A section 1
137	4	4.1.1	Landscaping: administrative area	Since no separate administration building is envisaged in the scope of work for 1x660 MW plant kindly clarify the landscaping requirement for the same .	Administration building is not included in Bidder's scope. Landscaping is not envisaged for Admin. Building.
138	5	4.11.3.3	Blasting: No blasting shall be permitted for excavation of foundation even in rocky formation, unless permitted by the MSPGCL and subject to proper licenses and permission being obtained from the authorities concerned.	Weathered rocks are observed beyond 2.5m depth. Controlled Rock Blasting shall be permitted if required for laying foundation or any other work, subject to permissions from concerned authority.	Bid specification prevails

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
139	-	-	--	Pl.furnish the following drgs .in autocad format: 1. PE-189GA-101 P2 - Plot plan	Already furnished.
140	-	-	-	Please furnish the high flood level and rainfall intensity in mm/hr.	For HFL refer note no. 6 of Bid Plot plan. Bid specification prevails .
141	4	2.37	1) PCC paving of grade M-20, 100 mm thick laid over 75 mm thick bed of dry brick aggregate shall be provided for following areas: (i) 2.0 m wide pathway all along pipe/ cable corridor	It is the proposed to provide paving locally around the pipe/ cable corridor for the accessibility to the cage ladders.	2.0 m wide pathway all along the pipe/cable corridor consists of 150mm thick P.C.C. of grade M-20 overlaid on 230 mm thick stone soling with interstitches filled with sand by water flooding. For paving around cooling tower, volume VI A section 1 clause 4.7.20.18 shall be applicable.
142	4	2.5/ 5.1.2	Cl. 2.5: For half brick thick wall 2 nos. 8 mm diameter bars shall be used at every third layer. Cl. 5.1.2 : 1:4 cement sand mortar with 2 nos. 6 mm diameter M.S. rod in every fourth layer.	We propose to follow Cl. No. 5.1.2 as per standard industrial practice.	Clause 2.5 of section 4 prevails.

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
143	4	3.0 (a) (iii)	Intensive landscaping zone- Canteen, Service Building & similar buildings	Intensive landscaping will be provided for Canteen & Service Building only.	Bid specification prevails except Administrative building
144	4	3.1.3	Canteen, service building & similar building area:	Intensive landscaping shall be provided for Canteen & Service Building only. Please confirm.	Bid specification prevails except Administrative building
145	4	4.0	The control room shall have very high quality furniture of approved make similar to Godrej / Feather light	Furnitures required shall be provided only for Control room building of STG building, supply of furnitures for all other buildings & facilities shall not be in bidder's scope. Please confirm.	Bid specification prevails.
146	4	4.1(a)	Tree height shall be 6 to 15 m	Tree heights in the intensive landscaping will be 3 to 10m. Please confirm.	Bid specification prevails.
147	4	4.1.1	Landscaping shall be provided for administrative area,	We understand that there is no separate Administration building (not indicated in the Plot Plan / Specification also). Kindly clarify the administrative area.	Administration building is not included in Bidder's scope. Landscaping is not envisaged for Admin. Building.
148	4	4.1.2(a)	BROAD GUIDELINES FOR PLANT SELECTION Cooling tower area	Trees are not required in this Cooling Tower area. Please confirm.	To be decided during detail engineering

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
149	4	5.1.10 (e)(f)(g)	(e) All windows and ventilators shall be glazed aluminium windows conforming to IS: 1949. & IS: 1948 (f) Alternatively pre-coated (polyester painted) steel windows and ventilators may be used for auxiliary plant buildings. (g) Alternatively, steel reinforced UPVC windows may be used for Service building if agreed by the owner.	It is proposed to provide Pre-coated (polyester painted) steel windows and ventilators in all buildings.	Bid specification prevails.
150	4	5.1.10(d)	Doors of W.C. and shower shall be wooden panel door. Cl 2.13: it shall be hinged type single leaf shuttered FRP with heavy-duty aluminium box section frame black powder coated. Cl. 5.1.10 (d) the same shall be wooden doors.	It is proposed to use FRP doors as per clause no. 2.13.	Clause no. 2.13 of section 4 shall prevail.
151	4	5.1.9 (g)	Plinth Protection Cl. No. 2.36, 1000mm wide and 100 mm thk plinth protection shall be provided. Cl. No. 5.1.9 (g), plinth protection shall be 750 mm wide.	We shall follow Cl. No. 5.1.9 (g) for all buildings.	1000 mm wide & 100 mm thk PCC of M20 grade plinth protection alongwith drains shall be provided for all buildings.

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
152	4 10	4 2.4.4	4.0 (VI-A/4): Flooring: Total thickness of floor finish shall be 40 mm 2.4.4(IV-B/10) : Earthing conductors shall be embedded in concrete floor of the building without having direct contact with the reinforcement rods. Minimum concrete cover above earthing flat shall be 50 mm.	Earthing flat bars will be embedded within the 50 mm thk. floor finish.	Floor finish thickness 50 mm shall be accepted.
153	4	2.29 III-I/ 3/D	Two numbers of roof water tanks (one for storing service water and another for potable water) of adequate capacities depending on the number of users and 8 hours storage capacity shall be provided for each building and pump house Annexure I - SCHEDULE OF MISCELLANEOUS STEEL TANKS (1) DM water storage tank in the vicinity of DM plant - 850m ³ - 2 Nos (2) Condensate Storage Tank near Compressor House - 1000 m ³ 1No (3) DMCW Make up tanks By Bidder - 2No (4) Service Water Storage Tank -75 m ³ 2 Nos (5) Potable water Storage Tank -25m ³ 2 Nos	Discrepancy noted between referred clauses for over head tank. We propose to provide following tanks: Service water: Two Steel tanks of 75 m ³ each capacity in TG building. Potable water - Two Steel tanks 25 m ³ each in TG building. Further, 5 m ³ capacity sintex or equivalent tank will be provided for Service building and 1 m ³ capacity sintex or equivalent overhead distribution tank in other building, where potable water will be required.	Clause as per III-I/3 / D shall prevail

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
154	5	10.0	Signalling & Telecommunication for Railway Siding	The Tender Document is prescriptive of "Route Relay Interlocking". However we wish to propose the state-of-art "Electronic Interlocking" systems which shall benefit the Employer with improved line capacities, better traffic management, lesser maintenance and optimum life cycle cost.	Signaling & Telecommunication system for railway siding shall be as per railway norms.
155	A/1	4.4	Ash Handling Plant: Works shall include bottom ash slurry pipe supports, bottom ash extraction equipment supports, ash slurry pipe supports from ash slurry pump house to existing ash dyke area at VELHALA	We request customer to furnish the contours , details of existing structures, road/ nala crossings etc.	Refer Addendum II
156	A/1	3.1 k	Complete railway siding facilities for the project. The brief scope of railway siding consists of following works.	We request customer to exlcude this work from EPC scope as it innvolves many complicated works which can be done only by railway or regulor railway contractor.	Bid specification prevails.
157	A/1	4.4.1	The unsupported length of the all pipelines shall not be more than 6.0 meters.	We propose unsuported length shall be 7 meters normaly and more span shall be provided if required & support shall be designed acordingly. Please confirm.	Bid specification prevails.

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
158	A/4	2.37	Paving: 2.0 m wide pathway all along pipe/ cable corridor	Please confirm whether paving along the ash slurry pipe line upto ash pond.	Paving along the ash slurry pipe line up to ash pond is not envisaged in bid.
159	A/4	2.11 a/b	12 mm thick 1:4 Cement: Sand Plaster with neeru finish in 2 coats to all internal surfaces....	Insude & Outside plastering shall be in CM 1:6. Please confirm the acceptance.	Bid specification prevails.
160				2. PE-189-CV-SK-4003 P2 - Area grading drawing	Adequate data in readbale format has already been furnished.
161				3. PE-189-CV-SK-4005 P2 - Road layout	
162				4. PE-189-CV-SK-4006 P1 - Compound Wall	
163				Please provide the AutoCAD version of following drawings: PE-189-CV-SK-4003 (Area Grading), PE-189-CV-SK-4005 (Road Layout), PE-189-CV-SK-4006 (Compound Wall Layout) PE-189-GA-101 (Plot Plan)	

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SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
164				a) Please advise if the available soil investigation report, provided for BH12 (near crushed coal pile area), can be used for the boundary wall design between N' 500 and N' 1000 and E' 1500 through E' 2100. b) Also please advise about the soil data along the ash pipe corridor.	Please refer Volume VI A Section 2 clause no. 2 For soil data along ash pipeline refer Volume VI A Section 1 clause 4.4
165				Please provide legible version of Bore hole drawing No. PE-189-CV-SK-4001.	Will be furnished if available.
166			Pipe sleepers for Ash Piping	It is observed during site visit that for laying ash piping there is no space on the existing sleepers/ culverts/ bridges. Therefore, additional land for sleepers, culverts/ bridges would be required to lay ash piping. Owner to provide the necessary details.	Ash pipe line shall be laid in the existing / available land strip by making suitable supporting arrangement. Refer Addendum II
167			Road along the ash pipe	As observed during site visit, there is an existing road along the ash piping corridor outside plant boundary. Additional road as stipulated in Cl. No. 3.3, Vol VI -A.. Section1 may not be required. Please confirm.	Refer Addendum II

BHUSAVAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - VI A

SR. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
168				It is observed during site visit, a RCC culvert below railway siding is existing, which is designed to discharge the anticipated storm water effluent from the proposed plant area. Please indicate the terminal point of the storm water drainage. We do not envisage any additional flow to be considered other than the proposed plant area (Offsite storm water).	There will be 2 nos. of disposal points for storm water drains. The locations of the same is at bridge no. 17 & 18 of railway siding for 2 X 500 MW unit. The required data will be provided to successful bidder during detail engineering Bidder to consider topography of entire plot area while designing the storm water drainage scheme.
169				Please provide the existing rail layout and proposed rail layout with levels.	Already shown in the Bid plot plan drawing (Rev P3)
170				Water retaining structures and other under ground structures will be designed as per IS 3370 with crack width limiting to 0.1 mm. Please confirm.	All water retaining structures and other under ground structures except filtered water shall be designed with limiting crack width to 0.1 mm.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

RESPONSE TO PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1

VOLUME - VI B

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - VI B

S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
1	1	2.5.2	Necessary arrangement shall be done by the contractor at his own cost for locating and using the borrow areas as the source of supply of filling materials.	Identification of borrow pits, it's distance from plant boundary, acquisition & right of way shall be in Owner's scope. Please confirm.	Bid specification prevails
2	1	2.5.2	Borrow material...	The sub soil existing at project site, for soils other than clean graded sand, if found suitable, can the same be used for filling / grading.Pl.confirm.	The existing sub soil at site can be used as back fill material provided it does not have any swelling potential and the sub soil shall be tested for use as structural back fill material by the successful bidder as per approval of the Engineer incharge.
3	1&2	2.5.2 & 2.5.2	Borrow Material	Owner to indicate the location/source for borrowed earth.	Bid specification prevails
4	1	3.4	Felling of trees	All statutory clearances & permissions for tree cutting is excluded from bidder's scope. Please confirm.	Confirmed
5	1	3.6.5	Disposal of excess earth	Identification of disposal area, it's distance from plant boundary & right of way/acquisition shall be in Owner's scope. Please confirm.	Identification of disposal area outside plant boundary and right of way is included in bidder's scope

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - VI B

S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
6	1& 2	3.6.5 & 3.5.6	Disposal of excavated Surplus material	All surplus material from excavation shall be disposed off within plant boundary. Disposal of surplus earth outside plant boundary is not in the bidder's scope of work. Please confirm.	Disposal of all surplus material within inside & outside plant boundary is included in the bidder's scope.
7	1	3.8.1	Area filling for grading...	The sub soil existing at project site, for soils other than clean graded sand, if found suitable, can the same be used for filling / grading.Pl.confirm.	The existing sub soil at site can be used as back fill material provided it does not have any swelling potential and the sub soil shall be tested for use as structural back fill material by the successful bidder as per aproval of the Engineer incharge.
8	3	3.3	Structural concrete shall be of M30 grade and for other part of the work shall be as shown on the drawing as per grade classification of IS-456. In case of liquid retaining structures, IS:3370 will be followed.	Grade of concrete shall be provided as stipulated in Cl. No. (Vol. VI-A, Section2; Cl. No. 4.1).	Confirmed

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - VI B

S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
9	22	2.4.1	Gradients: If not specified the minimum gradients of soil and drainage pipe line shall be as follows: (a) 100 mm nominal dia : 1 in 35 (b) 150 mm nominal dia : 1 in 65 (c) 230 mm nominal dia : 1 in 120 (d) 300 mm nominal dia : 1 in 200	The minimum gradients of soil and drainage pipes will be provided such that minimum self-cleansing velocity (0.75 m/sec.) is obtained.	Bid specification prevails
10	22	Annexure-I	List of Civil Units: (a) Inlet Chamber (b) Manual Screen Chamber (c) Sanitary Water Storage tank (d) Grit Chamber (e) Fine screen chamber (f) Aeration tank (g) MBR Tank (h) Sludge Holding Tank (i) Chemical House	Civil units/items will be decided based on the Sewage Treatment Plant vendor requirements. Please confirm.	Given list is indicative but should not be limited to. Sludge thickener & Centrifuge are also deemed to be included in the given list.
11	22	Annexure-I	Sewage treatment plant cap	No. of users to be considered is 1500, where as as per Volume VI A, Section 1, cl 4.18.2, page 163 of 639, no. of users is 650. Pl clarify.	Follow specification Volume VI A, Section 1, cl 4.18.2, page 163 of 639, no. of users is 650.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE -BID QUERIES from Prospective Bidders

Bid Specification No. DG/BSL U-6/2011/T-1, Volume - VI B

S. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	Resolution
12	ADDENDU M- I	2.4	The distance from the existing river water pump house to the 1 x 660 MW unit (Unit # 6) is approximately 3 km. The proposed pipe line from Tapi river water pump house shall join the line coming from Ozerkheda near one day reservoir for 1 x 660 MW. The scope under this addendum covers the two numbers of intake water pumps and connecting pipework from river water pump house to the one day reservoir for 1 x 660 MW.	For laying of raw water pipeline and all associated civil works request you to kindly provide us the survey report & bore log details of the pipe route. In absence of the above reports the same would be excluded from our scope of work. Please confirm. Further for raw water intake, it's right of way & all statutory permissions & clearances shall be in Owner's scope. Please confirm.	ADDITIONAL WATER SOURCING as per Addendum -I is deleted from the scope , hence not applicable.
13	ADDENDU M- I	9.3	For crossing of the pipe lines with nallahs, rivers, canals etc, pipe shall be laid over RCC supports and bottom of pipe shall be kept at 0.5 m above H.F.L.	Please provide the HFL of the pipe corridor area.	ADDITIONAL WATER SOURCING as per Addendum -I is deleted from the scope , hence not applicable.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

RESPONSE TO PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1

VOLUME - VII A1

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT					
PRE-BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1 "Volume-VII A1					
Sr . No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/ Stipulation	Resolution
1	101 P2 (PLOT PLAN)		Railway crossings	Proposed Pipe rack towards fly ash silo which is shown in the plot plan is crossing the railway lines. Please confirm whether enough space is available in between railway lines for laying of pipes with structural supports.	Bid Specification prevails.
2	Plot Plan		Engineering reference drawings	Please provide all the engineering reference drawings mentioned in the plot plan.	These are not required for bidder
3	Plot Plan		-	As per plot plan, from farthest ESP to remote area silo distance is approximately 850 m to 900 m. Request to revisit the silo location. Single stage pressure conveying system is installed upto approximately 700 m to 750 m. In this context we would like to shift the silo location towards ESP area. Request to check and confirm.	Bid Specification prevails.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT					
PRE-BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1 "Volume-VII A1					
Sr . No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/ Stipulation	Resolution
4		PE-189-GA-101 Rev P2 (General) 6.1.1 6.2.5 Criteria for Layout (Annexure-B) Sr No. 2.4.1 Specific Layout considerations (Annexure-D) Sr No. 20.0	All rail/road crossings for pipe/cable racks shall be done with minimum Seven (7) meters headroom from top of rail/road to bottom of rack. Similarly, top cover over underground pipes/cables shall be minimum one (1) meter. Vol II - Section 4 Fuel Oil (F.O.) piping shall be routed over trestles. The headroom for F.O. trestle in Boiler/ESP/ID fan/Chimney area shall be 8.0 M till the road behind chimney and 7.0 M in CD bay area. The headroom for F.O. trestle in outlying area shall be 3.0 M except at rail/road crossing where the headroom shall be 8.0 M. Under pipes/Cable racks at road crossings-: 8.0 Meters Head Room for pipe/cables trestles at rail, road crossing 8.0 M	We suggest that instead of 8 meters, the required Headroom over Road/Rail crossings shall be minimum 7 meters per Clause-6.1.1 of Vol-II Section-4. Please confirm.	Bid Specification prevails.
5		Drg no PE-189-GA-106	Vol II - Section 4 TG Building - Deaerator roof	We propose that Deaerator shall be without roof.	Bid Specification prevails.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT					
PRE-BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1 "Volume-VII A1					
Sr . No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/ Stipulation	Resolution
6	117 P1 (COAL HANDLING PLANT)		GA Drawing of GHP & Conveyor 8 i.e SEC H-H	Please furnish GA drawing of GHP and Conveyor 8 i.e Sec H-H since same is not available with the specifications.	Refer Dwg.PE-189-GA-120
7	117 P1 (COAL HANDLING PLANT)		Stock pile dimensions	Since the no. of hours working of CHP and no. of days for coal stock is not mentioned, we consider the coal stock pile dimensions, 270X 50X 11 m3 as specified in the plot plan. Please confirm.	Confirmed
8	Drg no PE-189-GA-118,119		Tunnel Cross section and typical gallery cross section for single and double gallery	Tunnel Cross section and typical gallery cross section for single and double gallery to be decided based on belt width. Please review & confirm the sizes.	Drawing is being amended
9	Drg no PE-GA-120-118		TP 3: Top Floor height shown as 4 m	Since ILMS will be provided at head end of conv 3A/B, 4 m height is not sufficient.	Bidder shall optimize as per the space requirement for ILMS
10	Drg no PE-189-GA-120		Ground hopper for conv 8	Please furnish hopper size/capacity required.	Hopper shall be sized for 150 tons capacity
11	Drawing no.PE-189-PI-125		General Arrangement: Fuel oil Transfer pump house	Fuel oil transfer pump house sizing shall be as per actual requirement.Pl.confirm.	Bid specification prevails.
12	Drawing no.PE-189-PI-126		General Arrangement: HFO & LDO DAY Tank Area	Dyke area shall be provided as per OISD 118. Pl.confirm.	Bid specification prevails.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT					
PRE-BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1 "Volume-VII A1					
Sr . No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/ Stipulation	Resolution
13	16		Service building GA PE-189-GA-136	No switchgear room is shown in the GA.	In case of switchgear room located in ground floor, the cable vault to be provided in the basement (Minimum 3.5m height) as per bid specification
14	General Arrangement - Service Building (Fourth Floor and Roof), PE-189-GA-138, Rev P0			As shown in the Bid drawings, AC Plant AHU room is provided in Service building roof at EL(+) 21.250 m. Considering the occupancy of this building, air distribution in each floor will be high and it will not be possible to distribute air from roof to all floors. Hence, it is proposed to provide air handling units/rooms in all floors of the building. Further, this will provide operational flexibility also. In view of the above, service building layout is expected to change during detailed engineering.	Bid specification prevails.
15	General Arrangement - Service Building (Fourth Floor and Roof), PE-189-GA-138, Rev P0		No switchgear room is shown in the GA.	We are considering switchgear room for Service building in ground floor. In case of switchgear room located in ground floor, the cables will be routed using cable trench. Please confirm.	In case of switchgear room located in ground floor, the cable vault to be provided in the basement (Minimum 3.5m height) as per bid specification

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

RESPONSE TO PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1

VOLUME - VII A2

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE-BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1 "Volume-VII A2

Sr . No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/ Stipulation	Resolutions
1	PE-189-PF-201 Note-1		 Bidder shall develop detailed P&IDs meeting the overall intent of the scope and performance and furnish as part of proposal.	We would like to clarify that P&IDs shall not be provided with bid proposal and to be submitted during detailed engineering stage.	Bid Specification prevails
2	PE-189-PF-201 B3 & B8		Pneumatically operated spray control valves for HP & LP turbine bypass are shown.	We would like to clarify that if hydraulically operated HP & LP turbine bypass station is envisaged, all valves including steam and spray control valves shall be hydraulically operated.	Specification is self-explanatory.
3	PE-189-PF-201 B3 & E3		Manual bypass globe valve with upstream and downstream isolation valves for spray control valve of HP turbine bypass are shown.	We would like to clarify that no manual bypass valve with upstream and downstream isolation valves for spray control valve of HP turbine bypass are provided.	Bid Specification prevails
4	PE-189-PF-201		Double lead / pipe line for MS, HRH & CRH line are shown.	We understand that option of both single and double lead / pipe lines for MS, HRH & CRH are available with bidders.	Bid Specification prevails
5	PE-189-PF-201 B4 & A7		Warm-up line for HP & LP turbine bypass valves.	We would like to clarify that warm-up arrangement shall be provided if required as per manufacturer's standard practice.	Bid Specification prevails
6	Volume VII A2/ Drawing no : PE-189-PF-201		2 x 100% - HP Bypass Valves 2 x 50% - LP Bypass Valves	We propose 1 x 100% HP Bypass Valves and 2 x 50 % LP bypass valve system. Kindly confirm the acceptance for the same.	Bid Specification prevails

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE-BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1 "Volume-VII A2

Sr . No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/ Stipulation	Resolutions
7	PE-189-PF-202 & 203		In PF-202 one control station is shown before LP htr 1 and one after LP htr 4.	Please clarify the purpose of two control stations. Normal practice is to provide single control station before LP heater #1.	Agreed that two control stations are not required
8	PE-189-PF-202		Dosing point shown after CPU outlet.	Dosing point should be just outlet of CPU to enable alkaline water should go to various make up and auxiliary cooling requirement.	Drawing is self- explanatory.
9	PE-189-PF-202		Common normal and emergency make up lines.	As per tender PFD there is duplication of control stations on emergency and normal make up line for better controllability and operatability we propose following, 1. Separate lines for normal (from DM plant) and emergency make up (From CST) shall be provided each having individual control station. 2. Both the emergency and normal make up lines shall directly feed to condenser and additional control station (as per tender PFD) shall not be provided.	Agreed
10	PE-189-PF-202 B5		Valve sealing, hydrazine, ammonia & sodium hydroxide dosing tapping are taken from CST discharge header.	These tapping shall be taken from CEP discharge.	Agreed
11	PE-189-PF-202 B8		Normal make-up water is shown connected from CST.	We would like to clarify that only emergency make-up shall be provided from CST and normal make-up shall be provided from DM water storage tank.	Bid Specification prevails

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE-BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1 "Volume-VII A2

Sr . No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/ Stipulation	Resolutions
12	PE-189-PF-202 B9		Normal make-up control valves and emergency make-up control valve in parallel with downstream level control valve in series connected to hotwell via common pipe line.	We would like to clarify that separate lines shall be provided for normal make-up control valve from DM water storage tank to hotwell and emergency make-up control valve from CST to hotwell. No additional level control valve as shown in customer PFD is envisaged.	Will be evaluated after receipt of detailed scheme by bidder.
13	PE-189-PF-202 D3		Boiler fill pumps are connected to condensate storage tank for boiler initial and deaerator filling.	We would like to clarify that boiler fill pump shall be connected to DM water storage tank for boiler initial filling and deaerator filling.	Bid Specification prevails
14	PE-189-PF-202 D8		Separate LP heater 1 and 2 with separate LP heater 1 drain cooler.	Please note that low pressure heaters 1 & 2 are duplex type and located in condenser neck as per standard and proven practice of the Bidder. Since the heat balance cycle is optimised without drain cooling zone as bidder's standard practice, separate external drain cooler is not required for this LP heater in condenser neck.	Bid Specification prevails
15	PE-189-PF-202 D9		CEP individual minimum flow recirculation along with GSC common minimum flow recirculation line are shown.	GSC-cum-CEP common minimum flow recirculation line is sufficient for all CEP protection. No CEP individual minimum flow recirculation line is envisaged.	Bid Specification prevails

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE-BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1 "Volume-VII A2

Sr . No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/ Stipulation	Resolutions
16	PE-189-PF-202 E4, F6, C5, C8		Motorised bypass ball valves with upstream and downstream manual isolation valves are shown for condensate control valve, condenser level control valve, normal make-up valve, emergency make-up valve, GSC & CEP minimum recirculation valve.	We would like to clarify that these are highly reliable control valves carefully selected with all operating conditions for the process control. As per Alstom standard practice and operation concepts, manual operation or control of the plant with motorised ball valves is detrimental to the safety of the plant and not recommended. Hence request you to delete these motorised bypass ball valves with upstream and downstream isolation valves.	Agreed
17	PE-189-PF-202 E4		Main condensate control station is 2 x 100% pneumatic control valve and 1 x 100% motorized ball valve.	We would like to clarify that condensate level control valves shall be 1 x 30% + 1 x 100% capacity pneumatic control valve for better controllability during start-up and normal operation of the plant. No motorised bypass valve is envisaged as explained above.	Bid Specification prevails
18	PE-189-PF-202 F4		Motorized bypass valve with upstream and downstream motorised isolation valves are shown for condensate polishing unit.	We would like to clarify that individual vessel isolation valves with complete CPU bypass valve shall be provided as per CPU supplier's standard practice and shall be in CPU supplier's scope. Hence no separate CPU motorized bypass valve with upstream and downstream motorised isolation valves are envisaged.	Bid Specification prevails
19	PE-189-PF-202 F7		Motorized bypass valve with upstream and downstream motorised isolation valves are shown for gland steam condenser.	As per Alstom standard and proven practice, GSC motorized bypass valve with upstream and downstream motorised isolation valves are envisaged.	Bid Specification prevails

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE-BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1 "Volume-VII A2

Sr . No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/ Stipulation	Resolutions
20	PE-189-PF-202 G8		As per tender PFD, CEP sealing and wet steam washing line are shown after GSC.	We would like to clarify that as per equipment supplier's standard practice no Cep sealing and wet steam washing is required.	CEP sealing shall be provided.
21	PE-189-PF-202 G9		As per tender PFD, control valve in tapping line from CEP discharge header for vacuum pump make-up, valve gland sealing, BFP turbine exhaust hood spray and drain cooler loop seal make-up etc.	We would like to clarify that no such control valve is envisaged for these water lines as shown in customer PFD. Also clarify that no drain cooler loop seal make-up is required.	Bid Specification prevails
22	PID no. PE-189-PF-202		Motorised valve provided at the inlet, outlet and bypass of Gland Steam Condenser	As per standard practice, Isolation valves are always kept open. Hence, motorisation of these valves is not required. Isolation and bypass for GSC shall be manual with locked open/closed facility. Please confirm.	Bid Specification prevails
23	PID no. PE-189-PF-202		Motorised valve provided at the inlet, outlet and bypass of Condensate Polishing Unit	As per standard practice , motorised valves at the inlet, outlet and bypass of CPU are provided integral with CPU package. Hence, these valves are not required on condensate discharge line.please confirm.	Bid Specification prevails
24	PID no. PE-189-PF-202		Non return valve provided in LPH-1 bypass line	As per standard practice non return valve is already provided in condensate discharge header upstream of main condensate control station. NRV indicated in LPH-1 bypass line is not needed. Please confirm.	Agreed.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT
PRE-BID QUERIES
Bid Specification No. DG/BSL U-6/2011/T-1 "Volume-VII A2"

Sr . No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/ Stipulation	Resolutions
25	PFD (PE-189-PF-203)		FW Control Station location	We propose FW control station to be located upstream of HP heaters	Agreed.
26	PE-189-PF-203 A1		Motorised on-off valve at economiser inlet is shown.	Employer to note that the feed check valve shall be located at the downstream of the HP heaters. However there is no requirement to provide an isolation valve at such location as per Bidder's standard & proven practice. It shall be further noted that as per IBR amendment dated March 12, 2007 to regulation 520, feed water discharge piping for feed water system without economizer inlet isolating valve can be designed. Hence request you to delete this motorised on-off valve at economiser inlet.	MOV at Economiser inlet may be deleted if the system design does not require it.
27	PE-189-PF-203 A6		Two stage attemperation system for superheaters is shown.	Bidder would like to clarify that single stage desuperheating station shall be provided as per Alstom standard and proven practice.	Bid Specification prevails
28	PE-189-PF-203 C3		Feed water regulating station at downstream of HP heater.	We would like to clarify that feed control station along with necessary isolation valve at economiser inlet (downstream HP heaters) is shown which shall be located upstream of the HP Heaters (after BFPs) as per Bidder's standard & proven practice. This will substantially reduce design pressure of the feed water piping and HP heaters and same shall be designed corresponding boiler economiser design pressure instead of BFP shut off head. Kindly accept.	Agreed.
29	PE-189-PF-203 G1		Condensate level control station upstream of deaerator is shown.	Please delete this condensate level control station upstream of deaerator as condensate level control station is already shown in PE-189-PF-202. This additional level control valve is not required.	Agreed

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PRE-BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1 "Volume-VII A2

Sr . No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/ Stipulation	Resolutions
30	PE-189-PF-203		1 x 100% HP Feed Heaters with individual motorised bypass & isolation valves are shown.	Please note that Bidder intends to offer either twin stream i.e. 2 x 50% HP feed water heaters with medium operated 3-way bypass valves at upstream and downstream of each train of heater (the bypass line of each train shall be 50% feed water flow capacity) or single stream i.e. 1 x 100% HP feed water heaters with medium operated 3-way bypass valve at upstream and downstream of each heater (the bypass line of train shall be 100% feed water flow capacity). These media operated 3-way valves ensures quick bypassing of HP heaters in case of tube leakages. In this case, motorized isolation valves at upstream and downstream of HP heaters and in bypass line are not required. Bidder confirms that there are many Alstom built plants worldwide which are in successful operation with same philosophy.	2 x 50 % heater trains agreed; rest to be taken up during bid evaluation.
31	PID no. PE-189-PF-203		Control station indicated near Deaerator in condensate inlet line	As per standard practice control station at this location is not required. Please confirm.	Agreed.
32	PID no. PE-189-PF-203		Arrangement of and around HP heaters	As per standard practice followed for supercritical units, all HP Heaters shall be of 2x50% capacity, arranged in 2x50% HP Heater banks provided with string bypass. Spring loaded bypass shall be provided for each heater bank.please confirm.	2 x50% heaters agreed; rest of the scheme will be evaluated during bid evaluation.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT**PRE-BID QUERIES****Bid Specification No. DG/BSL U-6/2011/T-1 "Volume-VII A2**

Sr . No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/ Stipulation	Resolutions
33	PID no. PE-189-PF-203		Location of Feed Control Station	As per standard practice followed for supercritical units, feed control station shall be located in BFP discharge line upstream of HP heaters and there shall be no isolating valve at boiler inlet. This meets IBR requirement. Please confirm.	Agreed
34	Process Flow Diagram - Feedwater System, PE-189-PI-203		Feed control station downstream of HP Heaters.	Boiler feed discharge pipe line downstream of feed control station shall be designed for maximum pressure expected from Steam generator side and not for BFP shut-off head. Feed control station shall be located upstream of HP heaters.	Agreed.
35	PE-189-PF-204		Extraction points for heaters	Location of extraction points shall be as per optimised design of bidder.	Specification is self-explanatory.
36	PE-189-PF-204		HP heaters 2 and 3 drain to deaerator	HPH3 and HPH2 emergency drain lines to condenser shall be provided. Separate emergency drain lines from these Heaters to deaerator as per tender PFD are not required and hence not envisaged. Please confirm.	Will be evaluated after receipt of detailed scheme by bidder.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT**PRE-BID QUERIES****Bid Specification No. DG/BSL U-6/2011/T-1 "Volume-VII A2**

Sr . No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/ Stipulation	Resolutions
37	PE-189-PF-204 G5 & G10		HP & LP drain flash tank for heater drains.	Owner to note that for all the drains which are routed to the condenser hotwell, instead of providing separate HP & LP flash tanks, Bidder shall provide flash boxes which shall be attached to the condenser as per standard and proven practice of the Bidder. Kindly accept.	Bid Specification prevails
38	PE-189-PF-204		Nos. and type of NRVs on turbine extraction lines.	NRVs in each extraction line will provided as per bidder's safety guidelines and standard proven practice. Please confirm acceptance of bidder's standard proven practice.	Bid Specification prevails
39	PID no. PE-189-PF-204		HP heater drains being led to deaerator	Drains from HP heaters shall be led to the next lower pressure heater, while the drain from the lowest pressure HP heater shall be led to deaerator. Alternate drain from all heaters shall be led to condenser. Please confirm.	Agreed
40	PID no. PE-189-PF-204		Spray line from CEP discharge to LP drain flash tank	As per standard practice spray connection for LP drain flash tank is not required, please confirm.	Bid Specification prevails
41	PID no. PE-189-PF-204		Non return valves indicated in various extraction lines	Non return valves in various extraction lines shall be provided as per turbine manufacturer's recommendations and turbine integral schemes. Please confirm.	Bid Specification prevails

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE-BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1 "Volume-VII A2

Sr . No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/ Stipulation	Resolutions
42	PE-189-PF-205		High temperature and low temperature auxiliary steam header pressure temperature.	Bidder would like to clarify that high temperature auxiliary steam header pressure & temperature considered by us is 16 kg/cm2 and 310 deg C and low temperature auxiliary steam header pressure & temperature considered by us is 16 kg/cm2 and 210 deg C. Please confirm.	The scheme will be evaluated based on comprehensive data regarding the steam consumption requirement at the operating regimes expected.
43	PID no. PE-189-PF-205		Motorised isolation valve indicated in MS & CRH tap-off for Aux. PRDS	As motorised isolation valve is being provided on the upstream of high capacity pressure reducing valve (drawing steam from MS) and low capacity pressure reducing valve (drawing steam from CRH), additional motorised isolation valve in the tap-offs is not required. Please confirm.	Specification is self-explanatory.
44	Drg. no. PE-189-PF-226 Process Flow Diagram Coal Handling System		The Process Flow Diagram Coal Handling System Drg. no. PE-189-PF-226, travelling tripper TTR 1, 2, 3, 4, and Conveyor 5A,5B,6A,6B are provided with One way chute & end discharge Chute is provided at discharge end	In Travelling Tripper Motorized Two way discharge chute is required. Please Confirm.	Bid specification prevail.
45	226 P1 (COAL HANDLING SYSTEM)		GHP-Grizzle Hopper	We understand Grizzly hopper is a hopper which is having grating on the top of hopper.	Confirmed

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT**PRE-BID QUERIES****Bid Specification No. DG/BSL U-6/2011/T-1 "Volume-VII A2**

Sr . No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/ Stipulation	Resolutions
46	226 P1 (COAL HANDLING SYSTEM)		Only Rod gate has been shown below the GHP in the coal flow diagram	Since Rack & pinion gate is required below the GHP along with the rod gate and also spares for rack & pinion gate were given in the spares list so we will consider rack & pinion gate in our offer. Please confirm your acceptance.	Confirmed
47	PE-189-PF-226 / P1 Process Flow Diagram : Coal Handling System		Reversible Belt Feeder-1 & 2 and Belt Feeder in crusher house.	Reversible Belt Feeder-1 & 2 and Belt Feeder in crusher house are shown. Please recheck whether these are required or not. We feel Reversible Belt Feeder-1 & 2 and Belt feeder both are not required and unnecessarily building height will increase.	Self explanatory
48	PE-189-PF-226 / P1 Process Flow Diagram : Coal Handling System		Vibrating screen is listed with the symbol in the Legend table.	Vibrating screen is no where located in the coal flow diagram but it is listed in the legend table. Please confirm the location of Vibrating screen if it is required.	Not required.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE-BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1 "Volume-VII A2

Sr . No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/ Stipulation	Resolutions
49	Vol-VII-A1, Drg no. PE-189- PF-226		Additional Belt Weigh Scale BW-5	BW-5 are required for the CC-8. Please confirm.	Confirmed
			Metal Detector MD-1 & MD-2	Position of metal detector are replaced from CC-4A & 4B to CC-3A & CC-3B.	Bid Specification prevail
			Additional Metal detectors MD-3 & MD-4 (Proposed)	Addition Metal Detectors MD-3 & MD-4 are included in scope of supply as the material before feed to crusher should not contain any metal particles. Please confirm.	Bid Specification prevail
			Magnetic Separators ILMS-3	ILMS-3 has been excluded from scope of supply as the same is not required.	Bid Specification prevail
			Bunkers.	Six (6) Nos. of bunkers are envisaged for this project and shall be located in the front of the boiler.	Bid Specification prevail
			Fixed tripper FTR-1 & FTR-2, Travelling tripper TTR-3 & TTR-4, transfer point TP-5, conveyor CC-5A & 5B and CC-6A & 6B.	These fixed trippers, travelling trippers and conveyors would not be required since the layout is based on front mill arrangement.	Bid Specification prevail

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE-BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1 "Volume-VII A2

Sr . No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/ Stipulation	Resolutions
50	Coarse Ash P&ID No. PE-189-PI-238, P1		Wet system with feeder ejector/Chimney ash tank/Jet pump	Ash collection in Chimney hopper being extremely low & of very fine nature, we recommend Stack hopper ash conveying in dry mode similar to ESP ash which will reduce water consumption & remove wet system equipment making the system cost effective. Please confirm acceptance.	Bid Specification prevail
51	Dwg No. PE-189-PI-242, P1	-		No. of bottom ash slurry pumps in series shall be decided based on system requirement and not as per the no. of ash slurry pumps indicated in the flow diagram. Please confirm.	Bid Specification prevail
52	flow diagram PE-189-PI-242, P1	-		Control valve in the ash slurry disposal system is not advisable. Please check and confirm the requirement.	
53	Process flow diagram - PE-189-PI-250 P0 _Effluent Treatment System (Zone M-5)		Plant rainfall runoff skid	Please confirm requirements of Plant rainfall runoff skid as no data and description is mentioned in Volume:III-E-1 water treatment system about Plant rainfall runoff skid. Please provide datasheet for the sump and pump.	Required details will be provided to the successful bidder during detail engineering

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE-BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1 "Volume-VII A2

Sr . No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/ Stipulation	Resolutions
54	Drawing no.PE-189-PI-252		P & ID Fuel oil transfer, storage, heating and forwarding system	As per tender specifciation, a tapping from existing LDO tank is to be taken for filling proposed day oil tanks. We understand that the instruments indicated in the P&ID are already installed on tanks and none are to be provided by the bidder for existing tanks. Pl confirm. Further, we understand that a separate nozzle is available in the existing LDO tank for filling the proposed day oil tank. Pl. confirm.	Bidder shall collect the data from site.
55	Drawing no.PE-189-PI-252		P & ID Fuel oil transfer, storage, heating and forwarding system	Drain oil tank is used for draining of transfer pump. As there are both LDO and HFO transfer pumps in the system, drain oil tank will contain both LDO and HFO. As no heating facility is available in LDO storage tank. Hecne, it is not advisable to transfer oil from drain oil tank to LDO storage tank and oil from drain oil tank will be connected to HFO tank only. Pl confirm.	The schemes will be evaluated based on comprehensive data regarding the steam consumption requirement at the operating regimes expected.
56	Drawing no.PE-189-PI-252		P & ID Fuel oil transfer, storage, heating and forwarding system	since Rack & pinion gate is required below the GHP along with the rod gate and also spares for rack & pinion gate were given in the spares list so we will consider rack & pinion gate in our offer.	Agreed

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT**PRE-BID QUERIES****Bid Specification No. DG/BSL U-6/2011/T-1 "Volume-VII A2**

Sr . No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/ Stipulation	Resolutions
57	Drawing no.PE-189-PI-252		P & ID Fuel oil transfer, storage, heating and forwarding system	As indicated in P&ID, oil water separator tank along with oil water mixture collection tank which are to be provided is not clear. Customer to note that a gravity type oil water separator is provided for collection of oil water drain from the fuel oil handling area (In this case it is dyke area). Oil from oil water separator will be pumped back to the HFO day tank and water remains shall be discharged to plant drain. Customer to confirm.	Will be evaluated after receipt of detailed scheme by bidder.
58	P&ID For Fuel Oil Handling System,PE-189-PI-252		Return Oil Cooler	We understand that return oil cooler is required in the HFO return line even though it is not specified. Please clarify the scope of same.	Bidder shall consider as required.
59	General			Valves, instruments, scheme, accessories, specialties, etc. shown in P&IDs/Flow diagrams attached with specification are considered for reference. Valves, instruments, scheme, accessories, specialties will be decided during detailed engineering based on system requirement. Please confirm.	Specification is self-explanatory.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

RESPONSE TO PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1

VOLUME - VII B

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

PRE-BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1 "VOLUME-"VII-B"

Sr . No	Volume / Section	Clause No.	Bid Specification Stipulation	Bidder's query/ Stipulation	Resolution
ELECTRICAL					
1	PE-189-EL-501 Key Single Line Diagram	PE-189-EL-501 Key Single Line Diagram	PE-189-EL-501	Quantity & Rating : Quantity & Rating shown in the SLD considered for tender purpose only & not considered as minimum requirements. Master Single line diagram will be prepared during detail engineering, showing the actual quantity & rating required for Power & LT Transformers, HT Switchgears, LT PCC/PMCC/MCC/, IPBD, SPBD, NSPBD, HT & LT Motors, Lighting Transformer, ACDB, DCDB, MLDB, ELDB, DB, HT Cables, LT Cable, Control Cable, FS Cable, Battery & Battery Charger etc., with respect to the distribution scheme, geographical layout, load centres & as per the system requirement. Rating of each equipment will be substantiated with suitable calculation.	Bid Specification prevails
2	PE-189-EL-501 Key Single Line Diagram	PE-189-EL-501 Key Single Line Diagram	12 nos. dry type LT Transformers connected to 6 nos. of ESP LT PMCC by NSPBD & LT Transformers shall be fed from 11kV ESP switchgear feeder 6 nos. from each bus section of 11kV ESP switchgear through cables. 11kV ESP Switchgear shall be fed from 11kV Unit Switchgear 1 & 2	We confirm that adequate rating/quantity of 11/0.433kV ESP LT Transformers shall be provided & the same shall be connected to ESP LT PMCCs for feeding ESP loads. This ESP LT Transformers shall be fed from each 11kV Unit Switchgear.	Refer to corrigendum-II, & revised Key Single Line Diagram (PE-189-EL-501(P3))

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT**PRE-BID QUERIES****Bid Specification No. DG/BSL U-6/2011/T-1 "VOLUME-"VII-B"**

Sr . No	Volume / Section	Clause No.	Bid Specification Stipulation	Bidder's query/ Stipulation	Resolution
3		PE-189-EL-501	Lightning arrestor in SPBD connection to 11kV Station and Unit boards	Lightning arrestors on HV side of the GT & ST will be provided. Since BIL at 11kV side is already suitable for 75kVp, no Lightning arrestor is required in SPBD connection from Unit transformer and Station transformer to 11kV Station and Unit boards respectively.	Bid Specification prevails
4		PE-189-EL-501	Key SLD drawing.	We understand that electrical supply for Railway electrification shall be provided by Owner	Bid Specification prevails
5		PE-189-EL-501	Dry type station LT Aux. transformer.	We shall envisage dry type station LT Aux. transformer for power house area. Oil filled transformers shall be used for all other areas including transformers for ESP PMCC.	Bid Specification prevails
6		PE-189-EL-501 Note-1	"All ratings indicated in the drawings are the minimum required & tentative, exact rating of the same shall be decided by the vendor during detail engineering stage with owner's approval."	We propose that minimum rating of all equipment will be selected as per load requirement & associated sizing calculation	Bid Specification prevails
7		PE-189-EL-501		Spare motor feeder in 11kV Station switchgear is same as spare feeder for MDBFP	Confirmed

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT**PRE-BID QUERIES****Bid Specification No. DG/BSL U-6/2011/T-1 "VOLUME-"VII-B"**

Sr . No	Volume / Section	Clause No.	Bid Specification Stipulation	Bidder's query/ Stipulation	Resolution
8		PE-189-EL-501	11kV fire water and raw water Switchgear, 415V FW PMCC and 415V Raw water PMCC	We propose to remove 11kV fire water and Raw water Switchgear. Transformers SAT-7 & 8 for 3.3kV fire water and Raw water Switchgear shall be directly fed from 11kV Station Switchgear. Also, 415V FW PMCC and 415V Raw water PMCC shall be merged. SLT-21 & 22 shall be removed. SLT-17 & 18 shall be directly fed from 11kV Station Switchgear.	Bid Specification prevails
9		PE-189-EL-502	3.3kV, 40kA for 3 Sec.	The fault rating shall be finalized as per load data, transformer data viz. as per system study calculation. 40kA cannot be considered as the minimum rating.	Bid Specification prevails
10		PE-189-EL-502	IPBD	IPBD continuous current rating and CT ratio shall be as per approved sizing calculation. Minimum Primary rating cannot be fixed as 26kA.	Bid Specification prevails
11		PE-189-EL-503	5A CT secondary for GT differential protection	1A CT secondary shall also be acceptable for GT differential protection.	Bid Specification prevails
12		PE-189-EL-503	Spare CT in Generator neutral	Spare CTs shall be provided loose. It would not be mounted onto generator neutral side.	Bid Specification prevails
13		PE-189-EL-503	175KVA NGT	Minimum rating of NGT shall be as per approved sizing calculations and not 175kVA.	Bid Specification prevails

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT**PRE-BID QUERIES****Bid Specification No. DG/BSL U-6/2011/T-1 "VOLUME-"VII-B"**

Sr . No	Volume / Section	Clause No.	Bid Specification Stipulation	Bidder's query/ Stipulation	Resolution
14		PE-189-EL-509	ST and SATs are shown in east side of TG building.	Please provide confirmation that shifting of STs and SATs from east side of TG building to west side i.e. in front of service building is acceptable to MAHATRANSCO.	Bid Specification prevails
15		PE-189-EL-517	Earth mat is indicated in CW Pump house area.	Please note for BOP area would only have peripheral earthing as per IEEE 665.	Confirmed only for CW area. Other BOP area as per Bid specification
16		PE-189-EL-517	Illumination, Grounding & Lightning Protection zones in Power Plant EPC contractor's scope.	We understand that only hatched areas are to be considered for Illumination & Lightning	Drawing amended indicating hatching. Illumination, Grounding & Lightning Protection zones in entire Power Plant (EPC contractor's scope).
17		PE-189-EL-521	Wall separation between HT & LT Switchgears is indicated in the drawing.	We propose that no wall separation is required between HT & LT Switchgears.	Confirmed.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

RESPONSE TO PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1

VOLUME - VII C

BHUSAVAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT**PRE - BID QUERIES****Bid Specification No. DG/BSL U-6/2011/T-1 VII C**

Section No	Clause No	Bid Specification	Bidders query/ Stipulation	Resolution
PE-189-IN-SK-8001 P1 CONTROL SYSTEM ARCHITECTU RE		Controller Configuration	Controller Configuration will be as per ALSTOM's standard proven validated practice for all the power plants globally. Please confirm the acceptance.	Control system architecture is indicative only. Controller Configuration/grouping shall be per cl.no.5.3.27/section V/volume V

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

RESPONSE TO PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1

VOLUME - III A

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Revised Resolution
49	1	5.7.2	Primary reheat steam temperature control system shall utilise the tilting of burners.	Our offer envisages opposed wall firing with gas biasing dampers at economiser outlet in the divided backpass for Reheat steam temperature control.	Refer Corrigendum-IV
50		22.1.1	Arrangement of burners : Corner fire with Tilting arrangement		

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

RESPONSE TO PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1

VOLUME - III D

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-III-D

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Revised Resolution
41	PAGE 30 OF 175	4.4.3, 6.15.3	Vertical clearance of over head pipe lines at the rail/road crossings & walk ways	Please clarify the contradiction in vertical clearance to be considered for over head piping above walk ways and road ways/rail ways which is mentioned as 6.2m & 8m in tender specifications.	Corrigendum-I prevail
52	PAGE 33 OF 175	4.18	cross country pipe	The Owner shall arrange for approvals from relevant authorities or private parties with respect to the pipe laying including corridor to be adopted, right of way for piping, clearing of trees or plants etc in the corridor, clearance for routing piping crossing roads and railways etc.	Bid Specification prevails.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

RESPONSE TO PRE - BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1

VOLUME - IV A

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project

Pre - Bid Queries

Bid Specification No. DG/BSL U-6/2011/T-1 Volume-IV-A

Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Revised Resolution
27/135A	4	3.3.(b)	The Unit Transformer shall be designed for 100% Capacity each to provide reliability against forced or planned outage of one Unit Transformer. Normally each Unit transformer shall be loaded 50% capacity.	As per Key SLD, there is no tie between Unit switchgear 1 to 2 to take care 100% unit load during one UT outage condition. In the event of one UT outage, we presume that the respective unit board will get the back up power supply from connected Station transformer. Please clarify.	Refer Corrigendum IV Volume IV A
	5	3.1.2 (e)	(e) In case of forced/planned outage of either UT, its load get transferred to respective ST bus with which they are interconnected through tie breaker.		Bid Specification prevails.
47	1	6.1.12	Number of rails and rail gauge will be well coordinated with number of wheels and orientation of all large transformers including those in switchyard right from unloading bay of Power House.	Please note that the railway arrangement work for switchyard transformer is not envisaged, since switchyard is not in bidder's scope of work.	Refer Corrigendum II Volume IV A
159	6	3.5(b) DataSheet-A	SPBD	Material of enclosure shall be Al alloy grade-31000 & material for conductor shall be Al alloy grade-63401.	Bid Specification prevails.

BHUSAVAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT

CLARIFICATIONS TO PRE -BID QUERIES

Bid Specification No. DG/BSL U-6/2011/T-1,

Volume - VI A

Sr.No.	Volume	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Clarifications/Final Resolution
1	VI A	-	3.1a.Pg 6 of 76 Addendum-III	Providing and laying MS gravity pipeline in the inlet canal, from the existing river water pump house of Mahagenco located at tapi river to adequate slope.	During site visit it was observed that the inlet canal from existing pump house to the aqueduct was full of water. Hence, provide the cross sectional detail of inlet canal for estimation.	The cross section of inlet canal is enclosed herewith .
			13.8, Pg.37 of 76 Addendum-III	Laying of pipeline in canal and filling around with sand upto canal top.		
2			3.1c, Pg.7 of 76 Addendum-III	The scope shall also include cleaning and desilting approach canal to pump house.	We understand that the approach canal to be cleaned and desilted is stretched between the abandoned pump house and aqueduct. Please Confirm. Also, provide the detail of approach canal/adequate including cross section and longitudinal section for estimation.	Confirmed. Cross section of inlet channels and aqueduct enclosed. L-section of the proposed pipe line is already provided vide Addendum - III.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT**CLARIFICATIONS TO PRE -BID QUERIES****Bid Specification No. DG/BSL U-6/2011/T-1,****Volume - VI A**

Sr.No.	Volume	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Clarifications/Final Resolution
3			13.2, Pg. 36 of 76 Addendum-III	To obtain necessary various approvals from concerned departments/agencies.	Only customer's/customer consultant's approval on design/drawings are envisaged. Any statutory approval etc. from concerned department/agencies including necessary charges are beyond the scope of this tender. Please confirm.	Bid Specification shall Prevail.
4			13.7, Pg. 37 of 76 Addendum-III	Diversion of existing flow of water for connection of Pipeline from existing tank.	This clause is not understandable hence it needs to be clarified with details.	Proposed Pipe Line is to be laid in abandoned Canal which is Parallel to the Canal in use. After completion of Pipe Line work, end connection shall be done with existing tank near Tapi Pump House. Necessary arrangement for connections to existing tanks shall be done by the bidder.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT**CLARIFICATIONS TO PRE -BID QUERIES****Bid Specification No. DG/BSL U-6/2011/T-1,****Volume - VI A**

Sr.No.	Volume	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Clarifications/Final Resolution
5			9.3, Pg. 20 of 76 Addendum-III	The M.S. Gravity while designing the above pipeline, the agency shall ensure the same discharge after existing siphon arrangement.	Please provide the GA drawing for existing (abandoned) pump house indicating levels, as same are required for calculation of Pump TDH. Please provide the details of existing Siphon arrangement (including GA drawing) as same is not clear from specification. Please clarify.	For general arrangement of existing abandoned pump house the bidder is requested to visit the site. The drawings indicating the details of the siphon arrangement are attached herewith.



**MAHARASHTRA STATE POWER
GENERATION CO. LTD.**

**PROJECTS & PLANNING
DEPARTMENT**

BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1

**CLARIFICATIONS TO PRE-BID
QUERIES**

TECHNICAL

CONSULTANT
PROCON ENGINEERS
(DIV. OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)
202 A, Dosti Pinnacle, Plot E-7, Road no. 22,
Wagle Industrial Estate,
Thane (w)-400604

BHUSAWAL THERMAL POWER STATION 1X660MW UNIT - 6 PROJECT					
CLARIFICATIONS TO PRE-BID QUERIES					
BID SPECIFICATION No. DG/BSL U-6/2011/T-1					
VOLUME -II					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
1	Section-2	7.14	Rainfall: 112 mm average annually	The value seems too low. Please check. Regarding the hourly maximum rainfall, please provide the reference data for the existing 2x 500 MW plant for the basic design purpose.	Please refer Pre-Bid clarification at Sr. no. 1 , Volume II and Sr. no. 95, Volume - VIA (Issued on date 07.07.2012)
2	SECTION - 3	5.0	(a) Residential accommodation to be built by the Contractor at his own expense for his employees near site.	Please inform us the location and area(m2) of the land for Contractor's accommodation and office.	This clause is deleted. Please refer Sr. no. 11 of Corrigendum -II, page 12 of 274 and will be dealt according to the Volume- I, Section-2B, clause no. 4.1.1.
3	SECTION - 3	5.0	(b) Site office, pre-assembly/storage yard to be constructed by Contractor at his own expense within plant site	Please inform us the location and area(m2) of the land for Contractor's accommodation and office.	Please refer area for Lay down space/contrsuction yard/Fabrication yard in Plot Plan for contractor's purpose.
4	SECTION - 3	5.0	5.2 Construction power at 11 kV AC +-10%, 3 Phase, 50 Hz +-5% and Construction water shall be made available at one point near the erection site by the Owner. Regarding charges, please refer Volume-I of this specification.	Please confirm if there is the limitation of consumption in Construction Power & Water.	Please refer Sr. no. 12 of Corrigendum -II, page 12 of 274 and also refer Volume -I. For limitation of consumption in Construction Power & water , Please refer Cl. No. 4.2 & 4.3, section- 2B, Volume-I.
5	4	17.1	"In case Ministry of Environment & Forest stipulates any other conditions not specified hereunder while clearing the project, same shall be complied with by the contractor"	Kindly furnish MOEF document, so that we know specific stipulation made by MOEF, for system design as per their recommendation.	The document is available on MOEF website in public domain
6	SECTION - 5	2.0	2.2 Generator Stator Lifting may be considered by either of the two options as mentioned below :	From the referred clauses, we understand the followings: 1. Tandem operation of TG hall EOT cranes are required if generator stator lifting is envisaged with turbine hall EOT cranes. 2. Capacity of each turbine hall crane shall be computed as $Y = 1.25 a/2$, if bidder opts for generator stator lifting by turbine hall cranes. Kindly confirm our understanding. Also, Mahagenco is requested to reconsider single EOT crane with generator stator lifting option (b) since our generator stator is not recommended to lift after erection, which will save i. one TG hall EOT ii) Civil cost of TG building & other auxiliaries (Electrical).	Each crane shall have 125% of equipment weight. In case of bidder opting for option (b) mentioned in the specifications for lifting Generator Stator , two cranes shall be provided as per bid specification (Vol. III-I). Please also refer Corrigendum - VIII ..

VOLUME -II					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
7	SECTION - 8	1.4.10	It shall be demonstrated at SH and RH outlets (in case of more than one outlet) that the temperature imbalance between the outlets does not exceed	It can be met during only steady state. Doosan recommend to revise paragraph as below. It shall be demonstrated at SH and RH outlets (in case of more than one outlet) than the temperature imbalance between the outlets does not exceed 10°C under all loads.	Bid specification prevails .
8	SECTION - 8	1.4.16	(b) Maximum continuous output at generator terminals corresponding to all HP Heaters out of operation under rated steam conditions with 1% make up.	Mahagenco to clarify whether 100% TMCR output is required during all HP heater out condition.	Please refer Corrigendum - II / Sr. 30, page 18 of 274.
9	SECTION - 8	1.4.18 (Sr.. no. 191 of Pre-bid clarification issued on 07.07.2012 and Sr. no. 16 of clarification issued on 10.12.2012.	(The constant pressure operation from 0 to 35/40% of TMCR & 90% TMCR to VWO condition and sliding pressure operation from 35/40% to 90% TMCR in conjunction with the steam generator, HP-LP bypass system and Instrumentation & Control system shall be demonstrated. In sliding pressure mode of operation, during quick load increase, the idle control valve (s) must respond rapidly to pick up 20% of operating load, so that immediate increase of boiler pressure is not required. The load response capability shall be demonstrated in steps of 5%. Changeover from constant pressure mode to sliding pressure mode and vice-versa shall also be demonstrated.	1) We are considering sliding pressure operation from 40% to 90% TMCR . Please confirm our understanding. 2) These capabilities of the plant can be checked as a part of Commissioning test and hence we request you to delete the requirement of category III guarantee. We propose following operation concept as per standard and proven practice of the Bidder : 1) 0 to 40% TMCR: Constant Pressure Operation. 2) 40% TMCR to 100% TMCR: Pure Sliding Pressure Operation, with instantaneous output increase of 5% achieved through overload valve. This is in accordance to cl. no. 4.8 (d) of Grid Code (L/68(84)/2006-CERC, dtd: 14/03/2006). 3) 100% TMCR to 105% TMCR: Constant Pressure Operation through overload valve. The generating unit shall be capable of instantaneously increasing the output by 5%, limited to 105% TMCR as per cl. no. 4.8 (d) of Grid Code (L/68(84)/2006-CERC, dtd: 14/03/2006). No throttling is envisaged in sliding pressure operation.	Bid specification prevails.
10	SECTION - 8	1.4.26	(c) Cold startup/hot startup of the unit using TDBFP with motive steam from auxiliary steam header shall be demonstrated.	Bidder requests Owner to delete this Category-III guarantee as unit start-up requirement using TDBFP is not envisaged in respective specification and customer PFDs i.e. PE-189-PF-204 & PE-189-PF-205. Auxiliary steam if considered for BFP Drive turbine operation then operation of drive turbine becomes inefficient with primary source of steam and is loss of cycle heat rate. It is therefore recommended to use 2 x 30% MDBFP for starting of the plant in case of cold startup/ Hot start up. Also, as per pre-bid clarification (sl no. 187), Mahagenco has clarified TDBFP connection with auxiliary steam is not required. Hence, MAHAGENCO is requested to clarify the same.	Pl. Refer PBQ clarification no. 205, Bid specification prevails.

BHUSAWAL THERMAL POWER STATION 1X660MW UNIT - 6 PROJECT					
CLARIFICATIONS TO PRE-BID QUERIES					
BID SPECIFICATION No. DG/BSL U-6/2011/T-1					
VOLUME -III A					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
1	SECTION - 1	5.1.3	The Steam Generator unit shall be capable of operating on sliding pressure mode .The load range for sliding pressure unit operation shall be from 35% to 90% Turbine Generation Maximum Continuous Rating (TGMCR) to 90 % TGMCR and constant pressure mode between 90% TGMCR to 100% TGMCR.	1) We are considering sliding pressure operation from 40% to 90% TMCR . Plaes confirm our understanding. 2) These capabilities of the plant can be checked as a part of Commissioning test and hence we request you to delete the requirement of catagory III guarantee. We propose following operation concept as per standard and proven practice of the Bidder : 1) 0 to 40% TMCR: Constant Pressure Operation. 2) 40% TMCR to 100% TMCR: Pure Sliding Pressure Operation, with instantaneous output increase of 5% achieved through overload valve. This is in accordance to cl. no. 4.8 (d) of Grid Code (L/68(84)/2006-CERC, dtd: 14/03/2006). 3) 100% TMCR to 105% TMCR: Constant Pressure Operation through overload valve. The generating unit shall be capable of instantaneously increasing the output by 5%, limited to 105% TMCR as per cl. no. 4.8 (d) of Grid Code (L/68(84)/2006-CERC, dtd: 14/03/2006). No throttling is envisaged in sliding pressure operation.	Bid specification prevails.
2	SECTION - 1	5.16	5.16.20 Coal chutes of approved type and size shall be provided between raw coal Bunker shut off gate and inlet to the raw coal feeder and from feeder to the Mills. Height of coal chute between Bunker outlet and feeder inlet shall be adequate to prevent hot air to come up. A minimum height of 300 mm for each 75 mm water pressure shall be kept. Size of the coal chute at feeder inlet and outlet shall be minimum 900 mm. Material of chute shall be stainless steel. Coal chutes shall be provided with poke holes with 50% flanged type opening area and emptying chute to be suitable for loading trucks placed in ground floor.	Coal feeder outlet chute size will be applied minimum 600mm as per CEA regulations. In addition, to optimise coal mill performance & coal distribution coal chute design shall be applied as 600mm We have many experience applying to coal feeder outlet chute size as minimum 600mm.	Bid specification prevails.
3	SECTION - 1	5.16	5.16.23 The Bidder shall clearly describe in the proposal, the means provided to measure the coal level in the mill.	Coal level measuring is applied to tube mill. It isn't applicable to vertical spindle type mill.	Bid specification prevails .
4	SECTION - 1	DATASHEET - A	7.3 Unburnt Combustibles at Economiser outlet as % of Fly Ash to be considered for determining boiler efficiency	Please clarify whether 1.0% of fly ash is unburned heat loss(UBL) or unburned carbon in fly ash(UBC).If it means UBC, 1.0% is generally too low to meet.	Bid specification is self explanatory.

5	SECTION - 1	DATASHEET - A	10.5 RH temperature variation C (a) By burner tilting with supplementary water spray (between 60% and 100% BMCR) within $\pm 5^\circ\text{C}$ under steady state and in case of load change at the rate of 3% per minute within $\pm 10^\circ\text{C}$.	The 3%TMCR/min ramp rate with expected RH temperature variation $+15^\circ\text{C}$, -24°C are recommended for the stable operation of plant. And, the ramp rate test shall be conducted according to following conditions. 1. Ramp rates and times are based on no mills being put into or taken out of service during the ramp rate test. 2. Steady-state conditions of pressures, temperatures and flows must be established at the start of the test. 3. A dead band time due to the combustion system must be ignored to the ramp time. 4. The last part of load range must be ignored to the ramp time, because the controller will automatically reduce the the ramp rate near the final target load to reduce the variation and improve the stability.	Bid specification prevails.
6	SECTION - 1	DATASHEET - A	14.7 Material of Construction	All material and thickness of mill will be covented according to mill manufacturer's standard. Spring journal -> Hydraulic system applied.	Bid specification prevails .

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CLARIFICATIONS TO PRE-BID QUERIES

BID SPECIFICATION No. DG/BSL U-6/2011/T-1

VOLUME -III B

Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
1	1	Data Sheet -A clause no. 1.3	0.5 to 35% TMCR - Constant Pressure Operation 35 % to 90% TMCR - Sliding Pressure Operation 90% to VWO - Constant pressure operation Maximum sustained overpressure of at least 10% of the design turbine inlet steam pressure.	1) We are considering sliding pressure operation from 40% to 90% TMCR. Please confirm our understanding. 2) These capabilities of the plant can be checked as a part of Commissioning test and hence we request you to delete the requirement of category III guarantee. We propose following operation concept as per standard and proven practice of the Bidder : 1) 0 to 40% TMCR: Constant Pressure Operation. 2) 40% TMCR to 100% TMCR: Pure Sliding Pressure Operation, with instantaneous output increase of 5% achieved through overload valve. This is in accordance to cl. no. 4.8 (d) of Grid Code (L/68(84)/2006-CERC, dtd: 14/03/2006). 3) 100% TMCR to 105% TMCR: Constant Pressure Operation through overload valve. The generating unit shall be capable of instantaneously increasing the output by 5%, limited to 105% TMCR as per cl. no. 4.8 (d) of Grid Code (L/68(84)/2006-CERC, dtd: 14/03/2006). No throttling is envisaged in sliding pressure operation.	Bid specifications prevail.
2	1	12.12	Components The system comprises of oil tanks, defoaming chambers, vapour extractors, pumps, coolers, filters, interconnecting pipes, fittings, valves, gauges, thermometers. A Control and monitoring panel complete with annunciation shall be furnished. Damper tank for supply of oil to seal oil system under emergency condition may be considered.	As per Bidder's standard practice, seal oil coolers are not provided.	Bid specifications prevail.
3	1	5.2.5, Data Sheet-A	SCR : Not less than 0.48	As per Bidder's standard practice SCR not less than 0.45 shall be provided.	Bid specifications prevail.
4	1	12.11	One (1) detector in water inlet and one (1) in water outlet of each hydrogen cooler.	As per Bidder standard practice only simplex type RTDs shall be provided.	Bid specifications prevail.
5	1	12.11	One (1) detector in gas stream entering and one (1) in gas stream leaving each hydrogen cooler.	As per Bidder standard practice only simplex type RTDs shall be provided.	Bid specifications prevail.

VOLUME -III B					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
6	1	12.11	Twelve (12) detectors, four per phase and uniformly distributed around the stator, should be located at hottest possible zones between insulated coil sides in stator slots.	As per Bidder standard practice only simplex type RTDs shall be provided.	Bid specifications prevails .
7	1	12.11	Twelve (12) detectors for stator core of which six (6) shall be located in the end zones.	As per Bidder standard practice only simplex type RTDs shall be provided.	Bid specifications prevails .
8	1	12.12.3	Main Features The seal oil stream shall have three (2 x 100% AC & 1 x 100% DC motor driven) pumps one running and others standby for automatic cutting in on loss of seal oil pressure. Upon failure of both pumps, the seal oil supply shall be maintained by a 100% emergency seal oil pump (D.C. motor driven) without any interruption. There shall be individual starting/control panels for each pump and one common signalling panel. The A.C. seal oil pump shall also be connected with D.G. set to cater emergency. Seal Oil Coolers and filters shall be of 2 x 100% capacity designed for 36°C cooling water (DM quality) temperature. The piping and valve arrangement shall permit taking out any cooler/filter without affecting operation of the system. Seal Oil System shall have connection to turbine main oil system for make-up and also for excess return. The turbine main oil system shall also serve as a back-up to seal oil system. The H2 side oil drain shall be suitably degassed before being returned to main oil system. The Seal Oil system shall be supplied through two separate and independent streams - one for air side and the other for H2 side. The arrangement shall be such that even in case of failure of H2 - side stream, sealing shall be maintained by the air-side stream.	As per Bidders standard practice only one Main Seal Oil pump shall be provided.	Bid specifications prevails .
9	1	12.13	The gas system comprises a hydrogen gas circuit for cooling the stator core and rotor windings, a carbon-di-oxide scavenging system and compressed air supply. The system is required to fill the generator with hydrogen, maintain it under pressure, monitor and control gas purity, and to empty the generator of hydrogen. The design is such as to ensure safe filling/emptying by preventing formation of explosive H2 - air mixture. For filling, air is first displaced by CO2, which in turn is replaced by H2. While emptying, H2 is first displaced by CO2 before admission of air in the machine. The major system components are H2 and CO2 gas manifolds, H2 gas coolers, side stream H2 drying equipment, inter-connecting piping, fittings, valves, gauges and other instruments, control monitoring panel complete with annunciation. Hydrogen shall be circulated in the generator in closed circuit by fans fitted on the rotor shaft at either end. H2 gas is cooled by DM water heat exchangers located in the generator housing. The cooler shall be of sectionalised design such that with one cooler section out of service, the unit can carry at least three-fourth rated load continuously, without exceeding the permissible temperature limits. Hydrogen coolers shall be so designed that it is possible to meet the full load requirement of the machine with at least ten (10) percent of the tubes in each cooler plugged.	As per Bidder's standard practice hydrogen gas dryers are not provided.	Bid specifications prevails .

VOLUME -III B					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
			Two (2) full capacity refrigeration type H2 - drier with in-situ reactivation facility shall be provided. The arrangement shall be such that one drier can be taken out of service for reactivation without affecting the system performance in any way. H2 Storage and handling Unit shall be located as per the rules of Indian Explosives. H2 Purity unit, online dew point measurement equipment & Gas analyzer shall be provided. The valves in gas system shall be of special design to minimise gas leakage. Safety relief valves shall be furnished both on low and highpressure sides of the gas system. A manually operated vent valve shall be provided for discharging casing hydrogen to atmosphere in case of emergency to a location outside the building top. During the transportation, storage and also during long shut down the machine shall be kept under nitrogen atmosphere. Bidder shall bring out the requirement, if any, of Nitrogen gas. The complete nitrogen system along with the necessary nitrogen cylinders shall be furnished.		
10	1	2.1.12.9 (e)	Simulated tests on excitation and AVR circuits to demonstrate control, response, discrimination and excitation limit features.	It is not Bidder's standard practice to perform integrated tests.	Bid specifications prevail .
11	SECTION - 3	1.1	Two (2) Turbine driven pumps will be operating normally while the two electric motor driven pumps (2 x 30%) shall remain as a standby units and will come into operation automatically in case any of the working pumps fail.	We understand that, during normal operation, on failure/trip of any working TDBFP, the 2 x 30% motor driven stand-by pumps will come into operation sequentially and not simultaneously	Confirmed that on failure/trip of any working TDBFP, the 2 x 30% motor driven stand-by pumps will come into operation sequentially and not simultaneously.
12	SECTION - 3	1.2	1.2.3 The pumps shall be designed to withstand transient condition due to load swing of the unit from full load to no load. Adequate design margins shall be provided in the pumps for turbine bypass operation.	"Adequate design margins shall be provided in the pumps for turbine bypass operation", does it mean only two(2 x 50%) CEP shall be able to cater the turbine bypass requirement? or the third CEP can also be taken into service during turbine bypass?	Only two(2 x 50%) CEP shall be able to cater the turbine bypass requirement.
13	SECTION - 3	2.1	2.1.1 (d) Sole plates, pin and key blocks or other support structure and a common base plate (with foundation anchor bolts/inserts, drip lip and drain) for booster pump and gearbox, motor drive.	We understand that "motor drive" is not applicable here.	Confirmed.
14	SECTION - 3	2.1	2.1.2 (b) Balance chamber leak-off flow orifice for boiler feed pump.	Cl. no. 2.1.1 (a) for Turbine drive BFP says "Balance chamber leak-off flow orifice for boiler feed pump, if required." we understand that the Cl. no. 2.1.2 (b) as "Balance chamber leak-off flow orifice for boiler feed pump, if required"	Confirmed.

VOLUME -III B					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
15	SECTION - 3	2.1.3	(b) Exhaust ducts from the auxiliary turbines along with metallic expansion joint and butterfly valve. The exhaust duct shall be self-draining to the condenser.	In case of Drive turbine at 0m.(ground floor), the complete exhaust duct may not be self draining to condenser, in such case suitable drain arrangement along with automatic drain valve shall be provided to drain the condensate to condenser.	Agreed. Draining must be positive.
16	SECTION - 3	3.1	3.1.3 Each pump shall exhibit the same type continuously rising characteristic from rated duty point to shut-off. The pumps should be capable of parallel operation without instability at all speeds and share equal load. Shut-off head shall not, however, be less than 120% and shall not be more than 130% of the head developed at pump design point.	"...share equal load." we understand that this point is applicable only if either Two TDBFPs are operating in parallel or Two MDBFPs are operating in parallel.	Agreed.
17	SECTION - 3	3.1	3.1.5 The pumps shall be capable of accepting, without damage, any transient reduction in suction pressure including dry run condition causing cavitation and shall accept, without distress, the re-establishment of normal suction conditions following the transient, with no necessity for a pump shut down.	what is meaning of dry run condition? full dry running of BFP is not recommended by pump manufacturers.	Bid specifications prevail .
18	SECTION - 3	3.1	3.1.25 The Boiler Feed Pumps shall be capable of coasting down safely to standstill after it is tripped in the event of a sudden interruption of suction flow. The Bidder shall demonstrate this capability by a suitable dry-running test at his works and shall furnish full details of this proposed test including its duration etc in the bid.	is it required to be submitted during the bid stage?	Yes. It is required.
19	SECTION - 3	3.1	The feed pump shall be capable of a full dry running condition. The feed pumps shall have following capabilities:	Full dry running of pump is not recommended by suppliers.	Bid specifications prevail .
20	SECTION - 3	3.1	(b) The Feed Pumps shall be capable of accepting without damage transient reduction in suction pressure well below those required for freedom from cavitation and shall accept without distress, the re-establishment of normal suction conditions following the transient, with no necessity for a pump shut down.	Operation of pump with suction pressure below vapour pressure is not recommended.	Bid specifications prevail .
21	SECTION - 3	3.1	(c) The Feed Pump shall be capable of operating under full vapour locked condition for 15 minutes (i.e. following an inadvertent closure of suction valve) and rundown to rest from this vapour locked condition without endangering the pump rotor or subsequent detrimental effect in pump overall performance.	Meeting this requirement may not be possible. (to be checked with pump suppliers)	Bid specifications prevail .
22	SECTION - 3	3.1	(c) To establish above criterion, the Bidder shall necessarily submit the full backup calculation, rotor response characteristics, various internal clearances and other features, test reports for similar pumps meeting the above design condition.	as commented in the previous clause, meeting all the above conditions may not be possible	Bid specifications prevail .
23	SECTION - 3	3.1	In order to demonstrate the above capabilities at shop, the Bidder shall furnish complete testing procedure along with the bid.	we understand that this is not required during bid stage	Please refer Sr.no. 211 of PBQ clarifications dtd. 07.07.2012
24	SECTION - 3	3.2	3.2.3 Each Steam Turbine exhaust shall be separately ducted to the steam Surface Condenser, which serves the main Turbine Generator Unit. The exhaust duct shall be self draining to the Condenser.	In case BFP and the drive turbines are at ground floor, the drive turbine exhaust ducts may not be self draining to condenser, in such case suitable draining provision shall be provided to drain the exhaust duct to condenser.	Agreed. Draining must be positive.

VOLUME -III B					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
25	SECTION - 3	3.3	3.3.9 The pump rotor assembly (with guides) shall be so designed as to keep its vibration, in both wet and dry running conditions, within the safe limits as specified in relevant International Standards/Codes. (e.g. 'Good' range of VDI 2056/MIS, USA recommendations).	Pump Vibration limits shall be as per HIS	Bid specification prevails .
26	SECTION - 3	5.6	5.6.1 Each Pump set shall be provided with a complete pre ssure lubrication system of sufficient capacity for both pump and drive motor, consisting of oil pump, sump tank, water cooled oil coolers (2 x 100%, shell & tube type or plate type heat exchanger), duplex oil filter, level indicator, sight flow indicator, thermometers, relief valves, pressure regulators and necessary valves, all interconnected piping and accessories. The oil cooler tubes shall be of SS-304. The coolers shall be designed for service with de mineralized water. The oil pump shall be driven by the feed pump shaft and all parts of the system shall be mounted as an integral part of the feed pump assembly. Provision must be made to ensure continuity of oil supply even during reverse rotation of feed pump, and during low frequency operation of oil pumps.	"The oil pump shall be driven by the feed pump shaft" -we understand that this is applicable for Motor driven BFP only	Noted. Bid specification prevails.

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CLARIFICATIONS TO PRE-BID QUERIES					
BID SPECIFICATION No. DG/BSL U-6/2011/T-1					
VOLUME -III C					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
1	Vol-III C	2.1.2	Rack and pinion gates	As per referred clause, Rack & Pinion Gates in between Apron Feeder & W. T. Hopper have been proposed which is not feasible whereas in the Process flow Diagram : Coal Handling System (Dwg. No. PE-189-PF-226, P1) nothing has been shown. So please confirm whether these are required or not.	Please refer corrigendum - I Sr. no. 3
2	Vol-III C	2.1.3	Coal feed	As per referred clause, Conveyor 1A/1B shall feed to conveyor 2A/2B through chutes and rack and pinion gates whereas in the Process flow Diagram : Coal Handling System (Dwg. No. PE-189-PF-226, P1) flap gates have been shown in the discharge chute of conveyor 1A/1B. Kindly specify which one to be considered.	Please refer corrigendum - I Sr. no. 4
3	Vol-III C	2.1.16	Coal feed	As per referred clause, Conveyor 5A/5B shall feed bunkers through Travelling Trippers having one way discharge chute whereas as per the Process flow Diagram : Coal Handling System (Dwg. No. PE-189-PF-226, P1) Conv 5A/5B shall discharge either by Travelling Trippers or discharge at head pulleys in the Bunkers. We are considering the travelling Trippers (TTR-1 & TTR-2) shall be fitted with two way discharge chutes with Flap gates. Please confirm.	Bid specification prevails.
4	Vol-III C	2.1.17	Coal feed	As per referred clause, Conveyor 6A/6B shall feed bunkers through Travelling Trippers having one way discharge chute whereas as per the Process flow Diagram : Coal Handling System (Dwg. No. PE-189-PF-226, P1) Conv 6A/6B shall discharge either by Travelling Trippers or discharge at head pulleys in the Bunkers. We are considering the travelling Trippers (TTR-3 & TTR-4) shall be fitted with two way discharge chutes with Flap gates. Please confirm.	Bid specification prevails.
5	Vol-III C	2.1.18 & 2.1.21	Blending	Kindly elaborate the capacity controlling method for blending of indigenous & imported coal.	Bid specification prevails.
6	Vol. - III C	5.1.7	Idlers	We are considering idler shall be fitted with seize resistant ball bearings instead of split case type bearings. Kindly confirm.	Please refer corrigendum - II, Sr. no. 25
7	Vol. - III C	5.1.10, 5.1.11, 5.1.12, 5.1.13, Data sheet of Gear Box, Couplings.	Type of drive	Please confirm the type of drive to be used.	Please refer PBQ clarification 51 dtd.07.07.2012
8	Vol. - III C	Data Sheet-A, Note-6	Standard	As per the referred clause, power requirement and belt tensions shall be calculated as per CEMA standard whereas in Sl. no. 10 of pg no. 267 of 495 of Data Sheet B of Vol.-III- A1, section -13, it is specified that power requirement and tension calculations shall be calculated as per IS-11592. Please clarify which one (CEMA or IS) we should follow.	CEMA should be followed for power and belt tensions.
9	Vol. - III C	8.1.3	Flow path	Kindly specify which of the flow paths to be considered for arriving at the Auxiliary power Consumption for Coal Handling System.	Bidder shall indicate Auxiliary Power Consumptions for all the paths and the path having maximum power consumption shall be considered for arriving at the Auxiliary Power Consumption for Coal Handling System.

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CLARIFICATIONS TO PRE-BID QUERIES					
BID SPECIFICATION No. DG/BSL U-6/2011/T-1					
VOLUME -III D					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
1	Vol-III D	CL No. 3.1.1 & 5.4.1 ©	BA hopper volume	Bottom ash hopper volume shall be 8 hours of actual bottom ash generation at BMCR, as per data from boiler supplier. Kindly confirm.	Bid specification prevails.
2	Vol-III D	4.2.4 & DRG. No. PE-189-PI-238, P3	Flushing boxes	Flushing box with necessary arrangement below each eco-hopper shall be provided as specified in Vol-IIID, CL No. 4.2.4 , Page 25 of 175. Where Feeder ejector below each eco-hopper has been shown in DRG. No. PE-189-PI-238, P3. We understand that the scheme shown in drawing will prevail. Please confirm.	The scheme shown in DRG. No. PE-189-PI-238, P3 shall prevail.
3	Vol-III D	4.19 & 6.18.8 (d)	Flange connections on disposal piping	As per CL. No. 6.18.8 (d), Page 72 of 175, bidder to provide 10 disposal points. Hence, flange connections shall be provided on those 10 points and no other flange connection are required in HCSD system. Please confirm.	Bid specification prevails.
4	Vol-III D	5.5.1	FA extraction capacity	All 6 Nos. FA pressure conveying system may not be of same capacity as specified. Pressure conveying streams from 1st and 2nd field may be of higher capacity than that of from remaining fields. However the total FA transportation capacity for the unit will be 220 TPH which will evacuate entire ash of 8 hours shift in 6 hours as specified. Please review and confirm.	Bid specification prevails.
5	Vol-III D	4.21.17	PRV	No such automatic pressure relief valves are being installed in HCSD system and the same may be reviewed and deleted.	Agreed.

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CLARIFICATIONS TO PRE-BID QUERIES					
BID SPECIFICATION No. DG/BSL U-6/2011/T-1					
VOLUME -III E1					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
1	1	4	4.8.5 (h) Necessary toilets with basin & mirror and operator's cabins with drinking water facility.	As per tender, filtered water reservoirs to be sized to store filtered water of 24 hours requirement or 45000 m3 and 900 m3 for Non DM & DM filtered water storage tank respectively, whichever is higher. This requirement is unusual in power plant application. Kindly review the same & amend the requirement accordingly.	The query raised is not related to the clause in the specification. However, the reservoir capacities are already reviewed as 15000m³ and 900 m³ for Non DM & DM filtered water storage tank respectively.
2	1	2.2.1	Two numbers (2 x 100%) vertical wet pit type Potable water pumps for plant shall convey potable water to the potable water overhead Storage Tank to be located on the roof of TG building. Tank shall be designed for minimum 50 m3 storage.	Bidder offered the pressurized Potable water distribution system instead of gravity distribution to optimize the design load on TG building. Accordingly, Bidder provided 5 M3 capacity Potable water storage tank on TG building instead of 50 M3.	Bid specification prevails.
3	1	2.2.3	Service Water from Filtered Water Storage Tank shall be transferred to the Overhead Service water tank located on TG building roof by means of two numbers (2 x 100%) vertical wet pit type service water pumps. Tank shall be designed for minimum 150 m3 storage.	Bidder offered the pressurized service water distribution system instead of gravity distribution to optimize the design load on TG building. Accordingly, Bidder provided 10 M3 capacity service water storage tank on TG building instead of 150 M3.	Bid specification prevails.
4	1	4.5	Filtered Water Storage Tank for Non-DM shall be adequately designed for effective total capacity of one day storage, minimum 45000 m3.	Bidder provided 4 Hrs storage capacity to store the filtered water for Non-DM instead of 24 Hrs. Please confirm.	Please refer Corrigendum-VIII.
5	1	4.5	Filtered Water Storage Tank for DM shall be adequately designed for effective total capacity of one day storage, minimum 900 m3.	Bidder provided 4 Hrs storage capacity to store the filtered water for DM instead of 24 Hrs. Please confirm.	Bid specification prevails.
6	2	ANNEXURE-I	7.0 TDS ppm 870	Cation & Anion mentioned in the Raw water analysis as 585 ppm each, therefore TDS should be around 1170 ppm. Please clarify.	Annexure - I Sr. no. 7 shall prevail.
7	2	ANNEXURE-I	20.0 Total Suspended Solids ppm Not Available	Please furnish the following Raw water parameters currently mentioned as "Not Available": TSS, Carbonates, Boron, Oil&Grease.	TSS & Carbonates - Not available .Oil & Grease - Nil and boron - Less than 1 (one) ppm.
8	2	ANNEXURE-I	21.0 Carbonates as CaCO3 ppm Not Available	Please furnish the following Raw water parameters currently mentioned as "Not Available": TSS, Carbonates, Boron, Oil&Grease.	TSS & Carbonates - Not available .Oil & Grease - Nil and boron - Less than 1 (one) ppm.
9	2	ANNEXURE-I	22.0 Boron ppm Not Available	Please furnish the following Raw water parameters currently mentioned as "Not Available": TSS, Carbonates, Boron, Oil&Grease.	TSS & Carbonates - Not available .Oil & Grease - Nil and boron - Less than 1 (one) ppm.
10	2	ANNEXURE-I	23.0 Oil & Grease ppm Not Available	Please furnish the following Raw water parameters currently mentioned as "Not Available": TSS, Carbonates, Boron, Oil&Grease.	TSS & Carbonates - Not available .Oil & Grease - Nil and boron - Less than 1 (one) ppm.

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Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
11	2	1.1	The design flow rate of Gravity filters for DM & Non DM is 50 m3/hr and 2000 m3/hr respectively.	As per the data sheet A (Clause No. 19.2.1 / Page no. 64 of 313) , Bidder considered the design capacity of the gravity filters is 1800 m3/hr & 100 M3/hr for Non-DM and DM. Please confirm.	Please refer PBQ clarification 12 dtd. 07.07.2012
12	2	3.1.5	Dosage rate of poly electrolyte : 5 ppm.	5 ppm Dosage rate of poly electrolyte is seems to be on higher side. 2 ppm is more than sufficient for Pre treatment plant applications. Please check and confirm.	Min. 2 (Two) ppm
13	2	7	Analysis of raw water : TDS - 870 ppm.	As per the tender specification, Resin based demineralization plant is envisaged. Resin based demineralization plant is not an economical option for such a high TDS i.e. 870 ppm. Please check and confirm.	Bid specification prevails.
14	3	3.4	The total time of regeneration of a complete DM Stream (Dual Media Filter, Activated Carbon Filter, Cation Exchanger, Anion Exchanger and Mixed Bed Exchanger Unit) shall not exceed four (4) hours.	As per the tender P & ID and specification for PT / DM Plant, Dual media filter is not applicable and bidder not considered the same. Please confirm.	Clause no.3.4 of the specification shall prevail.
15	3	1.0	1.1 The DM Plant capacity shall be arrived at based on bidder's basic engineering. However, a minimum net capacity of 2 x 100 m3/hr shall be provided. Under normal condition, one stream is envisaged to be kept in operation.	As per tender requirement two stream DM plant with 100 m3/hr each is envisaged. Also as per tender raw water chemistry, TDS of DM plant inlet is about 850 ppm. According to the above conditions, following are the concern for your review- 1. DM plant vessels size will be large enough which will not be techno commercial justified. 2. Since tender requires 2 DM storage tanks of 1000 m3 each & 1 CST of 850 m3. DM plant capacity seems to be on much higher side. 3. As per supercritical power plant worldwide there is no normal make up & 1% make is followed to compensate aux steam consumption & other cycle losses. Hence, 2x100 m3/hr DM plant is not suited for 1x660 MW supercritical power plant. We request Mahagenco to review our below proposals & amend the DM plant type & capacity- 1. RO-MB based DM plant with 100 m3/hr capacity, if Mahagenco requires high flow DM plant otherwise 2. Conventional DM plant (as asked in tender) of 60 m3/hr, each stream.	Bid specification prevails.
16	4	1.2.8	To reduce the Suspended Solids in the cooling water, at least 2.0 % of the total Circulating Water shall be passed through Automatic Valve less Gravity Filter Units.	As per the specification, Filtered water is envisaged as a make to the cooling tower. Hence, side stream filter is not applicable to maintain the solids load. Please check and confirm.	Bid specification prevails.
17	4	1.2.9	The redundancy in the Side Stream Filtration System shall be at least 15 % with a minimum of two (2) modules as standby. Autom atic Valve less Gravity Filters and all other accessories.	As per the data sheet A (Clause No. 2.1.1 / Page no. 216 of 313) , Bidder considered the One (1) number of standby filter (AVGF) as a redundancy instead of Two (2) numbers / 15% . Please confirm.	Bid specifiction prevails.
18	5	4.5	The treated water from OWS may be discharged in retention pit for treated water from OWS collection pit from where treated water shall be pumped finally to Ash Slurry Sump.	Mismatch with tender P & ID. As per the tender P & ID of effluent treatment system, the treated water from OWS shall be routed to in plant ash water tank. Please confirm.	There is no mismatch . The treated clear water from OWS shall be pumped in to the ash water sump and then finally to ash slurry sump through process. The sludge water shall be pumped to Ash Slurry sump.

VOLUME -III E1					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
19	5	4.5	Suspended solids in treated water : 50 mg/l max.	Mismatch with data sheet. As per the data sheet A (Clause No. c / Page no. 261 of 313) , the suspended solids in treated water not to exceed 20 ppm. Please confirm.	Please Ref. Corrigendum -II/ #16
20	Addendum-III	2.2	Raw water source : From Ozerkheda (pipe line terminal) to One Day Reservoir as indicated in the plot plan and in line with the other details like terminal points etc. indicated in the Original Tender specification.	Kindly specify the coordinate of the tapping point from the existing pipe line for 2x500 MW unit for the Raw water to be drawn from Ozerkheda Reservoir along with the flow rate of raw water to be drawn from this point for the proposed 1X660 MW TPP and the available pressure at this tapping point. Also kindly furnish the relevant geotechnical report and contour along the said pipe route.	Minimum diameter of pipe leading to 1x660MW unit from Tapping point of Ozerkheda Pipeline shall be 1600mm. Also necessary isolation arrangement / flow control valve on pipe line leading to 2x500MW shall be provided to ensure required discharge for 1x660MW. Other details are as follows: (1) Intake level of water supply pipe line from Ozerkheda dam for 2X500MW unit is 261.600 M. (2) Intake level of tapping point from Ozerkheda pipe line leading to 1X660 MW project is 204.550 M. The head available at tapping point is (261.600 - 204.550) i.e. 57.050 M. (3) Considering the top of one day reservoir at FGL, the invert level of pipe line at one day reservoir will be 213.000 M.
21	Addendum-III	2.4	The scope under this addendum covers providing and laying MS gravity pipeline of requisite diameter in the existing inlet canal from Tapi river pump house to aqueduct along with tapping and isolation arrangement for 2x500 MW project.	Kindly furnish the coordinate of the interconnection point of proposed Raw water pipeline with the existing pipeline for 2x500 MW unit. Also kindly furnish the Contour along this path.	Co-ordinate of interconnection point will be decided during detailed engineering. Approximate length of pipe to be connected is given in data sheet. The existing pipe is to be extended for connection to the proposed pipe line coming through inlet canal as per site conditions with provision of isolation valve on MS. gravity line.
22	Addendum-III	3.1 (c)	Providing and laying M.S. pipe line from existing (abandoned) Pump House to one day reservoir of 1x660 MW unit including necessary isolation wherever required renovation of Pump House and sump along with provision of required electrical and mechanical works, including providing Three pumps (2W+1S/B), valves, electrical, control and instrumentation, and appurtenances."	We understand that the modification is required to be done by the EPC contractor. Kindly furnish the GA & elevation drawing of Existing (Abandoned) Pump house indicating the High, Low & Normal water level. Also kindly furnish the high & low level of the Canal.	Please refer note # 1 of the Annexure-II- May 2013.- Layout of proposed pipe line from Tapi river water pump house to aqueduct & proposed pipe line from existing (abandoned) pump house to one day reservoir of 1x660MW and clarification at Sr. no. 5 (Letter no.1863 dtd. 03.06.2013)
23	Addendum-III	-	'L Section of Pipe line for 660 MW' and 'Plan for pipe route 660 MW'	In the L-section drawing of proposed Raw Water Pipe line along the Intake canal from Existing River Water Pump House at Tapi river to existing Aqueduct, we found that there is a steady slope from 210.4 to 206.84. There is no crossing of any river/nallah/road. However, in the drawing named 'Plan for pipe route 660 MW', few crossing has been shown. Hence, requesting you to review the same and confirm. Also kindly furnish the geotechnical report for the said path.	There is no crossing of any river/nallah along the proposed route of pipe line between existing river water pump house at Tapi River and existing aqueduct.

VOLUME -III E1					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
24	Addendum-III	-	'L Section of Pipe line for 660 MW' and 'Plan for pipe route 660 MW'	In the L-section drawing of proposed Raw Water Pipe line from Existing (Abandoned) pump house to one-day reservoir of proposed unit, we found that there are only two road crossing and one Ash pipe line crossing. However, in the drawing named 'Plan for pipe route 660 MW', crossing of 2 nos railway track, 5nos road crossing are shown. Hence, requesting you kindly review the same and confirm. Also kindly furnish the geotechnical report for the said path.	The tentative route of porposed raw water pipe line from abandoned pump house to one day reservoir is shown in the drawing shown plan view & number of crossings shall be considered accordingly. The Final route of the pipe line shall be decided during detailed engineering as per availability of space. Bidder may visit site for required details. The soil investigation along the route of pipe is in the scope of EPC bid.

BHUSAWAL THERMAL POWER STATION 1X660MW UNIT - 6 PROJECT					
CLARIFICATIONS TO PRE-BID QUERIES					
BID SPECIFICATION No. DG/BSL U-6/2011/T-1					
VOLUME -III E2					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
1	SECTION - 1	3.1	3.1.1 (c) Each individual sump in the CW Pump house shall be designed in accordance with the recommendations specified in Hydraulic Institute/British Hydraulic Research Association/equivalent international standard and its dimensions shall be finally selected after conducting necessary sump model tests by the Bidder.	As per Vol III E2, Sec-1, Cl 2.1.1, Page 13, we understand process software (CFD) is adequate for CW/ACW sump study. Please confirm our understanding.	Clause no. 3.1.1 (c) shall prevail .
2	SECTION - 1	3.1	3.1.11(g) Adequate provision shall be made in each of the pump sump so as to facilitate insertion of isolation gates. Gates shall be fabricated from mild steel, shall be water tight type and shall preferably be of identical size/dimensions to facilitate interchangeability. Sump gates shall be accessible by the pump house overhead crane.	As per CW & ACW pump house GA drawing PE-189-GA-108, Rev P1, we undersatnd that sump gate & screen shall be handled by monorail hoist instead of CW pump house overhead crane. Please confirm our understading.	Please refer Corrigendum-VIII
3	SECTION - 1	3.2	3.2.1 The required flow in this system shall be based on the requirement of each individual connected cooler in this system with respect to flow and terminal temperature rise as encountered during maximum possible thermal load conditions. Bidder shall list out the required flow and terminal temperature rise of each cooler and the number of individual eq uipment coolers (operating/standby) in his Bid proposal. A minimum of 20 % margin shall be considered over and above the total required flo w and heat load to compute the design DMCW flow and design heat load respectively in the closed circuit. In computing the design heat load and design DMCW flow in	Our understanding on heat load margin 20% shall be 20% margin on heat duty during 100% TMCR condition with two TDBFP in operation. Please confirm.	Please refer PBQ Sr. 13 , 14 & 16 dtd. 10.02.2012. Bid specification prevails.
4	SECTION - 1	3.2	3.2.1 individual DMCW system, Bidder shall ensure that the average temperature rise of DMCW is limited to 5.5 0C under all circumstances.	We are requesting Mahagenco to allow us 6.7 deg C average temperature rise of DMCW temperature as per our standard design. Please confirm.	Bid specification prevails.
5	SECTION - 1	3.2	3.2.2(b) Total dynamic head : A minimum of ten (10) % margin over frictional losses based on pumping capacity as obtained in (a) above. Bidder shall compute the frictional losses assuming C = 120 on Hazen and William's formula for design purposes.	We understand that 10% margin will be taken on piping frictional losses only not for losses due to equipment friction. Please confirm.	Confirmed that 10% margin will be taken on piping frictional losses only.
6	SECTION - 2	DATASHEET - A	Sr. 20. (a) Casing <----- ASTM-A296 Gr. CF8M ----->	Since ASTM A296 is withdrawn & replaced by ASTM A743, we are considering ASTM A743 wherever written as ASTM A296. Please confirm.	Please refer PBQ clarification (Sr. no. 24) dtd.07.07.2012
7	SECTION - 2	DATASHEET - A	Sr. 20. (b) Casing Liner <----- ASTM-A296 Gr. CF8M ----->	Since ASTM A296 is withdrawn & replaced by ASTM A743, we are considering ASTM A743 wherever written as ASTM A296. Please confirm.	Please refer PBQ clarification (Sr. no. 24) dtd.07.07.2012

VOLUME -III E2

Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
8	SECTION - 2	DATASHEET - A	Sr. 20. (c) Diffuser <----- ASTM-A296 Gr. CF8M----->	Since ASTM A296 is withdrawn & replaced by ASTM A743, we are considering ASTM A743 wherever written as ASTM A296. Please confirm.	Please refer PBQ clarification (Sr. no. 24) dtd.07.07.2012
9	SECTION - 2	DATASHEET - A	Sr. 20. (d) Impeller <----- ASTM-A296 Gr. CF8M----->	Since ASTM A296 is withdrawn & replaced by ASTM A743, we are considering ASTM A743 wherever written as ASTM A296. Please confirm.	Please refer PBQ clarification (Sr. no. 24) dtd.07.07.2012
10	SECTION - 2	DATASHEET - A	Sr. 20. (e) Wearing Rings <----- ASTM-A296 Gr. C440 ----->	Since ASTM A296 is withdrawn & replaced by ASTM A743, we are considering ASTM A743 wherever written as ASTM A296. Please confirm.	Please refer PBQ clarification (Sr. no. 24) dtd.07.07.2012
11	SECTION - 2	DATASHEET - A	Sr.21. (f) Suction and discharge pressure Indicator Yes, along with Diaphragm Seal Yes, along with Diaphragm Seal	Diaphragm Seal is not required for passivated DM water service. Mahagenco to check & confirm.	Agreed.
12	SECTION - 3A	DATASHEET - A	18.2 Pump type Below floor discharge	As per amendment, metal casing CW pump may be used as an alternate option. Hence, we are requesting Mahagenco to provide above floor discharge pump as an option for ACW & CW pumps.	Bid specification prevails.
13	SECTION - 3B	5.1	5.1.5 The maximum closed valve head shall not be greater than 15% of the rated head including tolerance, to prevent over-pressurisation of the concrete volute.	Shut off head 15% of the rated head seems to be on lower side for this type of pump. We are requesting Mahagenco to leave this clause to bidder & the same will be decided based on pump manufacturer recommendation during detail engineering.	Please refer PBQ clarification (Sr. no. 29) dtd. 07.07.2012
14	SECTION - 3B	5.1	5.1.12 The upper limit of pump efficiency to be considered for this contract is 89%. No credit shall be given for higher efficiency values. (Not applicable in this case).	We understand this clause is not applicable for this project. Kindly confirm.	Specification is self explanatory.
15	SECTION - 3B	5.1	5.1.17(ii) 5% margin over the maximum pump shaft input power required within its operating range including the shut-off point.	As per our understanding, pump motor will be selected based on 5% margin over the maximum pump shaft input power required within its operating range including the shut-off point at 50 Hz. Please confirm.	Bid specifications prevail(Worst condition shall be considered)
16	SECTION - 3B	DATASHEET - A	: All CW Pumps with the job motor	Concrete volute pump(prototype) will not be possible for performance test at shop. Mahagenco to clarify.	Agreed.
17	SECTION - 4	4	4.4.1. The required heat load shall be computed by obtaining the summation of the maximum permissible heat loads encountered in the respective operating coolers of Boiler and TG Islands which shall be cooled by DMCW system. A minimum of 20 % margin over and above the total required heat load as obtained above shall be taken into account by the Bidder to work out the design heat load rejected by DMCW system and to be picked up by ACW system for the same.	Clarification raised as above.	Please refer PBQ clarification (Sr. no. 32) dtd. 07.07.2012
18	SECTION - 4	DATASHEET - A	5.3 However, DMCW system temperature rise not to exceed 5.50C.	Please refer clarification raised above.	Bid specification prevails.
19	SECTION - 4	DATASHEET - A	5.4 . 39 0C (Max.) Bidder to workout. However, ACW temperature rise not to exceed 5.50C	Please refer clarification raised as above.	Bid specification prevails.

BHUSAWAL THERMAL POWER STATION 1X660MW UNIT - 6 PROJECT					
CLARIFICATIONS TO PRE-BID QUERIES					
BID SPECIFICATION No. DG/BSL U-6/2011/T-1					
VOLUME -III -I					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
1	SECTION - 1/A	4.1	4.1.1 The safe working load (Y) for E.O.T. cranes shall be computed as $Y = 1.25 a$	From the referred clauses, we understand the followings: 1. Tandem operation of TG hall EOT cranes are required if generator stator lifting is envisaged with turbine hall EOT cranes. 2. Capacity of each turbine hall crane shall be computed as $Y = 1.25 a/2$, if bidder opts for generator stator lifting by turbine hall cranes. Kindly confirm our understanding. Also, Mahagenco is requested to reconsider single EOT crane with generator stator lifting option (b) since our generator stator is not recommended to lift after erection, which will save i. one TG hall EOT ii) Civil cost of TG building & other auxiliaries (Electrical).	Each crane shall have 125% of equipment weight. In case of bidder opting for option (b) mentioned in the specifications for lifting Generator Stator, two cranes shall be provided as per bid specification (Vol. III-I). Please also refer Corrigendum - VIII ..
2	SECTION - 1/A	ANNEXURE-I	1.0 Turbine Hall - Two (2)	From the referred clauses, we understand the followings: 1. Tandem operation of TG hall EOT cranes are required if generator stator lifting is envisaged with turbine hall EOT cranes. 2. Capacity of each turbine hall crane shall be computed as $Y = 1.25 a/2$, if bidder opts for generator stator lifting by turbine hall cranes. Kindly confirm our understanding. Also, Mahagenco is requested to reconsider single EOT crane with generator stator lifting option (b) since our generator stator is not recommended to lift after erection, which will save i. one TG hall EOT ii) Civil cost of TG building & other auxiliaries (Electrical).	Please refer clarifications to Sr. no.1 above.
3	SECTION - 1/A	ANNEXURE-I	CW Pump House Outside: - Two (2) Semi Gantry Cranes	As per CW & ACW pump house GA drawing no. PE-189-GA-108, Rev-P1, Two nos. monorail hoist (3 ton each) are shown to handle screen & stop log gate instead of semi gantry cranes. Mahagenco is requested to clarify the requirement.	Please refer Corrigendum - VIII.
4	SECTION-3/D	ANNEXURE-I	(4) Service Water Storage Tank Vertical Cylindrical By Bidder 75 2	Since both huge volume tanks are to be located on deaerator floor, it will have major impact on TG hall structural design. Hence, Mahagenco is requested to review the tank capacity & also the location can be left to the bidder choice to meet other tender functional requirement. Also please clarify pressurized service water system is acceptable or not (without tanks).	Please refer Corrigendum - I
5	SECTION-3/D	ANNEXURE-I	(5) Potable water Storage Tank Vertical Cylindrical By Bidder 25 2	Since both huge volume tanks are to be located on deaerator floor, it will have major impact on TG hall structural design. Hence, Mahagenco is requested to review the tank capacity & also the location can be left to the bidder choice to meet other tender functional requirement. Also please clarify pressurized service water system is acceptable or not (without tanks).	Please refer Corrigendum - I

VOLUME -III -I					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
6	3/C	3.8	Two (2) Emergency make-up supply pumps located in Filtered Water pump house for Non-DM complete with electric motor drives and all other accessories as specified in this section and in the datasheet-A attached herewith.	Two (2) nos. Emergency make up supply pumps located in filter water pump house-Non DM have been mentioned in the referred clause although the same is not shown in Process Flow Diagram : Plant Water System (Dwg. No. PE-189-PF-227, P1). Kindly confirm the validity of these pumps along with its purpose.	Two (2) Emergency make-up supply pumps - Deleted.
7	4 /D	3.1	"The details of miscellaneous steel tanks.....as follows:"	Since it is not indicated in the tender specification, Bidder considered IS:2062, Gr. B as the grade of steel for DM water storage Tanks , Service Water Tank and Potable Water Tank fabrication with epoxy painting inside. Kindly confirm your acceptance.	Confirmed.

BHUSAWAL THERMAL POWER STATION 1X660MW UNIT - 6 PROJECT					
CLARIFICATIONS TO PRE-BID QUERIES					
BID SPECIFICATION No. DG/BSL U-6/2011/T-1					
VOLUME -IV-A					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
1	SECTION - 1	5.9	5.9.3 Connection of the L.T. dry type transformers to 11kV HT switchgear will be through cable and to L.V. Boards through non-segregated phase bus duct.	Please note that the requirement of NSPBD or Cable at incomer of LV board shall be decided as per current rating during detailed engineering. Customer is requested to accept the same.	Bid specification Prevails.
2	SECTION - 2	3.0	3.2 GT shall be suitable to meet the Generator power rating of 660MW at 0.85 power factor lag without deducting the unit auxiliary power, excitation power or any other power. GT shall be sized with 10% design margin.	Toshiba envisages sizing of Generator Transformer as per Clause no. 3.10 of the bid specification which states- Generator Transformer should be sized to deliver the gross unit output of the generator with turbine operation in VWO (Valve Wide Open) condition and Unit Transformers out of service. The loads of Unit Transformers will be supplied from the station bus for an extended period.	Refer CORRIGENDUM - II , S.No:18, Page No: 104 of 274
3	SECTION - 2	3.0	3.6 The transformer shall be so designed that it is capable of operation at 125% rated voltage for a period of one minute and 140% rated voltage for a period of five seconds due to sudden load throw off.	Toshiba understands that the transformer shall be so designed that it is capable of operation at 110% rated voltage continuously, 125% rated voltage for a period of one minute and 140% rated voltage for a period of five seconds due to sudden load throw off. Please confirm.	Bid specification prevails.
4	SECTION - 2	4.3	4.3.1 Off-circuit tap change (OCTC) as specified in the annexure shall be provided on the high voltage winding.	Please clarify which annexure to be referred to.	Annexure here means Data Sheet - A
5	SECTION - 2	4.7	4.7.5 In general, the arrangement shall be such as to permit removal of transformer without dismantling the bus duct /cable connection.	Please clarify on this requirement.	Bid Specification prevails.
6	SECTION - 2	4.14	4.14.1 Neutral bushing current transformers and phase bushing current transformers shall be furnished when specified in the annexure.	Please clarify which annexure to be referred to.	Refer Annexure - A, Section - 2, Page No: 113 of 440 in same volume IV-A
7	SECTION - 2	4.16.2	Impact recorder/indicator shall be provided to monitor the impact experienced by the transformer during transport.	We envisage impact recorder on returnable basis. Please confirm.	Confirmed . Pl. Refer Corrigendum -XI, Sr. No.1.
8	SECTION - 2	5.0	5.31 Tap-changing gear complete with tap position indicator, operation counter etc. For OLTC gear (where specified), oil surge relay (OSL) with shut-off valve, Local control cabinet and tap changer control in ECP (RTCC) and also DDCMIS/DCS.	We understand OLTC gear is not applicable here. Please confirm.	Confirmed. Pl. Refer Corrigendum -XI, Sr. No.2
9	SECTION - 3	3.0	3.7 IPBD (main run IPBD, Delta run, common tap-off to UT/Individual IPBD tap off to UT, Excitation Transformer Tap-off, SPVT cubicle) shall be sized considering generator voltage +/-10% voltage variation from grid source & generator source.	IPBD (main run) will be sized based on Generator output at VWO condition with 5% negative voltage variation (as mentioned in Volume-IIIB, section-1, page no 53 of 308, clause no:11.6) at generator terminal. Please confirm.	Refer Addendum -V. Sr. no.1
10	SECTION - 3	3.8	(b) 10% margin shall be considered on rating arrived at (a) above.	As mentioned in corrigendum-II, volume-IV-A, sl no:18,IPBD will be sized inline with generator transformer rating. Please confirm.	Deleted. Pl. Refer Corrigendum -XI, Sr. No.3.

VOLUME -IV-A

Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
11	SECTION - 3	4.7	4.7.2 The links shall be suitable for shorting bus conductors/enclosures of three	The mentioned drawing is not available. Please furnish the drawing.	Pl. refer Corrigendum -XI, Sr. No.4.
12	SECTION - 3	DATA SHEET - A	1.1 Rated voltage kV Generation Voltage +-10%	In view of contradiction between the mentioned clauses, we have envisaged voltage variation of generator as +/-5%. Please confirm.	Pl. refer Corrigendum -XI, Sr. No.5.
13	SECTION - 3	DATA SHEET - A	2.3 RATED CONTINUOUS CURRENT	Continuous current ratings shall be as per system calculations. Please confirm.	Pl. refer Corrigendum -XI, Sr. No.6
14	SECTION - 3	DATA SHEET - A	3.6 C.T. RATINGS	Quantity & parameters of CTs shall be finalized during detailed engineering & shall be as per Toshiba standard.	Bid specification Prevails.
15	SECTION - 3	DATA SHEET - A	5.7 OTHER RATINGS Accuracy Class Rated VA	VA rating of VT shall be finalised during detailed engineering.	Bid specification Prevails.
16	SECTION - 3	DATA SHEET - A	6.4 Voltage Ratio Generator voltage/ 220 volt	Secondary voltage of NGT shall be as per Toshiba standard.	Bid specification Prevails.
17	SECTION - 3	DATA SHEET - A	6.5 Rated Output kVA 175 for 5 min	NGT will be sized for 10 second. Accordingly rating of NGT shall be determined However continuous rating will be lesser than short time rating. Please confirm.	Bid specification Prevails.
18	SECTION - 3	DATA SHEET - A	7.3 Resistance ohms 0.212 (Tentative to be	NGR will be sized for 10 second duration. Current rating & ohmic value of the resistor will be as per actual requirement.	Bid specification Prevails.
19	SECTION - 3	DATA SHEET - A	7.5 Voltage V 220	Voltage rating of resistor shall be inline with Toshiba standard practice.	Bid specification Prevails.
20	SECTION - 4	1.0	1.2 MVA rating of the transformer, as indicated above, shall be considered as the minimum requirement for the project. HV side voltage shall change according to Generator voltage. Transformer offered by the bidder & shall be sized according to the maximum demand considering No Load Voltage Correction factor 4% while sizing of Transformer at most stringent condition plus minimum 10% margin. Bidder shall furnish sizing calculation for owners/ consultant review/approval	We have envisaged 5% margin on the operating load and 5% No Load Voltage Correction Factor over that for ST Sizing. Request to accept our proposal.	Bid specification Prevails.
21	SECTION - 4	4.3	4.3.1 On load tap changer (OLTC) as specified in the annexure shall be provided on the high voltage winding, i.e 21 kV	Please clarify which annexure to be referred to.	Annexure here means Data Sheet -A
22	SECTION - 4	4.7	4.7.6 In general, the arrangement shall be such as to permit removal of transformer without dismantling the bus duct/cable connection.	Please clarify on this requirement.	Bid specification prevails.
23	SECTION - 4	4.15	4.15.1 Neutral bushing current transformers shall be furnished when specified in the annexure.	Please clarify which annexure to be referred to.	Annexure A of section IV shall be referred for details of Neutral bushing current transformers.
24	SECTION - 4	4.17	4.17.2 Impact recorder	We have envisaged the impact recorder to be on returnable basis. Please Confirm.	Pl. Refer Corrigendum -XI, Sr. No.7
25	SECTION - 4	4.17	Impact recorder/indicator shall be provided to monitor the impact experienced by the transformer during transport.	We envisage impact recorder on returnable basis. Please confirm.	Pl. Refer Corrigendum -XI, Sr. No.7

VOLUME -IV-A					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
26	SECTION - 4	DATA SHEET - A	14.0 Short-circuit impedance at 75c at principal tap 11.5% +-10% on 35 MVA base	% Impedance of the transformers shall be finalized based on System Study results carried out during detail engineering.	Bid specification Prevails.
27	SECTION - 4	DATA SHEET - A	21.3 (b). Protective creepage distance	We have envisaged the protective creepage distance to be less than or equal to 50% of the Creepage distance. Please Confirm.	This will be decided during detail engineering.
28	SECTION - 5	1	1.3 Transformer offered by the bidder shall be sized according to the maximum demand at most stringent condition plus minimum 10 % margin	We have envisaged 5% margin on the operating load and 5% No Load Voltage Correction Factor over that for ST Sizing. Request to accept our proposal.	Bid specification Prevails.
29	SECTION - 5	4.7	4.7.8 In general, the arrangement shall be such as to permit removal of transformer without dismantling the bus duct/cable connection.	We understand that the arrangement shall be such as to permit the removal of transformer only by dismantling bus duct/ cable termination.	Bid specification prevails.
30	SECTION - 5	4.16.2	4.16.2 Impact Recorder	We have envisaged the impact recorder to be on returnable basis. Request to accept our proposal.	Pl. Refer Corrigendum -XI, Sr. No.8.
31	SECTION - 5	DATA SHEET - A	21 (b). Protective Creepage distance mm/Kv Bidder to specify	We have envisaged the protective creepage distance to be less than or equal to 50% of the Creepage distance. Please Confirm.	This will be decided during detail engineering.
32	SECTION - 6	2.0	2.1 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.	Please note that standards available as on date of bid submission shall be considered as latest version of standards. Further modification if any shall be considered with implication in all respects. Customer is requested to accept the same.	Standards available on date of bid submission shall be considered as latest version of standards.
33	SECTION - 6	3.0	3.6 Bus duct and auxiliary equipment shall be capable of withstanding the mechanical forces and thermal stresses of the short-circuit currents listed in the annexure without any damage or deterioration of material.	We understand that the annexure here means the "DataSheet-A" of Segregated Phase Bus-duct". Please confirm.	Annexure here means Data Sheet - A
34	SECTION - 6	4.2	4.2.9 Shipping length of the bus duct shall be not more than three (3) metres in length. Each shipping section shall have at least two (2) supports both for conductor in each phase and enclosure.	Please note that the shipping length of busduct shall be as per manufacturer standard. Customer is requested to accept the same.	Bid specification Prevails.
35	SECTION - 7	1	1.2 (d) 3.3 kV Bunker Switchboard	Please note that the voltage level of Bunker switchgear shall be selected as per the system requirement. Please confirm.	Pl. refer corrigendum XI, Sr. no. 9.
36	SECTION - 7	1	1.3 Additional 11kV switchgears or 3.3kV switchgears for power plant, if required shall also be included under the Scope of power plant EPC Contractor without any price implication. However, Unit rates of HT switchgear feeder shall be furnished for each type of rating.	Please note that we have considered the number of switchgears as per system requirement and the same is basis for our proposal. No additional switchgears are considered. Customer is requested to inform the same should there be any additional requirement, if any, at this stage. Addition of switchgears during detailed engineering stage shall be considered with implication in all respects.	Not acceptable. Specification is self-explanatory.
37	SECTION - 7	1	1.12 Incomer from all the Unit Transformers & Station Transformers shall be provided with Lightning Arrestor 11kV side.	Please note that there is no technical requirement for providing Lightning Arrestor on 11kV side of Unit & Station transformer. Customer is requested to revisit this requirement.	Bid specification Prevails.

VOLUME -IV-A					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
38	SECTION - 7	2	2.1 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.	Please note that standards available as on date of bid submission shall be considered as latest version of standards. Further modification if any shall be considered with implication in all respects. Please confirm.	Standards available on date of bid submission shall be considered as latest version of standards.
39	SECTION - 7	3	3.5 Switchgear ratings and quantities are detailed in the Enclosed drawings and Annexure. Equipment shall be furnished in strict accordance with the same. For indicative power distribution, scheme ""Key Single Line Diagram for Electrical systems"" Dwg. No. PE-189-EL-501 shall be referred. All the rating shown in the above drawing represents the minimum requirement only; exact rating, number and type of feeders etc. shall be decided by the bidder.	We understand that the annexure here means the "Data Sheet-A" of HT Switchgear". Please confirm.	Annexure here means Data Sheet - A
40	SECTION - 7	3.11	The continuous rating of the 11/3.3kV switchgear bus and incomer breaker shall be based on the rated LV winding current of the transformer with 20% margin rounded off to the next higher standard rating.	Please note that while arriving at MVA rating of transformer, margin is already considered and next higher standard rating is selected. So as common engineering practice the incomer breaker rating of associated switchgear shall be same as that of transformer secondary winding ampere rating. There is no need of further margin of 20% which will result in oversizing of breaker. Customer is requested to revisit this requirement.	Bid specification Prevails.
41	SECTION - 7	4.1	4.1.9 Each switchboard should be supplied with suitable d rilled foundation frame and anchor bolts from mounting the switchboard at site.	The switchgear baseframe mounting arrangement shall be as per manufacturer standard. Request to accept the same.	Bid specification Prevails.
42	SECTION - 7	4.3	(4.3.9 (a) Two (2) nos. of Trip Coils	We understand that two coils shall be provided. One Closing Coil and One Tripping coil. Please clarify whether our understanding is correct or not.	Specification is self- explanatory. Bid Specification prevails.
43	SECTION - 7	4.17	4.17.4 Wherever, the schematic diagrams indicate a definite ground at the for each switchgear, a single wire circuit thus grounded shall be run independently to the ground bus and connected thereto.	This requirement is not clear. Customer is requested to please clarify the same.	Pl. refer Corrigendum - XI, Sr. no. 10
44	SECTION - 7	4.24	An automatic 32 bit or higher micro processor based real time operated fast backed up by slow transfer scheme shall be provided for change over between unit to station sources and vis-a-vis, station to station sources (11KV & 3.3KV). All hardware pertaining to above transfers shall be mounted in Auto Bus transfer (ABT) panel. The bus transfer module shall have features such as graphical user interface, virtual test simulation, object oriented programming, on line viewing, sequence of event logging, self diagnostic features and communication port for remote communication. The ABT panel shall be indoor, simplex type construction, vertical free standing, floor mounted type, metal clad suitable for installation at 50 C ambient. Panel enclosure shall be fabricated from 2 mm thick sheet steel and the same shall be IP 52 protected. Detail write up on	Please note that fast Auto Bus Transfer shall be provided at 11kV unit and station switchgear as per specification. 3.3kV switchgears shall be provided with slow bus transfer. Please confirm.	Pl. refer Corrigendum - XI, sr. no. 11

VOLUME -IV-A					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
45	SECTION - 7	4.25	Microprocessor Based Fast Bus Transfer System (BTS) shall be provided for unit to station and vis-a-vis & station-to-station supply changeover on all 11kV & 3.3 kV unit /station Switchboards.	Please note that fast Auto Bus Transfer shall be provided at 11kV unit and station switchgear as per specification. 3.3kV switchgears shall be provided with slow bus transfer. Please confirm.	Pl. refer Corrigendum - XI, sr. no. 12
46	SECTION - 7	4.26	Microprocessor Based Fast Bus Transfer System (BTS) shall be provided for unit to station and vis-a-vis & station-to-station supply changeover on all 11kV & 3.3 kV unit /station Switchboards.	Please note that fast Auto Bus Transfer shall be provided at 11kV unit and station switchgear as per specification. 3.3kV switchgears shall be provided with slow bus transfer. Please confirm.	Pl. refer Corrigendum - XI, sr. no. 13.
47	SECTION - 8	5.1	5.1.14 PCCs/PMCCs/MCCs/DBs/SVBs shall be supplied with base frames of 100mm height of structural steel sections along with all necessary mounting hardware required for bolting/welding the base frames to the foundation.	The switchgear baseframe mounting arrangement shall be as per manufacturer's standard. Customer is requested to accept the same.	Bid specification Prevails.
48	SECTION - 8	5.5	5.5.1 Switches shall be triple/double pole, air break type and designed for duties as specified in Annexure-A. Motor duty switches shall be capable of safely making and breaking the locked rotor current of the associated motor circuit.	Please note that the "duties" are not specified in "Annexure-A". Customer is requested to please provide the relevant Annexure details for the same.	Pl. refer Corrigendum - XI, sr. no. 14.
49	SECTION - 8	5.6.1	(c) Contactors for forward and reverse direction of reversible drives shall preferably be both electrically and mechanically interlocked.	Please note that as per common engineering practice, only electrical interlock is provided between the forward and reverse operation contactor and the same is widely accepted. Customer to revisit the requirement of providing Mechanical interlock.	Pl. Refer Corrigendum -XI, Sr. No.15.
50	SECTION - 8	5.10	5.10.3. (a) Class PS for differential	We understand that this clause is not applicable as the LT transformers shall not be differentially protected. Please confirm.	Pl. Refer Corrigendum -XI, Sr. No.16.
51	SECTION - 8	5.13.1	(a) All relays & timers in the protection circuit shall be flush mounted with connection from inside. They shall have transparent, dust tight covers, removable from the front. They shall have built-in testing facilities. Except small auxiliary relays and timers, all relays shall be drawout type.	Timers shall be installed and mounted inside the panel/ cubicle so there is no requirement of flush mounting. Customer is requested to accept the same.	Pl. Refer Corrigendum -XI, Sr. No.17.
52	SECTION - 8	5.13.1	(k) All DDCMIS/DCS/PLC operated motor feeders of any rating shall have ammeter & current transducer at "Y" phase.	Ammeter & current transducer at 'Y' Phase will be provided for motor rated 30 KW and above. Kindly confirm	Bid specification Prevails.
53	SECTION - 8	5.13.3	(a) Unless otherwise specified, relay shall be suitable to accept both AC/ DC supplies with range 110V to 240V with tolerance of +20%. The auxiliary power supply shall preferably be site selectable requiring no additional hardware.	Please note that tolerance shall be $\pm 10\%$ for AC and $+10\%$, -15% for DC as per specification requirement. Please confirm.	Bid specification Prevails.
54	SECTION - 8	5.16	5.16.3 Gland plates shall be minimum 4 mm thick. The gland plate and supporting arrangement for 1/C power cables shall be non-magnetic type to minimise the flow of eddy current.	We propose Gland Plates of 3 mm thickness. Kindly confirm.	Bid specification Prevails.
55	SECTION - 10	6.7	6.7.1 Motor terminal box shall be phase segregated (PSTB) type and located in accordance with Indian Standards clearing the motor base- plate/ foundation.	Phase segregated (PSTB) motor terminal box shall be provided only for HT Motors. Please confirm.	Pl. Refer Corrigendum -XI, Sr. No.18.

VOLUME -IV-A					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
56	SECTION 13	1.0	1.2 MVA rating of the transformer, as indicated above, shall be considered as the minimum requirement for the project. Transformer offered by the bidder shall be sized according to the maximum demand considering additional running of one largest standby motor with driven equipment, No Load Voltage Correction factor 4% while sizing of Transformer at most stringent condition plus minimum 10 % margin	We have envisaged 5% margin on the operating load and 5% No Load Voltage Correction Factor over that for Transformer Sizing. Request to accept our proposal.	Bid specification Prevails.
57	SECTION 13	4.11	4.11.2 Wiring shall be done with flexible, 650V grade PVC wires in conduit or PVC armored cable. Minimum wire size shall be 2.5 mm ² copper. Not more than two wires shall be connected to a terminal. 10% spare terminals shall be provided.	We understand that this shall be 660 V grade. Please clarify.	Pl. Refer Corrigendum -XI, Sr. No.19

BHUSAWAL THERMAL POWER STATION 1X660MW UNIT - 6 PROJECT					
CLARIFICATIONS TO PRE-BID QUERIES					
BID SPECIFICATION No. DG/BSL U-6/2011/T-1					
VOLUME -IV-B					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
1	SECTION - 2	3.1	3.1.4 15% margin shall be considered while calculating the total load on Transformer.	LT transformer will be sized based on operating load with 10% design margin including largest motor starting criterion. Please confirm.	Bid specification prevails.
2	SECTION - 2	3.1	3.1.7 All anticipated future loads in or around the load centres shall be taken into consideration while finalising size of L.T. Transformers.	We have not envisaged any anticipated future loads for sizing of L.T. transformers. Please confirm.	Bid specification prevails.
3	SECTION - 2	DATA SHEET	21.2 L.V. Non-segregated phase busduct	LV terminal will be suitable for cable/ NSPBD. Please confirm.	Bid specification prevails.
4	SECTION - 3	DATA SHEET - A	2.6.2 The ripple content in charger DC output Limited to 1% (rms) with or without battery	We propose ripple content in output DC as 3%. Please confirm.	Bid specification prevails.
5	SECTION - 4	4.6	(h) Current rating capacity of cables should be 110 % of full load current, after considering the derating factors.	Please note margins shall be considered for transformer & motor sizing and selection from pump capacities. Therefore, further margins on full load current is not proposed to be considered for cable sizing. Derating factors shall be considered in line with the standards while cable sizing. Request to accept our proposal.	Bid specification prevails.
6	SECTION - 5	2.0	2.2 Main plant electrical system shall be controlled and monitored from Station DDCMIS/EDMS through dedicated operator's consoles.	We understand that DDCMIS & EDMS both are same. Please confirm.	DDCMIS & EDMS are different. (Refer Cl 13.0 of section-1 of Vol IV-A for details of EDMS). Bid Specification prevails.
7	SECTION - 5	2.0	synchronizing equipments, HT Switchgear manual synchronizing equipment, governor and excitation control, metering equipment, breaker control switches for GTs, 11kV, 3.3 kV & 415V Unit / Station switchgear incomers, tie and outgoing non-motor feeder breakers, synchronizing selector switches, Auto-Manual, Remote-Local and other selector switches as required along with annunciation windows, indications and mimic diagram (from 400kV level to 415V level). Cooler control for Generator Transformers, Unit Auxiliary transformer, Station auxiliary transformer, Cooler control & Tap changer control for Station Transformers and Unit Transformers in Remote- Manual mode shall also be provided in the Back-up Control Panel. DGs shall also be control from DDCMIS/EDMS as well as Electrical control panel. OTI & WTI of GT, ST, UT, SAT and UAT shall also be repeated in Back up control panel in addition to EDMS/DDCMIS.	Coolers for Generator Transformers, Unit Transformers, Station Transformers shall be controlled from local and their control is not envisaged from ECP.	Bid specification prevails.
8	SECTION - 5	ANNEXURE - B	1.1.12 Generator Rotor second earth fault (trip) Operated	We have envisaged only single stage rotor earth fault protection. Hence alarm for the same is not envisaged.	Bid specification prevails.

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CLARIFICATIONS TO PRE-BID QUERIES					
BID SPECIFICATION No. DG/BSL U-6/2011/T-1					
VOLUME - V					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
1	SECTION - 1	4.0	4.15 In general, temperature transmitters shall not be used. Instead, temperature elements shall be directly connected to their respective input modules. For non-critical measurement applications (such as measurements for Boiler metal temperature and Generator winding temperature) where the measurements are not used for control/ protection, Sensors may be grouped and connected to I/O modules in DCS.	As per Bidder's proven practice, temperature transmitter shall be used for all temperature measurements of Steam Generator. Please confirm.	Bid specification prevails.
2	1	7.5.3 (b)-i	In addition to above, 20% wired input/output spare channel should be provided for each I/O modules.	Based on our past EPC experiences we feel that 10% total spare channel are sufficient & optimised design. We request Owner to reconsider their specification.	Bid specification prevails.
3	1	7.10.6(g)	At least 20 percent spare unwired terminals shall be provided for all panels/cabinets /desks /junction box etc. This shall be in addition to 20% spare wired terminals of spare IO channels and 10% wired spare modules.	As per the specification total spare terminals required are 50%(20%+20%+10%) which is very high and will increase the size of DCS System & non-optimised design. Based on our past EPC experiences we feel total 10% spare is enough. We request Owner to reconsider their specification	Bid specification prevails.
4	2	1.3.13	In addition to this redundant 24 V DC battery system is envisaged for DCS system .	Control systems can efficiently work on external UPS 230VAC supply. UPS system are very reliable & Bidder has lot of experience. Any other voltage level like 24VDC shall be derived inside the control system from AC supply. Bidder will provide UPS of sufficient capacity for this purpose. This practice is very common & is followed all over the world. Therefore 24VDC battery system is not required.	Bid specification prevails.
5	2	1.3.14(k)	Fire detection & alarm system for entire power plant.	Fire detection & alarm system is already indicated in Vol-III-H. Bidder understand that this item is repeated in this clause.	The item is not repeated in the clause. The subject clause in Section-2 denotes "SCOPE OF WORK" , whereas "Volume-III H " is detailed technical specification for Fire Detection & Alarm System .
6	2	1.3.18	Optical Time Domain Reflectometer and splicing kit for optical fiber cable testing & maintenance.	This item will be covered under C&I Lab Instruments as described in section-9 of Vol-V. Bidder understand that this item is repeated in this clause.	The item is not repeated in the clause. The subject clause in Section-2 denotes "SCOPE OF WORK" where as Optical Time Domain Reflectometer and Splicing Kit (2 nos. each) shall be supplied as per specification given in the Section- 5 Clause no. 6.20.1.
7	2	1.3.19	Bidder shall set up instrument laboratory with all necessary testing & calibrating equipments & instruments and test bench etc this shall include supply, installation & commissioning of all equipment.	As per bidder's understanding, this is C&I Laboratory Instrument package as described in cl. No. 1.3.35, page no. 76 of 718.	Section -2, clause. No. 1.3.19, specifies that Bidder has to set up Control & Instrument laboratory of adequate dimensions and facilities where all necessary testing & calibrating equipment & instruments and test bench etc as specified in Section -9 shall be supplied , installed & commissioned.

VOLUME - V					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
8	2	1.3.21	Minimum 2 (Two) numbers of hand held configurators for SMART Transmitters.	This item will be covered under C&I Lab Instruments as described in section-9 of Vol-V.	Minimum 2 (Two) numbers of hand held configurators for SMART Transmitters shall be supplied as described in Section-9 of Vol-V.
9	3A	10.4	AAQMS shall include monitoring of the following pollutant gases/parameters. However, any other gases/parameters recommended by relevant Central & State regulatory agencies during project implementation phase shall also be provided. There shall not be any cost implication for the same to Owner.	We feel it will be judicious that cost for any additional analyser shall be borne by Owner.	Bid specification prevails.
10	3A	10.8(k)	Facility to interface exiting plant AAQMS shall be envisaged.	We request to provide more detail	Existing AAQMS Central Monitoring System to be interfaced with the new system.
11	3B	6.4.7 (b)	Balance leak off Pressure	This specification requirement is not clear. Pl clarify	Bid specification prevails.
12	3B	6.4.7 (i)	Top & bottom temperature	This specification requirement is not clear. Pl clarify	It means suction & discharge.
13	3B	7.1(q)	Ejector steam pressure control station with pressure transmitters.	Vacuum pump will be applied for this project hence this is not applicable.	Noted.
14	5	5.1.7	Selected data from Owner's system & off-site plants such as Ash Handling Plant, Raw water & Pretreatment plant, Dematerialized water plant and Coal Handling Plant etc shall be displayed/historized in CCR.	Please clarify what is "Owner's System"?	The clause shall be read as " Off-site plants such as Ash Handling Plant, Raw water & Pretreatment plant, Dematerialized water plant and Coal Handling Plant etc shall be displayed/historized in CCR."
15	5	5.1.27(k)	Management Information System (MIS) (Plant View Server) - Total 40 off located all over the plant including service building, shift charge engineer's room etc.	Please refer Cl. No. 5.1.17 (page no. 310 of 718) of sec-5, Vol-V, where specified the requirement of only MIS server and MIS stations will be in owner scope. Please clarify	Bidder to supply MIS Server only which shall be capable of connecting to and serving 40 Clients.

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CLARIFICATIONS TO PRE-BID QUERIES					
BID SPECIFICATION No. DG/BSL U-6/2011/T-1					
VOLUME - V I A					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
1	SECTION- 1	2.1.3 (k)	VDI:2056 : Criteria for assessing mechanical vibrations of machines	As per latest, VDI 2056 and VDI 2060 are replaced with ISO 10816 and ISO 1940 respectively. Please replace the codes in the code list.	Refer volume -VI-A, section-2, Annexure-I, Clause no. 7.0 (Special attention)
2	SECTION- 1	2.1.3 (l)	VDI:2060 : Criteria for assessing the state of balance of rotating rigid bodies.	As per latest, VDI 2056 and VDI 2060 are replaced with ISO 10816 and ISO 1940 respectively. Please replace the codes in the code list.	Refer volume -VI-A, section-2, Annexure-I, Clause no. 7.0 (Special attention)
3	SECTION- 1	3.1 (a)	Area Grading, levelling & dressing (finished grade levels shall be as mentioned in Plot plan and Area Grading Drawings. UCR/RCC retaining wall shall be provided as per requirement to retain the soil. If space permits, slope (1:3) shall be provided between two different grade levels. However slopes shall be protected with stone pitching with cement mortar (1:4).	As per Vol-II, Section-4, Annexure-B, Sl. No-2.1.3, The maximum allowable side slope for unpaved embankment is 1:2. Please clarify the requirement.	The slope of 1:2 shall be provided between two different grade levels instead of 1:3 slope. However, the slope shall be protected with stone pitching with cement mortar (1:4) to avoid erosion of slopes.
4	SECTION- 1	4.2.2	Building roof will be of Cast-in-situ R.C.C. over permanently colour coated (on exposed face) galvanized M.S. troughed metal decking of approved profile supported on steel beams/girders and the sides will be clad with permanent colour coated sandwiched insulated metal cladding system from Tripper floor to roof. The remaining portion of the building below Tripper floor up to ground floor shall generally be uncladded. However, brick cladding shall have to be provided, if required, as per TAC and any other statutory requirements.	Concrete slab on metal deck shall be provided only for feeder and tipper floor, and all other floors shall be grating / chequered plate. Roof shall be metal cladding. Please confirm.	Bid specification Prevails.
5	SECTION- 1	4.2.2	Floors shall be of cast-in-situ RCC over removable shuttering.	Concrete slab on metal deck shall be provided only for feeder and tipper floor, and all other floors shall be grating / chequered plate. Roof shall be metal cladding. Please confirm.	Bid specification Prevails.
6	SECTION- 1	4.7.5	4.7.5 The cold water from the basin shall be taken out through an opening connected to the main CW closed Channel/duct, which in turn leads to a fore-bay of the CW sump. The cold water from the basin shall flow by gravity to open approach channel leading to the fore-bay. The cold water channel shall be provided with a slide gate. Suitable handling arrangements with a monorail and a chain-operated hoist with a travelling trolley shall be provided for handling of the slide gate. In front of the outlet structure, provision shall be made for de-sludging facilities so that sediments can be withdrawn from the basin. In order to clean the cooling tower basin, sludge drain are to be provided along its perimeter with suitable sludge sump of minimum size 1.0 M x 1.0 M, from where the sludge will be taken out to sludge box/chamber outside the basin for pumping out. The size of Box	Please provide the location of the closed channel and open channel	Cold water channel including fore bay shall be closed type except maximum 5.0m portion near NDCT outlet required for operation of gates and screens.
7	SECTION- 1	4.7.17.3 (d)	(d) Loads due to temperature and shrinkage effects. Temperature effects due to solar radiation shall also be considered.	In general practice only temperature loads are considered. There is no provision for taking solar radiation effect in the loading. Please clarify.	Temperature stresses shall be considered as per Volume-VI (A), Section-II, Clause No. 3.1.6, Page 185.

VOLUME - V I A					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
8	SECTION- 1	4.17	For pipe drains, concrete pipes of minimum grade Class NP2 will be used. However, for road concrete pipes of Class NP3 will be used and for rail crossing, railway norms shall be followed.	For Road Crossings NP3 class Hume Pipes shall be provided encased in PCC, instead of RCC culverts. Please confirm.	Bid specification Prevails.
9	SECTION- 1	4.17	However, for road concrete pipes of Class NP3 will be used and for rail crossing, railway norms shall be followed. R.C.C. Manholes will be provided at maximum 30m intervals along the length, at connection points and every change of alignment, gradient or diameter of pipeline. The drains shall generally be of open type RCC rectangular construction. R.C.C. drains shall be covered with perforated R.C.C. pre-cast slab (M-25) of minimum 75mm thickness with provision of openable galvanized steel grating covers at every	Please specify the minimum length of the openable galvanized steel grating cover.	Minimum length of openable galvanized steel grating cover 1.2 M shall be provided.
10	SECTION- 1	4.18	Inside surface of the drain will have smooth neat cement finish over screed concrete. Invert of the drain shall be decided in such a way that the water can easily be discharged to the recommended nearest main plant drainage system. The minimum slope of the drain shall be 1:1000 longitudinally to take care of the silting problems.	We propose the only plaster to the drain wall.	Bid specification Prevails.
11	SECTION- 1	4.20	Above the chain link a 600 mm high tensile serrated galvanized wire (HTSW) concertina made with wire diameter of 2.5mm shall be stretched to 6m and attached to two strands of galvanized HTSSW of 2.5 mm diameter by means of clips at 1m intervals. These two HTSSW strands shall be attached to the fence posts with 12 mm security fasteners.	The maximum loop spacing should be specified.	Maximum loop spacing shall be 250mm.
12	SECTION - 2	3.1.11	All Power House columns adjacent to first row of Boiler columns shall be designed for an additional load of 500 kN to account for piping/cable rack loads.	We understand 500 kN vertical loads to be applied on each column adjacent to first row of boiler column. Please clarify at what level the load to be applied. (Or the load is distributed different levels like mezzanine floor, operating floor level etc.)	Bid specification is self explanatory.
13	SECTION - 2	3.4	Ultrasonic pulse velocity tests shall be carried out for the top decks of all machine foundations including. T.G deck slab, TG foundation and TG super structure/substructures to ascertain the homogeneity of concrete. In addition, additional cubes (at the rate of one cube per 150 Cu.m of concrete subject to a minimum of six cubes) shall be taken to carry out Ultrasonic Pulse velocity (UPV) testing on the cubes, to serve as reference UPV values. Testing shall be done as per IS:13311 (Part-1). In case of any defect, the EPC Contractor shall rectify the defects suitable using cement/epoxy grout, etc.	Please clarify whether UPV testing is required for block foundations like PA fan, FD Fan, ID fan, Mill foundations.	Ultrasonic pulse velocity test shall be carried out for the top decks of all machine foundations viz. T.G. , BFP, ID fan, FD fan, PA fan mill & sub structure & superstructure of TG foundation to ascertain the homogeneity and integrity of concrete. In addition-----using cement/epoxy grout, etc.
14	SECTION - 2	4.9	All underground water retaining/conveying system structures shall have plasticiser cum waterproofing cement additives conforming to IS: 9103 of SIKKA, FOSROC make. In addition, limits on permeability as given in contact with soil shall be provided with minimum two coats of bituminous painting of grade 85/25 conforming to IS:702 @ 1.7 kg/sqm (minimum) for water/damp proofing. Storm water drains shall not be provided with bituminous paint and weep holes also shall not be provided in storm water drains.	Please clarify if bitumen paint shall be done to the surfaces in contact with soil only for " All underground water retaining/conveying system structures" except storm water drains.	Bid specification is self explanatory.

VOLUME - V I A					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
15	SECTION - 2	5.2.7 (c)	Tension in piles shall not be allowed for any combination of loads.	As per general industrial practice, tension within the allowable uplift capacity of the pile should be allowed.	Bid specification Prevails.
16	SECTION - 3	1.7	1.7 Shop primer paint will be single coat of red oxide zinc- chromate primer conforms to IS-2074. The surface preparation will be done in accordance with IS: 1477 (Part I & II) Code of Practice for Finishing of Ferrous Metals in Buildings. Second coat of primer shall be applied after erection and final alignment of the erected structures. Two or more coats of synthetic enamel paint conforming to IS: 2932 of approved shade and quality shall also be applied after erection. Total Dry film thickness of the finished paint shall not be less than 110 microns.	As per Vol-II, section-4, cl. 15.4.2., the total minimum DFT is specified as 120 micron. Please clarify the requirement.	Stipulation in Clause no. 15.4.1 & 15.4.2 , Section -4 Volume -II - Master specifications shall prevail.
17	SECTION - 3	5.4	Grating flats : 5 mm	As per Cl. 5.0 of section-3, Vol-VI/A the minimum thickness of the main bearing bar shall be 4 mm. Minimum thickness of Grating flat shall be considered as 4mm. Please confirm.	All indoor gratings shall be ----- 30mm x 100 mm. The minimum thickness of the main bearing bar shall be 5 mm. All gratings shall be hot dip galvanized @ 610 gm. / sqm.
18	SECTION - 4	2.6	Masonry work facing any transformer yard up to a required height shall be fire resistant as per code/LPA requirement. Minimum thickness of firewalls shall be 345 mm for brick walls and 200 mm for concrete walls.	We understand that this 345 mm brick wall or 200 mm concrete wall.	Minimum thickness of firewalls shall be 345 mm brick wall or 200 mm concrete wall.
19	SECTION - 4	2.11 (b)	External : 20 mm thick 1:4 Sand faced cement plaster to be laid in two courses to all external surfaces.	As per Cl.No.5.1.5 of Section-4, for external and rough surfaces, 18 mm thick plastering shall be considered for power house and other building. Bidder requests to confirm the thickness of plastering (20mm or 18mm)to be provided for external surfaces of walls.	Stipulation at Clause no. 2.11(b) , Section- 4 shall prevail.
20	SECTION - 4	2.11 (e)	RCC walls : 12 mm thick 1:6 Cement: Sand Plaster	The Bidder recommends that the surface of RCC walls will be made smooth, and no need of plaster on RCC walls. Please confirm.	Bid specification prevails.
21	SECTION - 4	2.13 (b)	In non-plant buildings, solid core commercial flush doors shall be used unless otherwise mentioned.	Please clarify, whether this is solid core wooden flush door.	Type of doors & windows shall be as per doors & windows schedule given under clause No.6.1 of section-4 of Vol.VI/A.
22	SECTION - 4	2.17 (d)	All staircases shall be in structural steel unless otherwise noted.	As per Vol. VI-A, section-4, Cl. 2.4 (e) RCC staircase shall be provided for all RCC construction buildings and structural steel staircase for all structural steel buildings.Please clarify.	Volume-VI (A), Section-2.4(e) shall prevail.
23	SECTION - 4	2.20 (a)		Please clarify whether the access through lift shall be provided till roof level or machine room to be on roof level	The access through lift shall be provided till machine room to be on roof level.
24	SECTION - 4	4.1	The Technical Building is a 5-storied building (size 48M x 15M) including ground floor Building is located adjacent to the Power House Building as	Please confirm whether the bidder has any flexibility to reduce the building size without affecting the functionality of the same.	The Plan area specified under specification is minimum requirement.

VOLUME - V I A					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
25	SECTION - 4	4.1 (c)	For pantry and toilet false ceiling shall be perforated aluminium stove enamel finished panels of size 600x600mm.	Please clarify whether false ceiling is required for pantry and toilet.	For Pantry and Toilet area gypsym based false ceiling shall be provided.
26	SECTION - 4	5.1.5	Plaster : Exterior & rough side : 18 mm thick with 1:6 cemen t- sand of interior brick wall mortar in two layers except where special finish provided.	As per Vol- VI-A, Section-4, Cl. 2.11 Plastering: Exterior & rough side : 20 mm thick with 1:4 cement- sand of interior brick wall mortar in two layers except where special finish provided. Interior : 12 mm thick with 1:4 cement-sand mortar Ceiling : 6 mm thick with 1:3 cement-sand mortar Please clarify the requirement.	For all external and internal plastering of all buildings, Clause no. 2.11, Section- 4 , Volume VI shall be applicable. Clauses other than this clause describing plaster shall be superseded by this clause.
27	SECTION - 4	5.1.16 (a)	All stairs shall have not more than 13 risers in one flight but in case of fire escape stairs, 15 risers may be allowed instead of 13 risers. Height of risers and width of treads shall be 180 mm (maximum) and 250 mm (minimum) respectively for fire escape stairs and 166mm (maximum) & 250mm (minimum) for general staircases. Minimum width of stairs shall be 1000mm for fire escape stairs and 1200 mm for general stairs. In general, rises shall be 150 mm.	As per Vol- VI-A, Section-4, Cl. 2.17 (b) , All stairs shall have not more than twelve (12) risers in one flight. Please clarify the requirement.	Clause no. 5.1.6 (a) shall prevail.
28	SECTION - 4	5.1.19 (a)	(a) RCC roof water tank of adequate capacity depending on the number of users for 8 hours storage shall be provided for each building.	As per Vol- VI-A, Section-4, Cl. 2.29 , Two numbers of roof water tanks (one for storing service water and another for potable water) of Polyethylene water storage tanks conforming to IS: 12701 shall be used. The tanks shall be complete with all fittings including lid, float valve, stop cock, vent pipe, etc. There is a mismatch. Please clarify.	The capacity sizing criteria and type of material of service & potable water tanks specified under these clauses are applicable only for potable water & service water distribution tanks required for the users/personnel working in the respective buildings. While finalising the capacity of these tanks the water requirement for equipment cooling, makeup of associated system, floor washing, fire fighting etc. shall be suitably considered during finalisation of service / potable water scheme. The service & potable water distribution tanks upto 5000 litre capacity shall be of polyethylene make and tanks above 5000 litres capacity shall be of R.C.C. make. The capacity & make of potable & service water storage tanks located on main plant building and other system buildings shall be as per respective specifications and as per approved scheme of service & potable water system.
29	SECTION- 1	3.3	"Rainwater harvesting scheme which is statutory requirement.....Central Ground Water Authority /Board"	Please indicate the size of Rain Water Harvesting Pond based on Central Ground Water Agency. Also kindly specify whether the pond shall be earthen or RCC with weep holes.	Bid specification is self explanatory.
30	Addendum-III		Technical Specification for Additional Sourcing Of Raw Water	We understand the right of way of the pipe route and the aquaduct and other facilities along the route is arranged by the owner.	Bid specification is self explanatory.

VOLUME - V I A

Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
31	SECTION- 1	4.4	Scope include site survey, soil investigation, site development works, complete design engineering and construction of Civil, Structural. obtain necessary various approvals from Railways, other Departments/agencies well in advance including necessary charges for permission part born by the EPC contractor	We understand that the approval from Railway and other departments are included in the scope of EPC. However, the arrangement of land (purchase of land) along the pipe route is in scope of Owner. Please confirm.	Land for routing of ash pipe lines will be made available by Mahagenco
32	SECTION- 1	3.1 (h)	Drainage network (storm water drains, oils/effluent & sewage water)	As per clarification dated 07-07-2012, the outfall of the storm water drain shall be at existing bridge no. 17, 18 (box culverts) and the necessary detail for the same shall be given to the successful bidder. We understand our scope is to make arrangement to connect the drain point with the existing culverts and existing culverts are designed to cater the drain from this plant area. Please provide the invert level of the existing culverts (basic requirement) to design the plant drainage system.	The invert level of the existing culvert at upstream end is at RL205.010M and at downstream end is at RL204.690m .The upstream side of these culverts shall be extended beyond formation width of proposed railway siding. The plant storm water shall be connected to rain water harvesting scheme pond. The excess rain water from rain water harvesting scheme shall be disposed of through the extended existing culverts. The disposal of storm water from downstream of existing culverts into Bhogavati river including required cross drainage works at road / compound wall crossings are also included in the scope of EPC bid. The invert level of final disposal point of storm water drain shall be 500mm above HFL having RL 198.2m.
33	Addendum-III	3	Scope of work.	We understand there is no work in scope of bidder from the inlet of the aqueduct up to the forebay of the existing (abandoned) pump house. Please clarify.	Cleaning and desilting of the canal stretched between the abandoned pump house and aqueduct is in the bidder's scope. Pls refer Addendum III cl. 3.1 c page 7 to 76.
34	Addendum-III	3.1.(a) Page 6 of 76	Providing and laying M.S. gravity pipe line in the inlet canal, from the existing river water pump house of MAHAGENCO located on Tapi river to aqueduct including all necessary connections for conveyance of water to the existing Raw water system with adequate slope	During site visit it was observed that the inlet canal from existing pump house to the aqueduct was full of water. Hence, provide the cross sectional details of inlet canal for estimation.	Please refer sketch attached with our letter no. 1863 dtd. 03.06.2013.
	Addendum-III	13.8 Page 37 of 76	Laying of pipe line in canal and filling around with sand upto canal top		
35	Addendum-III	3.1.(c) Page 7 of 76	The scope shall also include cleaning and desilting of approach canal to pump house and sump pump house, repairing/replacing of screens, inlet gate, inlet canal including new utilities for electrical, mechanical and ICA works for smooth operation.	We understand that the approach canal to be cleaned and desilted is stretched between the abandoned pump and aqueduct. Please confirm. Also provide the detail of approach canal/aqueduct including cross section and longitudinal section for estimation.	Please refer Bid specification and also sketch attached with our letter no. 1863 dtd. 03.06.2013.

VOLUME - V I A					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
36	Addendum-III	9.3 Page 20 of 76	The M.S. gravity pipe line from existing river water pump house to aqueduct through inlet canal shall be designed for discharge of 9000 cum/hour (considering 24 hours operation per day). While designing the above pipe line, the agency shall ensure the same discharge after existing siphon arrangement.	Please provide the GA drawing for existing (abandoned) pump house indicating levels as same are required for calculation of pump TDH. Please provide the details of existing Siphon arrangement (including GA drawing) as same is not clear from specification. Please clarify.	Please refer Note no.1 of Annexure - II and sketch attached with our letter no. 1863 dtd. 03.06.2013.
37	Addendum-III	11.3.6(g)) Page 28 of 76	Cables coming from 6.6 KV feeders & from DG & compressor house shall have to cross railway line. Adequate duct bank shall be provided for crossing railway line.	If cables are coming from Existing 2x500MW Unit feeder, There is no cable crossing of railway line as per Plot plan, thus there is no Duct bank requirement. Please clarify.	Please refer Annexure-II- Layout of proposed pipe line from Tapi river water pump house to aqueduct & proposed pipe line from existing (abandoned) pump house to one day reservoir of 1x660MW.
38	Addendum-III	11.3.8 & Key SLD) Page 28 of 76	At present spare 220V DC feeders are not available in DG & Compressor house. Two feeders which are feeding 220 V DC supply to DG board PCC & AMF panel shall be disconnected and the same shall feed 2 nos new 220V DC Sub DBs to be supplied by the bidder. Required numbers of outgoing feeders are envisaged on these Sub DBs for owner's use. But as per Key SLD 4 nos. DC Fuse DB's are indicated.	Please clarify that DG and Compressor House pertains to 2x500MW or 3x210 MW unit for estimating cable route .	DG and Compressor House pertains to 2x500MW as indicated in Annexure II-Layout of proposed pipe line from Tapi river water pump house to aqueduct & proposed pipe line from existing (abandoned) pump house to one day reservoir of 1x660MW. Sr. no. 34 in Annexure-II is DG and Compressor House .
39	Addendum-III	13.2. Page 36 of 76	---to obtain necessary various approvals from concern Departments/agencies -----	Only customer's/customer's consultants approval on design/drawings are envisaged . Any statutory approval etc. from concerned department/agencies including necessary charges are beyond the scope of . Please confirm. this tender	Bid specification prevails.
40	Addendum-III	13.7 Page 37 of 76	Diversion of existing flow of water for connection of pipe line from existing tank.	This clause is not understandable , hence it needs to be clarified.	Proposed pipeline is to be laid in abandoned canal which is parallel to the canal in use. After completion of pipeline work, end connection shall be done with existing tank near Tapi Pump House. Necessary arrangement for connections to existing tanks shall be done by the bidders.

BHUSAWAL THERMAL POWER STATION 1X660MW UNIT - 6 PROJECT					
CLARIFICATIONS TO PRE-BID QUERIES					
BID SPECIFICATION No. DG/BSL U-6/2011/T-1					
VOLUME - V II-A2					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
1	PE-189-PF-210		Ammonia dosing at CCCW system	Since NaOH will be dosed to CCCW circuit, no other (like Ammonia) is required . Please confirm our understanding.	Bid specification prevails.
2	PE-189-PF-210		NRV at CCCW Pump suction	As per referred flow diagram, NRV shown on connecting line between CCCW expansion tank & pump suction, which will oppose to expand hot water. Mahagenco to clarify.	Agreed.
3	PE-189-PF-210		Type of valve	Type of instrument root valve, cooler inlet & outlet valve will be decided during detail engineering stage based on bidder standard practice. Please confirm.	Bid specifications prevail

BHUSAWAL THERMAL POWER STATION 1X660MW UNIT - 6 PROJECT					
CLARIFICATIONS TO PRE-BID QUERIES					
BID SPECIFICATION No. DG/BSL U-6/2011/T-1					
VOLUME - V II-D					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
1	PE-189-CV-SK-4005 P2 (ROAD LAYOUT)		Asphalt road in EPC scope.	In the Road layout drawing, there is road connecting existing road passing through the railway tracks of the existing plants. Please clarify the accessibility, permission for the construction of the roads to be arranged by the owner.	The road layout shall be finalised as per revised bid plot plan drawings & considering the accessibility to various systems /structures.



**MAHARASHTRA STATE POWER
GENERATION CO. LTD.**

**PROJECTS & PLANNING
DEPARTMENT**

BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1

**CLARIFICATIONS TO PRE-BID
QUERIES**

TECHNICAL

CONSULTANT
PROCON ENGINEERS
(DIV. OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)
202 A, Dosti Pinnacle, Plot E-7, Road no. 22,
Wagle Industrial Estate,
Thane (w)-400604

BHUSAWAL THERMAL POWER STATION 1X660MW UNIT - 6 PROJECT					
CLARIFICATIONS TO PRE-BID QUERIES					
BID SPECIFICATION No. DG/BSL U-6/2011/T-1					
VOLUME -II					
Sl. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final resolution
1	4	Annexure- D (SPECIFIC LAYOUT CONSIDERA TION)/CORRIGE NDUM-VII, S. NO. 2.0 PAGE 7 OF 34	AB -bay 36.0M, Mezzanine floor elevation : 9.0M, AB bay, BC bay floor levels at 0.0 M, 9.0M, 17.0M, 24.0M, 28.0M, 32.8M,38.0M. TDBFP Located at 17.0M Deaerator Floor - 38.0M	In line with present 660 MW projects under execution and OEM design, it is proposed to offer the optimised TG Building layout. The offered optimised layout will meet all O&M criteria. The overall project cost will unnecessarily increase if TG Building dimensions as specified in Tender Documents are retained. MahaGenco is requested to review & accept the optimised TG Building Layout. Following optimised layout dimesions of TG Building is proposed: AB-Bay-30.0M, Mezzanine floor elevation: 8.5M. AB & BC bay floor levels at 0.0 M, 8.5M,17.0M,25.5M & control tower floor elevations are at 0.0M, 8.5M,12.0M, 17.0M, 24.0M, 27.5M. TDBFP Located at 5.0M. Deaerator Floor- 25.5 M	Bid Specification and Corrigendum-VII, S. No. 2.0 Page 7 of 34 shall prevail.
2	4 PLOT PLAN (Drg. No. PE-189-GA-101) Issue-5, Note no.4	6.1.10 Note no.4	Plot Plan 1. Concept of various mechanical and electrical equipment location and building dimesnions (including column-row spacing) as shown in Plot Plan / Floor Plan drawing are to be adhered as far as possible. Any departure from this suggestive layout is primarily not recommended. 2. Bidder to note that the relative orientations and dimensions of various facilities as well as the inter-facility clerances shown in the plant layout have been conceived by the owner/ owner's consultant keeping in view the requirement of safe and hassle-free approach for operation and maintenance, Disaster management as well as logistic convenience with the existing power plant units. Bidder shall review the layout and improve upon, if deemed necessary keeping in view the overall intent of the project.	There is mismatch in the Tender requirements as per the two clauses. It is proposed to optimise the space requirements of various plant facilities as indicated in the Tender Plot Plan layout drawing. Various facilities as shown in the Tender Plot Plan drawing are proposed to be relocated / reoriented, without effecting the requirement of operation & maintenance space. The overall project cost will unnecessarily increase if the location / orientation / dimensions of various power plant facilities as indicated in Tender Plot Plan layout are retained. MahaGenco is requested to review & accept the optimised Plot Plan Layout.	There is no mismatch in the Tender Requirement as per the two clauses. Bid specification shall prevail. Bidder shall note that the dimensions indicated in Plot Plan & Tender Documents are minimum requirements and any increase in these dimensions, if required , from the point of safe and hassle free approach for Operation & Maintenance of the equipment, shall be in the scope of the Bidder only.



MAHAGENCO

**MAHARASHTRA STATE POWER
GENERATION CO. LTD.**

**PROJECTS & PLANNING
DEPARTMENT**

BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1

CLARIFICATIONS TO PRE-BID QUERIES

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT							
CLARIFICATIONS TO PRE -BID QUERIES							
Bid Specification No. DG/BSL U-6/2011/T-1,							
Volume - I							
Volume	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Mahagenco Reply	Bidder's Query/ Clarification	Final Resolution
I	3	6.3	Auxiliary Power Consumption table, Sl. No. 5 - Excitation losses (in case of static excitation system with rectifier transformer)	As per Specification Vol III-B, Section-1, C..... ..excitation losses from auxiliary consumption list.	Bid Specification Prevail	1. Excitation power is considered in HR calculation as well as in auxiliary consumption. 2. Mahagenco r..... Auxiliary power consumption. This clarity will bring bidder's understanding at the same level	Clause as per Vol -I prevails.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT					
CLARIFICATIONS TO PRE -BID QUERIES					
Bid Specification No. DG/BSL U-6/2011/T-1					
Volume - I					
S. No	Section No.	Clause No.	Bid Specification Stipulation	Bidder's query/Stipulation	MAHAGENC O Reply
292	3	2.2.2.3	"The generator to be supplied shall be manufactured assembled and tested in the factory where generator of at least 500 MW has been manufactured in the past or is under manufacturing / assembly at factory having testing facilities of international standard acceptable to technical agency / institutions to be approved by Owner	The clause may please modified to accommodate Indian manufacturing company set up to manufacture generators for supercritical projects Accordingly we request to you to add the following at the end of the para <i>"Alternately the same can also be manufactured in Indian Manufacuring Company set up as per clause 4.2.1 of Section 1/ Volume I"</i>	Refer Corrigendum- VI
293	3	2.2.3	Provenness Criteria of LPFWH: Capacity not less than 1300 MT/hr	Please modify as below: Feed Water Low Pressure Heater of a 500 MW or higher size unit	Refer Corrigendum- VI
294	3	2.2.3	Provenness Criteria of HPFWH: Capacity not less than 800 MT/hr for each string	Please modify as below: Feed Water High Pressure Heater of a 500 MW or higher size unit	Refer Corrigendum- VI
295	3	2.2.3	Provenness Criteria of LPFWH: Feed water handling Capacity not less than 1600 MT/hr	Please modify as below: Deaerator of a 500 MW or higher size unit	Refer Corrigendum- VI

296	3	2.2.3	Provenness Criteria of HP Bypass system	The HP Bypass Valves developed by us are suitable for both 500 MW sub-critical units as well as for 660 MW supercritical sets. These valves have been tested successfully at supercritical steam parameters and flow, temperature and pressure requirements and have been working for more than 2 years in 500 MW sets in the country. We interpret that our HP Bypass valves are proven. Kindly confirm.	Bid Specifications shall prevail.
297	3	2.2.3	Feed water high pressure heaters - Capacity not less than 800 MT / hour for each string	Client to note that as per prevailing practice 2 x 50 % HP Hetaers string can be offered. Please confirm	Refer Corrigendum-VI

298	3	2.4.1	Power cycle piping The contractor / his proposed sub vendors should have designed, engineered (including static and dynamic analysis) fabricated / got fabricated AND should have experience in fabrication and welding of main steam piping	The two conditions of this clause contradict each other as the 1st condition allows fabrication by others while the 2nd condition stipulates fabrication experience also. We request you to delete the 2nd condition since fabrication is a specialised job done by fabricators/erection agencies Further We request you to add a new condition at the end of this clause In case the bidder / his sub vendor does not meet the requirements stipulated above in part or full but he is a regular piping design and engineering firm and currently carrying out the design and engineering plant units, may also be considered qualified provided he collaborates subcontracts / associates with a design firm / agency who meets the requirement of the clause above for the purpose of execution of design and engineering of power cycle piping system for this package. In such a case the bidder / its subvendors shall get the design / engineering documents as per technical specification duly vetted by his collaborator / sub contractor / associate for the part of design for which he is not qualified."	Refer Corrigendum- VI

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT								
RESPONSE TO PRE - BID QUERIES								
Bid Specification No. DG/BSL U-6/2011/T-1								
VOLUME - II								
Sr No	Volume	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Clarification from Customer	Bidder's response	Final Resolution
1	II	4	17.2.1	Maximum noise level shall not exceed 85 dB (A) when measured at 1.0 M away from the noise emission source.	We understand that the.... of noise emissions.	Shall not exceed 85 dB(A) 1.0m equipment outline.	Bidder requests to consider "surface sound pressure level averaged over the measurement equipment area shall not exceed 85 dB(A)". Moreover equipment. Please confirm ISO 3746 to be followed for Noise	Earlier response prevails.
2	II	4	17.2.3	Any statutory changes to Maharashtra Pollution Control Board or Central Pollution Control Board or ll comply with the requirement. An exception will be made for the p.....and for the safety valves.	For the design of the Plant, ALSTOM can consider the statutory requirements regarding noise limitation, which are in force at the signing of the Contract and will be binding..	Bid Specification Prevail	With the specified tender requiriment the extent of meeting the statutory requirement is not limited and may impose the risk on bidder to meet the same wihtout additional cost even after signing of contract. Customer to relook at bidder's query.	Earlier response prevails.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT								
RESPONSE TO PRE - BID QUERIES								
Bid Specification No. DG/BSL U-6/2011/T-1								
VOLUME - II								
Sr No	Volume	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Clarification from Customer	Bidder's response	Final Resolution
3	II	4	ANNEXURE-D	Level of Mezzanine floor 9.0m	Mezzanine floor shall be 8.5m as per std practise. Please confirm.	Bid Specification Prevail	Bidder will follow Mahagenco's specification for overall plot plan, TG hall width etc. However Bidder has proven engineered TG hall layout with mezzanine floor at 8.5m elevation. change in elevation will not make any difference to performance but will get benefit from proven solution. Bidder requests to have flexibility in selecting floor levels of TG hall.	Elevation can be altered by bidder subject to provision of adequate clearances between equipments, trouble free access for O & M etc. However, the acceptance of this deviation is subject to comprehensive review and approval of the layout considering all aspects during detailed engineeering.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT								
RESPONSE TO PRE - BID QUERIES								
Bid Specification No. DG/BSL U-6/2011/T-1								
VOLUME - II								
Sr No	Volume	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Clarification from Customer	Bidder's response	Final Resolution
4	II	4	ANNEXURE-D	TDBFP at Operating Floor and MDBFP at Ground Floor in AB Bay	TDBFP at Operating Floor and MDBFP at Mezzanine Floor in AB Bay	Bid Specification Prevail	Bidder will follow Mahagenco's specification for overall plot plan, TG hall width etc. However Bidder has proven engineered TG hall layout, piping routing with MDBFP located at Mezzanine floor. change in elevation will not influence performance, but will get benefit from proven solution of bidder. Bidder requests to have flexibility to locate MDBFP at Mezzanine floor.	TDBFP can be located at mezzanine floor; however, this is subject to the bidder meeting all requirements related to engineering and O & M aspects; However, the acceptance of this deviation is subject to comprehensive review and approval of the layout considering all aspects during detailed engineering.
5	II	7	Annexure A	FORMAT OF QUALITY ASSURANCE PROGRAMME ANNEXURE - A	We understand that referred format is for Manufacturing quality plan. Bidder.....ble to transfer these into MAHAGENCO's format b. For BOP equipment, Quality plans shall be submitted in Annexure A- format	Bid Specification Prevail	Bidder request Owner to reconsider Bidder's clarification.	Bid Specification Prevail

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT								
RESPONSE TO PRE - BID QUERIES								
Bid Specification No. DG/BSL U-6/2011/T-1								
VOLUME - II								
Sr No	Volume	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Clarification from Customer	Bidder's response	Final Resolution
6	II	8	1.1.8 (III)	The P. G. test shall be carried out within four (4) months after first synchroni.....n the first synchronisation and PG test exceeds four (4) months. (i) 0.1 % for the following eight (8) months (ii) 0.06 % for the period following thereafter.	As per tender specification P. G. test shall be carried out in line with ASME PTC 6. Aging shall be considered in line with ASME PTC 6 Report. We request you to accept the bidders proposal.	Bid Specification Prevail	Bidder request Owner to reconsider Bidder's clarification inline with ASME PTC 6.	Earlier response prevails.
7	Volume-II	8	1.4.3	Run back capabilities: The automatic runback capability of the unit (boiler- turbine-generator) on loss of critical auxiliary equipment (such as tripping of one ID/FD/PA fan/airheater/BFP/ CEP etc) shall be demonstrated ensuring smooth and stable runback operation.		Bid Specification shall prevail	Boiler output shall be automatically reduced to a preset value when the follwing unit operating condition occurs: One ID fan Trip, One PA fan Trip , One FD fan Trip, One AH Trip, Loss of Main turbine. Target load is 50%BMCR, except for Loss of main turbine where it will be 60%BMCR variable pressure mode(HP-LP bypass capacity). Run back rate will be 50% per min. Please confirm	Earlier response prevails.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT								
RESPONSE TO PRE - BID QUERIES								
Bid Specification No. DG/BSL U-6/2011/T-1								
VOLUME - II								
Sr No	Volume	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Clarification from Customer	Bidder's response	Final Resolution
8	Volume-II	8	1.4.4	Rate of change of load and sudden load change withstand capability: The capability of boiler-turbine-generator in regard to ramp rate and step load change as specified shall be demonstrated.		Bid Specification shall prevail	The rate of load change as per design shall be as follows. <u>Ramp Rate</u> Load Range Sliding Pressure Operation 30-50% 2% MCR/min 50-90% 3% MCR/min 90-100% 1.5% MCR/min <u>Step Load Change(sliding pressure):</u> From 100% to 50% :±10%	Earlier response prevails.
9	Volume-II	vol- II,sec-8, pg 169-555	1.4.5	a) Capacity output of one coal pulveriser ----100% mill loading at rated pulverised coal fineness with specified design coal with new set of grinding elements	Capacity test of ONE mill at rated capacity (i.e 90% of the Mill max. theoretical capacity) will be done for establishing its capacity at rated pulverized coal fineness (i.e 70% through 200 mesh and 98% through 50 mesh) and specified "design coal", applying corrections for variation in HGI, Moisture and PF Fineness.The capacity test shall be done in ONE Mill after 3000 hours of Mill Operation.	bid specification prevail	Tender specification does not describe nearly worn out condition for grinding elements. Typically this is 80% of the allowable maximum wear. Please confirm for 80% Mill wear, 90% output of the new condition	Specification is self-explanatory.

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VOLUME - II								
Sr No	Volume	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Clarification from Customer	Bidder's response	Final Resolution
10	Volume-II	8	1.4.6	Life of mill wear parts Life of mill wear parts, in hours of operation, for the entire range of coal characteristics specified.	Wear life for grinding elements shall be 6000 hours with a coal of max. 50 YGP. Correction curve supplied by MILLS shall be used if actual coal being grinded is of a higher YGP. Wear life shall be defined as achievement 100 mm of wear on grinding rolls and 45 mm of wear on BRS.	bid specification prevail	Tender specification does not mention coal YGP or how the wear life is determined. We assume that wear life for grinding elements shall be 6000 hours with a coal of max. 50 YGP. Correction curve supplied by MILLS shall be used if actual coal being grinded is of a higher YGP. Wear life shall be defined as achievement 100 mm of wear on grinding rolls and 45 mm of wear on BRS. Customer to confirm.	Earlier response prevails.

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VOLUME - II								
Sr No	Volume	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Clarification from Customer	Bidder's response	Final Resolution
11	Volume-II	8	1.4.7	No fuel oil support above 30% BMCR load It shall be guaranteed that oil support for flame stabilization shall not be required beyond 30% of BMCR load when firing the coals from the range identified. It shall be demonstrated that with any combination of mills/ adjacent mills in service, the steam generator does not require any oil firing for stable and efficient boiler operation at and above 30% BMCR loads.	The minimum stable load without fuel oil support shall be 40% of BMCR load, with two adjacent mills in service and mill loading not less than 50%	bid specification prevail	OEM recommendation is as follows Min stable load without oil support will be 35%BMCR or 40%TMCR load. Please confirm	Earlier response prevails.
12	Volume-II	8	1.4.10	Steam temperature imbalance It shall be demonstrated at SH and RH outlets (in case of more than one outlet) that the temperature imbalance between the outlets does not exceed 10 deg. C under all loads including transients.	The SH & RH temperature imbalance between the outlets are considered maximum 30 °C differential during steady state operation only	bid specification prevail	OEM design is for maximum 30Deg C differential. Based on the bidder's experience, the steam temperature imbalance between outlets will exceed 10 deg.C during some transients; therefore, the specified imbalance is only offered during steady state operation. please confirm	Earlier response prevails.

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VOLUME - II								
Sr No	Volume	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Clarification from Customer	Bidder's response	Final Resolution
13	Volume-II	8	1.4.11	It shall be guaranteed and demonstrated that the spray water flow to SH attenuation system does not exceed the value considered for design (to be indicated in the bid) while maintaining the rated SH outlet steam temperature at BMCR. It shall also be guaranteed and demonstrated that the RH temperature is maintained at the rated value without any spray water requirement, at all loads for which the specified RH steam temperature is required to be maintained at the rated value.	SH spray shall be maintained at around 4% at all operating loads. RH spray shall be zero at guarantee load of 100% TMCR only.	bid specification prevail	The RH Spray (Nil) shall be guaranteed at TMCR DC (SG Performance Guarantee load) alone. Please confirm	RH sparay (Nil) shall be guaranteed at 100 % and 80 % TMCR

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VOLUME - II								
Sr No	Volume	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Clarification from Customer	Bidder's response	Final Resolution
14	Volume-II	8	1.4.12	It shall be demonstrated that maximum furnace exit gas temperature (FEGT) shall be minimum 60 Deg C below the minimum initial deformation temperature (IDT) of ash. A comprehensive thermal performance test (TPT) shall be conducted for this purpose. FEGT shall be demonstrated through such TPT by indirect measurement.		Bid Specification shall prevail	The maximum variation in FEGT is about 50 deg C higher than predicted value which is 60 deg C below IDT . TPT will be combined along with PG test. No separate TPT is envisaged.Please confirm	Earlier response prevails.
15	Volume-II	8	1.4.13	Air Heater exit temperature.		Bid Specification shall prevail	SG Efficiency is already being guaranteed per PTC 4. RAPH exit gas temp will be not be part of Functional guarantees. Pl. confirm	Earlier response prevails.
16	II	8	1.4.18	Constant Pressure and Sliding Pressure Operation - The c.....demonstrated. In sliding pressure mode of operation,.....hall also be demonstrated.	These tagory III guarantee. We propose following operation c.....R: Constant Pressure Operation through overload valve. The generating unit shall be capable of 3/2006). No throttling is envisaged in sliding pressure operation.	Will be evaluated after receipt of detailed scheme by bidder.	Bidder requests to accept the Bidder's operation concept as it have impact on guarantees.	Earlier response prevails.

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VOLUME - II								
Sr No	Volume	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Clarification from Customer	Bidder's response	Final Resolution
17	II	8	1.4.20	Short Circuit Capability The Gene.....ed voltage and with fixed excitation for 3 seconds as per IEC 34-4.	This requirement is design require.....tor electrical and mechanical integrity and should be avoided.	Bid Specification Prevail	Bidder request Owner to reconsider Bidder's clarification.	Refer to point no 4.0 Vol II ,of corrigendum V.
18	Volume-II	8	1.4.37	Flue Gas Temperature demonstration: The Bidder shall demonstrate that flue gas temperature at the entry and exit of various Boiler heating surfaces and also the variation across the cross section perpendicular to gas flow do not exceed the values considered for the pressure parts design at all loads of boiler.		Bid Specification shall prevail	Indicative value shall be provided and will not be part of Functional guarantees as It will be noted during commissioning. Please confirm	Earlier response prevails.

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Bid Specification No. DG/BSL U-6/2011/T-1								
VOLUME - III A								
Sr No	Volume	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Clarification from customer	Bidder's response	Final Resolution
1	IIIA	1	Data sheet A-1.19	Feed water temp at HP heater outlet (290-300 deg C)	Bidder wants to delete the band	Bid Spec prevail	Bidder wants to delete the band	Bid Spec prevail
2	IIIA	1	Note -1	BMCR Capacity	Bidder wants 107 % TMCR	Bid Spec prevail	Bidder wants 107 % TMCR	Bid Spec prevail
3	Volume-III A	1	2.3.12, 2.3.1.4 2.3.2.5 2.3.2.6 2.3.2.8 5.25.2.3	Start-up drain and vent regulating valves and isolating valves shall ... at superheater and reheater outlets, lowest set pressure safety valves on the water separators shall be provided with silencers. All vent pipes and safety valves escape pipes to a level of 1 meter above SG house roof. Start-up drain and vent regulating valves with motor drives Start-up drain and vent isolating valves with motor drives All start-up vents, lowest set pressure spring loaded safety valves on Superheater outlet and Reheater outlet shall be provided with silencers shall be provided with silencers. The start-up vent lines shall be provided with one motorised isolating valve and one motorised regulating valve.	For once through supercritical boilers start-up vents are not envisaged since the boiler will be started with HP-LP bypass in operation. The vent valves provided will be used for air release purpose only during boiler filling. Hence motorised valves and silencers are not necessary. As per the bidder standard the vent pipe shall be routed to the safe location.	Bid Specification shall prevail	As per design, Safety valve and ERV at SH O/L & RH O/L are provided with Silencer to lowest set pressure only. Startup vent at SH O/L is provided with silencer, however it is not provided at RH O/L for IP steam air vent. Two motorized isolating valve shall be provided for startup vent & drain. No regulating valves are envisaged. Please confirm	This will be taken up during bid evaluation stage after revieweing the details

4	Volume-III A	1	2.3.2.10	MSSV	we understand that the bypass line referred here is small capacity bypass for equalising. Please confirm.	motorised regulating as well as isolation valve for charging shall be provided.	Motorised ON/OFF type MSSV & manual isolation valve shall be considered as per OEM practice. Please confirm	Bid Specification is self-explanatory
5	Volume-III A	1	2.5.1 (c) 13.8	Electrically operated guillotine type gas tight isolations: Before and after each regenerative air heater on both flue gas and air side Double multi louvre type isolation dampers shall be provided before and after each regenerative air heater on air side	Kindly confirm whether double multi louvre type isolation dampers can be provided on the gas side also from layout considerations.	Bid Specification shall prevail	Guillotine type dampers /gates are envisaged at a) individuals FD and PA fan outlets, b) Inlet & outlet of each ESP gas stream, c) Before & after each ID fan. d) Manual transfer dampers shall be provided at seal air fan discharge. e) Pneumatic control & isolation dampers shall be provided at Hot and Cold air duct to each mill. f) Guillotine type dampers at inlet & outlet of APHs on flue gas side & air side are not envisaged, however Bi-planar/Louver type of isolation dampers shall be provided at each air heater inlet & outlet both on the flue gas side and air side. Please confirm	Earlier response prevails.
6	Volume-III A	1	5.8.1	The outlet temperature of SH and RH shall be guaranteed to be maintained within $\pm 5^{\circ}\text{C}$ of the rated temperature condition from 60% to 100% BMCR.....	Please clarify whether the required steam temperature control range has to be considered as 60% TMCR (control load) to 100% BMCR.	50% to 100 % BMCR	As per OEM design, 60%TMCR as a lower control range point for rated SH/RH temp to be considered. Please confirm	Earlier response prevails.

7	Volume-III A	1 / 53 1 / 53 1 / 90	5.11.95.11.9 Data sheet-A. Sr.No:13.1	The Air Heater shall have peripheral duplicate A.c. The Air Heater shall have peripheral duplicate A.c. drive to be able to run the air heater at the rated RPM in the event of failure of one of the Air Heater drives. Air Heater: Rotary Regenerative, Tri-sector type or Bisector Type. Each with two peripheral AC motor drive and one independent air motor drive along with one air receiver of minimum 10 minutes capacity.	As per OEM standard centrally mounted motor. As per OEM standard centrally mounted motor drive shall be provided.	Bid Specification shall prevail	Each Air preheater is provided with 1 AC motor and 1 air motor as per OEM design. Please confirm	Earlier response prevails.
8	Volume-III A		5.12.4	Cross-connections with sufficient number of power operated dampers shall be provided such that, to the limits of their capacity, the Steam Generator may continue to operate safely following the loss of any one F.D. fan, I.D. fan or air heater (if applicable).	Cross-connection duct at FD and PA fan outlet shall not be provided due to layout constraints. However Cross connection shall be provided at ESP outlet for ID fans.	Bid Specification shall prevail	Only single stream operation (1 FD fan, 1 ID fan, 1 PA fan & 1 RAPH on the same side) is applicable as per OEM design	Earlier response prevails.

9	Volume-III A	1	10.7	Tube and header materials: Design Metal Temperature: Upto & including 550° C :Alloy steel to ASME SA 335:P Upto & including 550° C :Alloy steel to ASME SA-335:P-11/ P-12/P-22/;ASME SA213:T-11/T-12/P-22/;ASME SA213:T-11/T-22/or equivalent Upto & including 600° C: Alloy steel ASME SA-335/P-91/ 92; SA213 T-91/92 or equivalent	Design Metal Temperature: Upto & including 550° C :Alloy steel to ASME SA-335:P-11/ P-12/P-22/;ASME SA213:T-11/T-12/T-22/or equivalent 22/or equivalent Upto & including 600° C: Alloy steel ASME SA-335/P-91/ 92; SA213 T-22/T-91/92 or equivalent, Austenitic stainless steel	Clause suitably amended; please refer Corrigendum- II	Upto & Including 400 deg C - SA 106Gr C, SA210 Gr C. Upto & including 510 Deg C : Alloy steel to ASME SA-335:P-11/ P-12/;ASME SA213:T-11/T-12/or equivalent Upto & including 550 Deg C : Alloy steel to ASME SA-335:P-22, ASME SA213:T-22 or equivalent Upto & including 605° C: Alloy steel ASME SA-335/P-91/ 92; SA213 T-91/92 or equivalent Temp >605 deg C. Austenitic Stainless steel, SA213 TP347H, SA 213 304H clause 10.6 while replying this point.	Upto & Including 400 deg C - SA 106Gr C, SA210 Gr C. Upto & including 500 Deg C : Alloy steel to ASME SA-335:P-11/ P-12/;ASME SA213:T-11/T-12/or equivalent Upto & including 550 Deg C : Alloy steel to ASME SA-335:P-22, ASME SA213:T-22 or equivalent Upto & including 600° C: Alloy steel ASME SA-335/P-91/ 92; SA213 T-91/92 or equivalent austenitic stainless steel Temp >600 deg C. Austenitic Stainless steel, SA213 TP347H, SA 213 304H/ equivalent.
10	Volume-III A	1	data sheet A	Minimum load with separator running dry shall be 30% BMCR	Minimum once through load with separator running dry shall be 35% BMCR (i.e SGMCR).	Bid Specification shall prevail	As per OEM design, minimum once through load with separator running dry shall be 35% BMCR (i.e SGMCR). Pls. Accept.	Earlier response prevails.

11	Volume-III A	1	Data sheet-A. Sr.No:19.5	ID fan capacity: (i) Excess air-20% over Stoichiometric air. (ii) Air heater air in-leakage - Primary air leakage 15% and Secondary air leakage 10%. (iii) Air in leakage-1 % of ESP inlet gas flow and 2% through ducts	(ii) Since bidder will provide the trisector air heater in the proposed project the total airheater leakage (primary + secondary) is about 6%. Hence for the ID fan selection the total airheater leakage shall be considered instead of primary air and secondary air leakage separately. (iii) Since we ensure the air ingress through the duct is zero same shall be considered for ID fan sizing.	Bid Specification shall prevail	The RAPH leakage shall be considered as 10% for ID fan sizing calculation at BMCR Worst coal. Please confirm.	Earlier response prevails.
12	Volume-III A	1	Datasheet :Note 6(page 106)	Mill turn down ratio shall normally be 4:1.	Mill turn down ratio shall be 2:1, as minimum 50% mill loading is recommended.	Bid Specification shall prevail	The Coal firing system (each mill with corresponding firing elevation) shall have a turndown ratio of 2:1, since mill loading 50%, with minimum two adjacent mills in operation is always recommended. Please confirm	1: 2.5 shall be considered against 1:4 specified.
6	Volume-III A	1	2.2.4	Steam generator structure, water circulation system, water-steam separator system with two or more separators and a storage vessel for collecting the separated water. Minimum Two (2) steam separators along with a drain collection vessel at the evaporator outlet shall be provided.	Alstom standard design is with two (2) nos. of Integral Separator cum Storage Tank for a 660 MW power plant capacity.	Bid Specification shall prevail	This is as per OEM design. Please accept	Bid Specification is self-explanatory

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Volume	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Mahagenco Reply	Bidder's Query/ Clarification	Final Resolution
IIIB	1	2.1.3	Duplex type Turbine digital electro hydraulic ure, level switch, primary sensing device etc.), as required	Load control will be carried out by Electrohydraulic sign. Please confirm acceptance of bidder's design.	Bid Specification Prevail	This is OEM specific design . Bidder request Owner to consider OEM standard design	Earlier response prevails.
IIIB	1	2.1.37	The scope of Instrumentation & Control shall include but not be limited to the following, as elaborated in Volume V. (g) Electro-hydraulic Governor with mechanical backup.	Electronic backup for electrohydraulic governor is provided as per bidder's proven practice. Mechanical backup is not applicable as per bidder's design. Please provide acceptance of bidder's standard design.	Bid Spec is self explanatory	OEM specific requirement.	Earlier response prevails.
IIIB	1	2.1.37	The scope of Instrumentation & Control shall include but not be limited to the following, as elaborated in Volume V. (g) Electro-hydraulic Governor with mechanical backup.	Electronic backup for electrohydraulic governor is provided as per bidder's proven practice. Mechanical backup is not applicable as per bidder's design. Please provide acceptance of bidder's standard design.	Bid Specification Prevail	This is OEM specific design . Bidder request Owner to consider OEM standard design	Earlier response prevails.

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Volume	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Mahagenco Reply	Bidder's Query/ Clarificafication	Final Resolution
IIIB	1 & 4	3.4 & 4.1	Condenser pressure to be 76 mm Hg absolute			In the corrigendum -II, deviation between cl.3.4(sec.I) and cl.4.1(sec 4) observed.Pl. clarify	Reply given against setioc -4, Cl. 4.1, at Sr. no. 30 on page 44 of 274 of the corrigendum - II shall prevail.
IIIB	1	5.1	The Steam Turbine shall be of Supercritical, Condensing, Reheat and output have been indicated in Datasheet-A.	As per bidder's design only throttling governing is envisaged. Please confirm acceptance of OEM design.	Bid Specification Prevail	This is OEM specific design . Bidder request Owner to consider OEM standard design	Earlier response prevails.
IIIB	1	6.1.4	The Steam Turbine casings shall be horizontally split at the centreline.	HP turbine casing shall be as per OEM proven design. Please confirm.	Bid Specification Prevail	This is OEM specific design . Bidder request Owner to consider OEM standard design	Earlier response prevails.
IIIB	1	6.2.1	Alternatively, the rotor could also be of proven welded construction. & If the HP-IP or IP-LP rotor is of welded type, only one weld is permissible between the rotors	OEM's standard & proven design is with w.....od ules & there is no welding involved for HP-IP or IP-LP.. Also refer to clause 6.2.2	Bid Specification Prevail	This is OEM specific design . Bidder request Owner to consider OEM standard design	Specification is self-explanatory

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IIIB	1	6.2.4	Critical speed of composite rotor and blade assembly shall not be within $\pm 15\%$ of operating speed.	As per bidder's design and proven practice the critical speed of the combined turbine and generator rotor shall not lie within a range of + 15% or - 10% of the operating speed of 3000 rpm. Please consider bidder's proposal.	Bid Specification Prevail	Critical speed is OEM specific design. Bidder request Owner to consider OEM standard design	Earlier response prevails.
IIIB	1	6.2.8	Facility for wet steam washing of turbine casings and rotors shall be provided with a tapping from nearby piping and procedure for the same shall be furnished by the bidder. Wet steam washing system for Turbines, if recommended by the bidder.	Wet steam washing system for turbines is not recommended by the bidder. Pl. refer to clause 2.1.13 also	Will be evaluated after receipt of detailed scheme by bidder.	OEM specific requirement.	Earlier response prevails.
IIIB	1	6.3.3	LP Turbine shall have stand-alone type blades capable of sustaining -5% & +3% grid frequency variation.	LP last stage blades shall be as per OEM's standard design.	Bid Specification Prevail	As per Bidder's design, last stage blade are shrouded to reduce vibration stresses and it improves life of the blades. This is OEM specific design . Bidder request Owner to consider OEM standard design	In case the bidder proposes shrouded blades, the bidder shall describe the wetness and erosion mitigation measures provided.

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IIIB	1	6.9.4(a)	Double valves shall be provided on all extraction lines except for extraction line to LP Heater-I in Condenser neck. For extraction line to de-aerator, both the NRV's shall be power operated type.	NRVs in each extraction line will provided as per bidder's safety guidelines and standard proven practice. Please confirm acceptance of bidder's standard proven practice.	Bid Specification Prevail	Bidders standard and proven practice inline with ASME TDP requirements.	Earlier response prevails.
IIIB	1	6.11.3	Speed Changer The Turbine shall be provided with a synchronising of the Generator with the bus	As per bidder's design, speed regulati..... and proven design.	Bid Specification Prevail	This is OEM specific design . Bidder request Owner to consider OEM standard design	Earlier response prevails.
IIIB	1	6.11.4	Load Limiting Device Turbine shall be equipped with e generator supervisory panel.	As per bidder's design, speed regulati.....f bidder's standard and proven design.	Bid Specification Prevail	This is OEM specific design . Bidder request Owner to consider OEM standard design	Earlier response prevails.
IIIB	1	11.11	CAPACITY WITH ONE GAS COOLER OUT OF SERVICE In the of the machine being exceeded.	Following IEC 60034-3, the offered generato.....the machine being exceeded.	Bid Specification Prevail	Bidder request Owner to reconsider Bidder's clarification.	Bidder's request is accepted. As per IEC 60034-3, the offer generator shall be capable of carrying 67% of rated load continuously without the permissible temperature of the machine being exceeded.

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Volume	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Mahagenco Reply	Bidder's Query/ Clarification	Final Resolution
IIIB	1	12.3	Ripple springs shall be provided below.....he bars in the slot during operation.	The Bidder's proven stator slot wedgi.....rs in firm position in slots.	Bid Specification Prevail	Bidder request Owner to reconsider Bidder's clarification.	Being OEM intrinsic design, bidder's request is accepted.
IIIB	1	12.4	The seal off bushing shall be porcelain type and complete with silver plated terminal connectors.	The bushings design will meet DIN 48124 Part 2 standard. The bushings are of moulded resin-insulated type.	Bid Specification Prevail	Bidder request Owner to reconsider Bidder's clarification.	Being OEM intrinsic design, bidder's request is accepted. However type test certificate shall be submitted along with the Bid. Also customer reference list of last five years shall also be submitted along with Bid.
IIIB	1	12.12.2 12.12.3	The system comprises of oil tanks, defoaming bef ore being returned to main oil system.	Bidder's seal oil system is separated from.....su pply, which should be always available by owner.	Specification is selfexplanatory	Bidder request Owner to reconsider Bidder's clarification.	Earlier response prevails.
IIIB	1	12.15.3.2	(iii) Gate Firing... b. It shall be able to shift the gate pulse in the time over a range of about 150 electrical degrees under a signal from the regulator.	In OEM solution of power converters, the gate pulses could be changed in range 10 to 140 electrical degrees.	Bid Specification Prevail	Bidder request Owner to reconsider Bidder's clarification.	Being OEM intrinsic design, bidder's request is accepted.

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Volume	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Mahagenco Reply	Bidder's Query/ Clarificafication	Final Resolution
IIIB	2	5.1.2	The lowest pressure heater may be located in the Condenser neck in case that is the standard arrangement of the manufacturer. In such a case, a separate external drain cooler may be provided instead of being integral to the heater.	Please note that low pressure heaters 1 & 2 are duplex type and located in condenser neck as per standard and proven practice of the Bidder. Since the heat balance cycle is optimised without drain cooling zone as bidder's standard practice, separate external drain cooler is not required for this LP heater in condenser neck.	Bid Specification Prevail	Bidders standard & proven practice used in all 660 MW supercritical plants supplied worldwide.	Earlier response prevails.
IIIB	2	5.1.3 (c)	Heat transfer area shall be calculated considering 10% of the tubes plugged.	Please note that as a standard & proven practice of the Bidder, the heaters shall be designed for 100% TMCR with 0% MU condition without considering any tube plugging margin. Kindly accept and confirm.	Bid Specification Prevail	Considering supercritical technology and very high quality of water chemistry, tube plug margin is not required andf not envisaged. Heaters with 10% additional margin will have impact on demonstrating the performance of heaters and in turn impact on performance guaratnees. Till date all heaters designed by Bidder is without any margin and running successfully.	Earlier response prevails.

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Volume	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Mahagenco Reply	Bidder's Query/ Clarificafication	Final Resolution
IIIB	2	5.1.4	The H.P. Heaters shall be designed for the shut-off pressure of the Boiler Feed Pumps (at maximum speed of operation) on the tube side.	We would like to clarify following : 1) As per & proven practice. 2) As per Tender PFD (PE-189, PF-203), feed.....as per Bidder's standard & proven practice. 3) As per IBR amendment dated March 12, 2007 t..... shut off pressure being communicated to the piping system. 4) This will corresponding boiler economiser design pressure. Kindly accept.	1). HP heater shall be designed for shut off pressure of boiler feed pumps. 2). Economiser isolation valve may be deleted. Rest will be evaluated after receipt of bid.	There is discrip.....iping corresponding to BFP shut-off pressure. Hence, HP heaters on tube side and feed water piping downstream feed control station shall be designed corresponding boiler economiser design pressure.	Earlier response prevails.

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Volume	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Mahagenco Reply	Bidder's Query/ Clarificafication	Final Resolution
IIIB	4	4.1	Performancre requirement The condenser shall be designed such that.... Lower with 5% of tube.	Since this is an EPC Contract,bidder.....the best heat rate for the turbine cycle.			Earlier response prevails.
IIIB	4	4.1	The Condenser shall be designed such that.....r shall remain within 9.5 °C (during maximum thermal load).	Datasheet-A, clause no. 3.0, Design margin on heat load at TG VWO, 1% make-up and design CWT of 33 °C. = 5 % We would like to clarify following points in continuation with the reference clauses: 1) Make-up water..... Data sheet A. 2) The c..... optimised by bidder. 3) As the e benefit in plant performance. 4) Only LP criteria accordingly..	Design Make up shall be 1 %; For the rest, Bid Specification shall prevail.	1) Reply is acceptable 2) As per corrigendum temp rise is withdrawn. 3) As the condenser is already designed at VWO condition with 1% make-up..... benefit in plant performance. 4) Only LP heater drains to the condenser to be considered for condenser sizing. Bidder confirms that the above design criteria is inline with best engineering & design practices followed in India & worldwide and request you to amend the design criteria accordingly..	Earlier response prevails.

Bhusawal Thermal Power Station 1 x 660 MW Unit - 6 Project**RESPONSE TO PRE - BID QUERIES****Bid Specification No. DG/BSL U-6/2011/T-1****Volume-III B**

Volume	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Mahagenco Reply	Bidder's Query/ Clarificafication	Final Resolution
IIIB	4	5.1.1	The condenser shall be of two pass..... The cooling water inlet connections shall be at the bottom and outlet connection at the top.	The offered condenser shall be of single pass type. Accordingly, the cooling water will enter at the centre from one side and exit from other side of the condenser water box. Hence, we request you to specify single pass condenser as well in the specification.	Bid Specification Prevail	Considering OEM design of TG pedestal, Bidder request to allow single pass condenser as double / two pass condenser has layout restriction.	From design perspectivem, single pass condenser is acceptable; however, bidder sall furnish the layout including CW intake/ outlet piping/ valves and ensure that there is no operational hassle. Final acceptance of the deviation is subject of approval of scheme and layout by Owner.

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT						
RESPONSE TO PRE - BID QUERIES						
Bid Specification No. DG/BSL U-6/2011/T-1						
VOLUME - III E2						
Sr No	Volume	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Final Resolution
1	III E2			CW Pump Type	Bidder wants metallic option also	Option shall be left to the bidder to select concrete volute OR vertical metal casing, wet type CW pump. However, if vertical pit type CW pump is considered then additional stand by pump shall be required. For Concrete Volute :- 2x 50% For Vertical Metal casing wet type : 3x 50%

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT							
RESPONSE TO PRE - BID QUERIES							
Bid Specification No. DG/BSL U-6/2011/T-1							
VOLUME - V							
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Clarification from Customer	Bidder's response	Final Resolution
1	1	3.4	Bidder shall indicate the year in which the offered models of C&I system have been introduced and how long the commercial production of the same is expected to continue. In any case, Bidder shall ensure supply of spare parts for the lifetime of the plant. In case if it is felt by the bidder that certain equipment is likely to become obsolete, Bidder shall clearly bring it to the notice of the owner and indicate step proposed to deal with obsolescence. Any part/ module not listed in recommended spares shall be deemed to have a life expectancy of 30 years.	During the first ten years of the plant operation, ALSTOM PAC commits itself to support the customer with spares and service. Beyond ten years, Spares and service can be offered "on request" basis through a separate dedicated maintenance contract.	Specification prevails	Due to continuous technology advancement, upgrades in C&I parts / modules by the manufacturer will be brought to the notice of the Owner / Consultant, in the form of recommended spares for upgradation. Owner may be required to upgrade, before these products become obsolete, even though the life expectancy of these items could be lesser than that of life expectancy of the plant.	Earlier response prevails

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT							
RESPONSE TO PRE - BID QUERIES							
Bid Specification No. DG/BSL U-6/2011/T-1							
VOLUME - V							
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Clarification from Customer	Bidder's response	Final Resolution
2	1	4.4	Transmitters and electro-pneumatic positioners shall be SMART type. Each SMART equipment shall communicate in the form of analog signal 4-20 mA DC with superimposed digital signal having proven HART protocol to facilitate configuration, zero adjustment, calibration and diagnostic from remote location. All microprocessor based transmitters/analyser shall have the same type of protocol. Bidder shall provide separate HART management system along with PC and necessary software and hardware for remote calibration and diagnostic.	Transmitters supplied for Steam Turbine are HART compatible. Most of these transmitters are associated with the Protection of turbine. In view of safety and availability concern the feature of online monitoring by HART management is not allowed. Hand held HART calibrators can be used for local calibration and use of it shall be as per O&M manual.	Specification prevails	Transmitters supplied for Steam Turbine are HART compatible. Most of these transmitters are associated with the Protection of turbine. In view of safety and availability concern the feature of online monitoring by HART management is not allowed. Hand held HART calibrators can be used for local calibration and use of it shall be as per O&M manual.	Earlier response prevails

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT							
RESPONSE TO PRE - BID QUERIES							
Bid Specification No. DG/BSL U-6/2011/T-1							
VOLUME - V							
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Clarification from Customer	Bidder's response	Final Resolution
3	1	4.15	In general, temperature transmitters shall not be used. Instead, temperature elements shall be directly connected to their respective input modules. For non-critical measurement applications (such as measurements for Boiler metal temperature and Generator winding temperature) where the measurements are not used for control/protection, Sensors may be grouped and connected to I/O modules in DCS.	Application of Temperature Transmitter in critical and non-critical temperature measurements will be as per standard & proven practice and grouping of temperature transmitters will be done in local JB's during detailed engineering.	Specification prevails	Application of Temperature Transmitter in critical and non-critical temperature measurements will be as per standard & proven OEM practice and grouping of temperature transmitters will be done in local JB's during detailed engineering.	Earlier response prevails

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT							
RESPONSE TO PRE - BID QUERIES							
Bid Specification No. DG/BSL U-6/2011/T-1							
VOLUME - V							
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Clarification from Customer	Bidder's response	Final Resolution
4	1	4.34	Above I/Os used in OLCS or CLCS loops shall be redundant	Redundant I/O is not required for all OLCS and CLCS. Normally only critical Loops IOs will be redundant. Please review.	Refer the CORRIGENDUM-II TO BID SPECIFICATION VOLUME - V CONTROL & INSTRUMENTATION Sr No 3.	Redundant I/O cards are not considered for all OLCS and CLCS loops, only critical protection related signals shall be redundant as per standard proven OEM practice	Earlier response prevails
5	3B	2.1	Turbine protection shall be based on triple modular redundant configuration in hardware & software meeting NFPA requirement. Configuration shall be realized with three independent trip channels.	Offered Turbine Protection is 2oo3 configuration, FireProtection is part of Turbine Protection scheme as per Bidder's standard and proven practice.	Refer the CORRIGENDUM-II TO BID SPECIFICATION VOLUME - V CONTROL & INSTRUMENTATION Sr No 11.	Offered Turbine protection scheme shall be of 2oo3 configuration, each rack has a separate controller and I/O cards with independent trip channels as per proven standard OEM practice and will comply to the codes and standards mentioned in the PTP20A47049-EJ ALSPA CONTROSTEAM V3 - Standards and Codes.pdf	Earlier response prevails
6	3B	2.1	Redundant EHG valve position control modules	EHG valve position control modules will be as per ALSTOM's standard proven validated practice for all the power plants globally. As per standard OEM practice, the control valve positioning module are distributed in such a way that failure of one module will result in only partial load reduction.Hence redundant EHG valve postion control modules are not envisaged.	Specification Prevails	EHG valve position control modules will be as per ALSTOM's standard proven validated practice for all the power plants globally. As per standard OEM practice, the control valve positioning module are distributed in such a way that failure of one module will result in only partial load reduction.Hence redundant EHG valve postion control modules are not envisaged.	Earlier response prevails

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT							
RESPONSE TO PRE - BID QUERIES							
Bid Specification No. DG/BSL U-6/2011/T-1							
VOLUME - V							
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Clarification from Customer	Bidder's response	Final Resolution
7	3B	3.13.1(b)	Frequency compensation adjustment shall be within 2 to 8%.	As per IEC-45-1 guideline, droop regulation shall be adjustable within 3 to 8% rated speed.	Specification prevails	As per IEC-45-1 guideline, droop regulation i.e. Frequency compensation adjustment shall be adjustable within 3 to 8% rated speed.	Earlier response prevails
8	1	4.25	All Drives shall have its local control station comprising of start and emergency stop pushbutton and with a local & remote selection switch in SWGR/MCC (Refer electrical volume of the specification). Local stop pushbutton shall always be active. During the trial run of drives from local, safety permit and protection shall be ensured.	Local field operation is not a part of Bidder's standard control philosophy for safety and availability reason.	Specification prevails	Emergency pushbutton shall be provided, but local field operation is not a part of Bidder's standard control philosophy for safety and availability reason.	Earlier response prevails

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RESPONSE TO PRE - BID QUERIES							
Bid Specification No. DG/BSL U-6/2011/T-1							
VOLUME - V							
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Clarification from Customer	Bidder's response	Final Resolution
9	5	5.3.24	Redundancy in input / output modules	At IO level -redundancy is considered only in the output module for HT drives, and few critical LT drives and modulating control drives.	Specification prevails	Redundant I/O cards are not considered for all OLCS and CLCS loops, only critical protection related signals shall be redundant as per standard proven OEM practice	Earlier response prevails
10	5	7.3.3(g)	All Printed Circuit card connectors shall be gold plated.	Offered control system electronic modules does not have gold plated connectors. Please confirm	Specification prevails	Offered control system electronic modules does not have gold plated connectors. Please confirm	Earlier response prevails

BHUSAWAL THERMAL POWER STATION 1X 660 MW UNIT - 6 PROJECT							
RESPONSE TO PRE - BID QUERIES							
Bid Specification No. DG/BSL U-6/2011/T-1							
VOLUME - V							
Sr. No.	Section No.	Clause No.	Bid Specification Stipulation	Bidder's Query / Stipulation	Clarification from Customer	Bidder's response	Final Resolution
11	5	7.3.5 (c)	Bidder shall provide atleast 20% or minimum 2 number whichever is higher and 10% or minimum 1 number, whichever is higher complete spare IO module in each control group.	Please clarify, how much spare IO's we have to consider minimum as 10% or 20% or 30%?	Bidder shall provide at least 20% or minimum two numbers, whichever is higher, spare channels as hot on rail spares in each configured IO modules. In addition to this 10% or minimum one number, whichever is higher, extra assigned complete spare IO modules mounted on rails in sub racks as hot on rail spare for each category of installed IO modules shall also be provided	Turbine control and protection shall be as per the standard proven OEM practice. Overall 30 % spare channels shall be considered. Please confirm.	Earlier response prevails



**MAHARASHTRA STATE POWER
GENERATION CO. LTD.**

**PROJECTS & PLANNING
DEPARTMENT**

BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1

**CORRIGENDUM – I
&
ADDENDUM – I**



**MAHARASHTRA STATE POWER
GENERATION CO. LTD.**

**PROJECTS & PLANNING
DEPARTMENT**

BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1

CORRIGENDUM - I



MAHARASHTRA STATE POWER GENERATION CO. LTD.

BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1

CORRIGENDUM - I

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.			
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CORRIGENDUM TO BID SPECIFICATION

VOLUME-I

COMMERCIAL AND GENERAL CONDITIONS OF

CONTRACT

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		CORRIGENDUM - I		
Sr. No.	Section/Page No./ Cl. No.	Existing Particulars	To be read as	
1.	Section 1, Page 33/Cl.No.11.1.2	The Queries shall be submitted so as to reach the at least 7 working days	The Queries shall be submitted so as to reach the owner at least 10 working days	
2.	Section 1, Page 40/ Cl. No.19.1 Sr. no.1	Loading for evaluation of shortfall in performance	Loading for evaluation of shortfall in performance	
		INR 15,000,000/- (INR Fifteen Million only)	INR 15,000,000/- (INR Fifteen Million only) per day	
3.	Section 2B, Page 272, Cl.No.27.3.1(ii)	Packing slip for each consignment included in invoice.	Service entry sheet approved by the owner: 3 copies.	

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CORRIGENDUM TO BID SPECIFICATION

VOLUME-II

MASTER SPECIFICATION

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		BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1			
		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
4.	II/Sec. 3/57 of 555/ 3.6	Exclusions		<u>To be added:</u> (3.6) Traction substation for railway OHE.	
5.	II/Sec. 3/57 of 555/ 4.1	Terminal Points	<u>RAIL TRACK</u> Take off point at the 2x500 MW railway line (as indicated in plot plan drawing) Exact co-ordinate will be furnished to the successful bidder.	<u>RAIL TRACK</u> Take off point at the 2x500 MW railway line (as indicated in plot plan drawing) is tentative. Exact co-ordinates will be finalised as per detailed engineering. Terminal point for OHE, Signalling and telecommunication shall be as per railway requirement/site requirement.	
6.	II,Sec- 3/60 of 555 /4.0	Terminal Points	----	<u>To be added</u> 4.12 Ash Recovery water from ash Bund– Tap off from the existing recovery water line for 2x500 MW units at convenient location preferably between (E900, E1000) and (N600, N700).	
7.	II, Sec- 4/70 of 555 /6.1.6		All buildings...facility for drinking water.....comp	All buildings including All Transfer points in Coal Handling Plant, Bunker Floor shall be provided with adequate number	

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		BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1			
		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
			lied with	of Toilets with effluent discharge system and facility for Drinking water which shall include water cooler and UV Purifier of reputed make as may be approved by Owner. complied with.	
8.	II, Sec-4/70 of 555 /6.1.7		All rail/road crossings for pipe /cable racks shall be done with minimum seven (7) meters head room from top rail /road to bottom of rack	All rail/road crossings for pipe /cable racks/ conveyors shall be done with minimum 8.5 meters head room from top rail /road to bottom of rack/ conveyor structure. All the clauses related to the head room at rail/road crossings in entire specification stands modified to this extent.	
9.	II, Sec-5/118 of 556 /1.4		Keeping in mind ----- will be held at initially at least once in two (2) months at Mumbai/site ----- once in a month.	Keeping in mind ----- will be held at least once in a month.	
10.	II, Sec-5/121 of 556 /1.13		Supply of LDO, Chemicals, lubricating oils up to COD	Supply of LDO, Chemicals, lubricating oil/ lubricants, consumables etc. up to COD. All the clauses related to the above in entire specification stands modified to this extent.	
11.	II, Sec-5/140		The Contractor shall provide-----	The Contractor shall provide----- in the form of Two (2)	

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		BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1			
		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
	of 556 /4.1		- in the form of one (1) soft copy in CD and 15 hard copies.	soft copy in CD form and fifteen (15) hard copies.	
12.	II, Sec-9	General	(a) 10% of total quantity used for each type & size with minimum One (1) for each type and size. (b) 10% of total quantity used for each type & size or minimum One (1) for each type and size.	Please note that wherever such or such type of sentence is mentioned in the specification for quantity of mandatory spares to be supplied , the bidder shall supply the quantity whichever is more in both cases [(a) & (b)].	
13.	II, Sec-9/ 197 of 555 /(new)	Annexure A - Mandatory Spares List (Mechanical)	--	<u>To be added</u> Spares for Mill Reject Handling System	
				Isolation valve seat	10% of each type and size
				Isolation valve gates/flaps/domes	10% of each type and size
				Isolation valve complete assembly/ Dome valve	10% of each type and size

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		BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1			
		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				Pneumatic Cylinder	10% of each type and size
				Pneumatic Cylinder internal gate	20% of each type and size
				Coupling	10% of each type and size
				Pipes	10% of each type and size
				Pipe line fittings (Bends/Elbows/ laterals)	15% of each type and size
				Switch valve	10% of each type and size or one(1) which is more
				Pneumatic panel	2 of each type or one(1) which is more
				Air Inlet valve (above Air lock vessel)	10% of each type and size
				Air discharge valve (below Air lock vessel)	10% of each type and size

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		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				Vent valve	10% of each type and size
				Spares of Conveying Compressor for Mill Reject Handling System	
				<u>HP STAGES OF COMPRESSOR</u>	
				HP element	One (1) Set
				Packing Set	Four (4) Sets
				Axial thrust brg.	Two (2) Sets
				Labyrinth oil seal or radial seals or double acting seals for drive shafts	Four (4) Sets
				Bearing for male & female rotors (DE & NDE)	Two (2) each
				Timing Gears	One (1)
				Suction & discharge valves	Two (2) each
				<u>LP STAGES OF COMPRESSOR</u>	
				LP element	One (1) Set
				Graphitic ring shaft seals for	Four (4) Sets

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		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				compressor chamber or white metal	
				Packing Set	Four (4) Sets
				Axial thrust Bearing	Two (2) Sets
				Bearing for male & female rotors (DE & NDE)	Two (2) each
				Timing Gears	One (1)
				Suction & discharge valves	Two (2) each
				Main Bearing	Two (2) each
				Set up gear/pinion	One (1)
				Air intake filter element with gaskets	Eight (8)
				Oil filter element with gaskets & seals	Eight (8)
				Safety valve springs & gaskets	Four (4)

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		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				One set of inbuilt automatic drain valve	Four (4)
				Gearcase breather filterelemnt	One (1)
				Drain valve kit	One (1)
				<u>COMPRESSORS COOLERS</u>	
				Gaskets & seals for inter cooler and after cooler	Four (4)
				Inter cooler drain check valve	One (1)
				<u>OIL PUMP/MOTOR</u>	
				Oil pump complete assembly	One (1)
				Pump impeller/ rotor with shaft	One (1)
				Set of bearings	Two (2) Sets
				Oil pump motor bearing	Two (2)

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		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				<u>SHAFT DRIVEN OIL PUMP</u>	
				Drive gear with shaft	One (1)
				Driven gear with shaft	One (1)
				Drain tap elements	Four (4)
				Moisture tap elements	Four (4)
				Oil cooler gaskets and seals	Four (4)
				Seal Washer	Two (2)
				Mass flow Meter	One (1)
14.	II, Sec-9/ 255 of 555 / (new)	Annexure A - Mandatory Spares List (Mechanical)	----	<u>To be added</u>	
				Spares for Belt Cleaners:	
				External Belt Cleaners	4 sets
				Belt cleaning Disc for return idlers complete with mounting brakes	20
				Internal Belt Cleaners	4 sets

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		BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1			
		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				Modular segments for Belt cleaners	10% of total population
15.	II, Sec-9/ 255 of 555/ (new)	Annexure A - Mandatory Spares List (Mechanical	----	<u>To be added</u> Spares for Metal detector:	
				Primary circuit Boards	Five (5)
				Relays	Five (5)
				Sand back Markers	Five (5)
16.	II, Sec-9/258 of 555 /3.3	Annexure A - Mandatory Spares List (Mechanical)	Apron pan: 10% of the total quantity for one machine	Apron pan: 10% of the total quantity used .	
17.	II, Sec-9/258 of 555 /3.0	Annexure A - Mandatory Spares List (Mechanical)		<u>To be added</u> 3.7 Spares for Apron Feeder Hydraulic Drive	
				Impeller with wearing plates	One(1) Set
				Pumps Bearings	One(1) Set
				Motor Bearings	One(1) Set
				Couplings	One(1) Set
				Gaskets, dust seals & 'O' Rings	One(1) Set

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		BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1			
		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				Shaft sleeves	One(1) Set
				Nuts & Bolts etc.	One(1) set
				Gland Packing	Two(2) sets
				Oil seals	Two(2) sets
				Pipe fittings for hydraulic system	One(1) set
				Valves for hydraulic system	One (1) set of each type and rating
18.	II, Sec-9/259 of 555 /4.3.1	Annexure A - Mandatory Spares List (Mechanical)	<u>Bucket Wheel</u> Complete Set of Drive Gear Box Unit : One (1) set	<u>Bucket Wheel</u> Complete Set of Hydraulic drive Unit : One (1) set	
19.	II, Sec-9/263 of 555 /5.1.1	Annexure A - Mandatory Spares List (Mechanical)	1800 mm Belt width (35 ^o Troughing angle)	1200 mm Belt width (35 ^o Troughing3 angle)	
20.	II, Sec-9/263 of 555 /5.2.1	Annexure A - Mandatory Spares List (Mechanical)	1800 mm Belt width	1200 mm Belt width	
21.	II, Sec-9/263 of 555	Annexure A - Mandatory Spares List	1800 mm Belt width	1200 mm Belt width	

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Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
	/5.3.1	(Mechanical)			
22.	II, Sec-9/264 of 555 /5.4.1	Annexure A - Mandatory Spares List (Mechanical)	1800 mm Belt width (35 ^o Troughing angle)	1200 mm Belt width (35 ^o Troughing angle)	
23.	II, Sec-9/264 of 555 /5.5.1	Annexure A - Mandatory Spares List (Mechanical)	1800 mm Belt width (35 ^o Troughing angle)	1200 mm Belt width (35 ^o Troughing angle)	
24.	II, Sec-9/264 of 555 /5.6.1	Annexure A - Mandatory Spares List (Mechanical)	1800 mm Belt width	1200 mm Belt width	
25.	II, Sec-9/264 of 555 /5.7.1	Annexure A - Mandatory Spares List (Mechanical)	1800 mm Belt width	1200 mm Belt width	
26.	II, Sec-9/264 of 555 /5.8.1	Annexure A - Mandatory Spares List (Mechanical)	1800 mm Belt width	1200 mm Belt width	
27.	Similar quantities of idlers indicated for 1800 mm width at Sr. No. 5 on page nos. 263/555 and 264/555 , Volume II, Section-9 shall also be applicable for 1400 mm belt width and shall be supplied by the Bidder.				
28.	II, Sec-9/ 265	Annexure A - Mandatory	Mandatory spares for Conveyor Drive	Mandatory spares for Conveyor Drive System wherever	

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		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
	of 555/ /6.3	Spares List (Mechanical)	System	applicable	
29.	II, Sec-9/ 265 of 555/ /6.0	Annexure A - Mandatory Spares List (Mechanical)		<u>To be added:</u>	
				6.9 Mandatory spares for Hydraulic Drive System for conveyors	
				Impeller with wearing plates	One(1) Set
				Pumps Bearings	One(1) Set
				Motor Bearings	One(1) Set
				Couplings	One(1) Set
				Gaskets, dust seals & 'O' Rings	One(1) Set
				Shaft sleeves	One(1) Set
				Nuts & Bolts etc.	One(1) set
				Gland Packing	Two(2) sets
Oil seals	Two(2) sets				

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		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				Pipe fittings for hydraulic system	One(1) set
				Valves for hydraulic system	One (1) set of each type and rating
30.	II, Sec-9/ 266 of 555/ /7.0	Annexure A - Mandatory Spares List (Mechanical)	Magnetic Separator	In Line Magnetic Separator	
31.	II, Sec-9/267 of 555 /8.4	Annexure A - Mandatory Spares List (Mechanical)	Liners with Bolts: One(1) set for each type	Liners with Bolts: Not Required.	
32.	II, Sec-9/268 of 555 /10.0	Annexure A - Mandatory Spares List (Mechanical)	RING GRANULATOR	IMPACTOR CRUSHER	
33.	II, Sec-9/272 of 555 /(new)	Annexure A - Mandatory Spares List (Mechanical)		<u>To be added:</u> Mandatory Spares for Fixed Tripper	
				Tripper Head Pulley with Pillow Block & Bearing	One (1) set
				Tripper Bend Pulley with Pillow	One (1) set

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		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				Block & Bearing	
34.	II, Sec-9/269 of 555 /10.13	Annexure A - Mandatory Spares List (Mechanical)	Hydraulic drive	<u>To be added</u> 10.13.10 Pipe fittings for hydraulic system – One(1) set 10.13.11 Valves for hydraulic system –One (1) set of each type and rating	
35.	II, Sec-9/272 of 555 /17.0	Annexure A - Mandatory Spares List (Mechanical)	Electric Hoists	Spares indicated shall be deleted. Following spares shall be supplied:	
				<u>ONE SET CONSISTING OF TWO (2) BEARING FOR:</u>	
				Travel wheel	One (1) set
				One set consisting of Two (2) brake linings with rivets for :	
				Hoist brake	One (1) set
				Travel brake	Two (2) sets
				Hoist creep brake	One (1) set
				<u>ONE SET CONSISTING OF TWO (2) BRAKE SHOES WITH LINING FOR :</u>	

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		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				Hoist brake	One (1) set
				Travel brake	Two (2) sets
				Hoist creep brake	One (1) set
				<u>ONE SET CONSISTING OF SIX (6) CARBON BRUSHES FOR :</u>	
				Hoist motor	One (1) set
				Travel motor	Two (2) sets
				<u>ONE SET CONSISTING OF THREE (3) BRUSH HOLDERS FOR :</u>	
				Hoist motor	One (1) set
				Travel motor	Two (2) sets
				Fixed and moving contacts for each type of contactor: One (1) set	
				<u>OVERLOAD RELAY FOR</u>	
				Hoist motor	One (1)
				Travel motor	Two (2)
				<u>MOTOR BEARINGS</u>	
				Hoist motor	Two (2)
				Travel motor	Two (2)

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		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				<u>BEARING FOR</u>	
				Main Pulley	Two (2)
				Eq. Pulley	Two (2)
				Bearings for gear boxes for each type of hoist: Two (2) sets	
				Brake liners for all the brakes: 100% of total population of each type & size	
				Oil seals: 100% of total population of each type, size rating	
				Brake springs for all brakes: 100% of total population of each type, size rating	
				Wire ropes for hooks: 100% installed on each hoist	
				Solenoid coils for brakes: Two (2) sets	
				Limit switches for hoists and travel mechanisms: Two (2)sets	
				Spare motors for hoist of each capacity: One (1)	
				Travel machinery	

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		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				Gear wheel	One (1) set
				Internal clip	Two (2)
				Pinion	One (1)
36.	II, Sec-9/273 of 555 /20.4	Annexure A - Mandatory Spares List (Mechanical)	Piston with Piston Rod Assembly for each stage : 100 % for one compressor	Not Applicable.	
37.	II, Sec-9/273 of 555 /20	Annexure A - Mandatory Spares List (Mechanical)	Sr No 20.1 to 20.12	<u>Spares for Compressors:</u> To be supplied as under	
				<u>HP STAGES OF COMPRESSOR</u>	
				HP element	One (1) Set
				Packing Set	Four (4) Sets
				Axial thrust brg.	Two (2) Sets
				Labyrinth oil seal or radial seals or double acting seals for drive shafts	Four (4) Sets
				Bearing for male & female rotors (DE & NDE)	Two (2) each
				Timing Gears	One (1)
				Suction & discharge valves	Two (2) each

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		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				<u>LP STAGES OF COMPRESSOR</u>	
				LP element	One (1) Set
				Graphitic ring shaft seals for compressor chamber or white metal	Four (4) Sets
				Packing Set	Four (4) Sets
				Axial thrust Bearing	Two (2) Sets
				Bearing for male & female rotors (DE & NDE)	Two (2) each
				Timing Gears	One (1)
				Suction & discharge valves	Two (2) each
				Main Bearing	Two (2) each
				Set up gear/pinion	One (1)
				Air intake filter element with gaskets	Eight (8)
				Oil filter element with gaskets & seals	Eight (8)
				Safety valve springs & gaskets	Four (4)

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		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				One set of inbuilt automatic drain valve	Four (4)
				Gear case breather filter element	One (1)
				Drain valve kit	One (1)
				<u>COMPRESSORS COOLERS</u>	
				Gaskets & seals for inter cooler and after cooler	Four (4)
				Inter cooler drain check valve	One (1)
				<u>OIL PUMP/MOTOR</u>	
				Oil pump complete assembly	One (1)
				Pump impeller / rotor with shaft	One (1)
				Set of bearings	Two (2) Sets
				Oil pump motor bearing	Two (2)
				<u>SHAFT DRIVEN OIL PUMP</u>	
				Drive gear with shaft	One (1)

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		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				Driven gear with shaft	One (1)
				Drain tap elements	Four (4)
				Moisture tap elements	Four (4)
				Oil cooler gaskets and seals	Four (4)
				Seal Washer	Two (2)
				Mass flow Meter	One (1)
38.	II, Sec-9/ 275 of 555 /42.0	Annexure A - Mandatory Spares List (Mechanical)	----	<u>To be added:</u> (42.0) Spares for Ash Water Pumps	
				Complete Bowl Assembly	One (1) Set
				Set of Impellers	One (1) Set
				Set of line shafts	One (1) Set
				Casing wear rings	One (1) Set
				Impeller wear rings	One (1) Set
				Shaft sleeves	One (1) Set
				Shaft coupling	One (1) Set
				Shaft nuts and keys	Two (2) sets

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		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				Pins (for non-reversible ratchet)	Two (2) sets
				Lantern rings	One (1) Set
				Bell mouth liner	One (1) Set
				Bearings of various types as applicable	Complete One (1) Set (one set means total requirements for one Pump)
				Coupling set (between pump and motor) with accessories	One (1) Set
39.	II, Sec-9/283 of 556 /15.10	Annexure A - Mandatory Spares List (Mechanical)	Air lock vessel (Below ESP Hopper) 5% of each type and size or minimum one	Air lock vessel (Below ESP Hopper) 5% of each type and size or minimum one number whichever is higher	
40.	II, Sec-9/315 of 556 /(new)	Annexure A - Mandatory Spares List (Mechanical)		<u>To be added:</u> <u>9.0 Spares for Ozonisation Plant</u>	
				Suction/Discharge	Two (2) each

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		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				valve for Compressor	
				Seal Kits for pneumatic valves	Five (5)
				H.T. elements for H.E. of Ozone Electrode	Four Hundred (400)
				Dielectric tubes for H.E. of Ozone Electrode	Four Hundred (400)
				Viton Gaskets for Ozone Electrode	One (1) set
				Compressor Lub oil	Eighty (80) lit
				Air/oil filters for Compressor	One (1) each
				Rota meter for ozone gas	Two (2)
				Drive Motor	One (1)
41.	II, Sec-9/286 of 556 /23	Annexure A - Mandatory Spares List (Mechanical)		<u>To be added</u> <u>Spares for Instrument Air Compressor</u>	

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		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				<u>HP STAGES OF COMPRESSOR</u>	
				HP element	One (1) Set
				Packing Set	Four (4) Sets
				Axial thrust brg.	Two (2) Sets
				Labyrinth oil seal or radial seals or double acting seals for drive shafts	Four (4) Sets
				Bearing for male & female rotors (DE & NDE)	Two (2) each
				Timing Gears	One (1)
				Suction & discharge valves	Two (2) each
				<u>LP STAGES OF COMPRESSOR</u>	
				LP element	One (1) Set
				Graphitic ring shaft seals for compressor chamber or white metal	Four (4) Sets
				Packing Set	Four (4) Sets
				Axial thrust Bearing	Two (2) Sets
				Bearing for male &	Two (2)

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		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				female rotors (DE & NDE)	each
				Timing Gears	One (1)
				Suction & discharge valves	Two (2) each
				Main Bearing	Two (2) each
				Set up gear/pinion	One (1)
				Air intake filter element with gaskets	Eight (8)
				Oil filter element with gaskets & seals	Eight (8)
				Safety valve springs & gaskets	Four (4)
				One set of inbuilt automatic drain valve	Four (4)
				Gear case breather filter element	One (1)
				Drain valve kit	One (1)
				<u>COMPRESSORS COOLERS</u>	
				Gaskets & seals for inter cooler and	Four (4)

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		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				after cooler	
				Inter cooler drain check valve	One (1)
				<u>OIL PUMP/MOTOR</u>	
				Oil pump complete assembly	One (1)
				Pump impeller / rotor with shaft	One (1)
				Set of bearings	Two (2) Sets
				Oil pump motor bearing	Two (2)
				<u>SHAFT DRIVEN OIL PUMP</u>	
				Drive gear with shaft	One (1)
				Driven gear with shaft	One (1)
				Drain tap elements	Four (4)
Oil cooler gaskets and seals	Four (4)				

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		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				Seal Washer	Two (2)
				Mass flow Meter	One (1)
42.	II, Sec-9/287 of 556 /24	Annexure A - Mandatory Spares List (Mechanical)	----	<u>Spares for Transport Air Compressor</u>	
				<u>HP STAGES OF COMPRESSOR</u>	
				HP element	One (1) Set
				Packing Set	Four (4) Sets
				Axial thrust brg.	Two (2) Sets
				Labyrinth oil seal or radial seals or double acting seals for drive shafts	Four (4) Sets
				Bearing for male & female rotors (DE & NDE)	Two (2) each
				Timing Gears	One (1)
				Suction & discharge valves	Two (2) each
				<u>LP STAGES OF COMPRESSOR</u>	
				LP element	One (1) Set
				Graphitic ring shaft seals for compressor chamber or white metal	Four (4) Sets

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Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				Packing Set	Four (4) Sets
				Axial thrust Bearing	Two (2) Sets
				Bearing for male & female rotors (DE & NDE)	Two (2) each
				Timing Gears	One (1)
				Suction & discharge valves	Two (2) each
				Main Bearing	Two (2) each
				Set up gear/pinion	One (1)
				Air intake filter element with gaskets	Eight (8)
				Oil filter element with gaskets & seals	Eight (8)
				Safety valve springs & gaskets	Four (4)
				One set of inbuilt automatic drain valve	Four (4)
				Gear case breather filter element	One (1)
				Drain valve kit	One (1)

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Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				<u>COMPRESSORS COOLERS</u>	
				Gaskets & seals for inter cooler and after cooler	Four (4)
				Inter cooler drain check valve	One (1)
				<u>OIL PUMP/MOTOR</u>	
				Oil pump complete assembly	One (1)
				Pump impeller / rotor with shaft	One (1)
				Set of bearings	Two (2) Sets
				Oil pump motor bearing	Two (2)
				<u>SHAFT DRIVEN OIL PUMP</u>	
				Drive gear with shaft	One (1)
				Driven gear with shaft	One (1)
				Drain tap elements	Four (4)
				Moisture tap elements	Four (4)

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Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				Oil cooler gaskets and seals	Four (4)
				Seal Washer	Two (2)
				Mass flow Meter	One (1)
				Drive Motor	One (1)
43.	II, Sec-9/287 of 556	Annexure A - Mandatory Spares List (Mechanical)	----	<u>Mandatory spares for Air Drying Plant.</u>	
				Pre filter element (ceramic candle)	Two (2)
				After filter element (ceramic candle)	Two (2)
				Heater element (if required)	Two (2)
				Blower bearing (if required)	Two (2)
				Blower motor bearing (if required)	Two (2)
				Valve actuators	Two (2)
				Inlet & Outlet valve for Dryer	One (1) Set
				Automatic drain valves (No air loss	One (1) Set

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Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				type)	
				Expansion valves	One (1) Set
				Filter Dryer	One (1) Set
				Air cooler condenser fan	One (1) Set
				Items as applicable as per the C & I list	As per the C & I list
44.	II, Sec-9/ 291 of 555/ /36.2	Annexure A - Mandatory Spares List (Mechanical)	Pipe (ERW and Seamless above 65NB)	Pipe (ERW and Seamless below 65NB)	
45.	II, Sec-9/ 293 of 555/ /38.9	Annexure A - Mandatory Spares List (Mechanical)	Drive Motor - One(1)	Drive Motor - One (1) of each type.	
46.	II, Sec-9/323 of 555 /1.0	Annexure A - Mandatory Spares List (Mechanical)	Compressed Air System (Applicable for one IA Compressor and one SA Compressor)	Bidder to supply two sets of spares mentioned against Sr. no. 1.1.1 to 1.1.18, one each for IA Compressor and SA Compressor	
47.	II, Sec-9/340 of 555 /2.0	Annexure A - Mandatory Spares List (Mechanical)	DIESEL ENGINE (ONE SET MEANS ITEM REQUIRED FOR ONE DIESEL ENGINE)	DIESEL ENGINE (ONE SET MEANS ITEM REQUIRED FOR ONE DIESEL ENGINE OF EACH TYPE AND MAKE). Bidder to supply one set of these spares for diesel engines of each type and	

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				make.	
48.	II, Sec-9/341 of 555 /4.0	Annexure A - Mandatory Spares List (Mechanical)	Package Compressor Air	<u>Spares for Air Compressor</u>	
				<u>HP STAGE OF COMPRESSOR</u>	
				HP element	One (1) Set
				Packing Set	Four (4) Sets
				Axial thrust brg.	Two (2) Sets
				Labyrinth oil seal or radial seals or double acting seals for drive shafts	Four (4) Sets
				Bearing for male & female rotors (DE & NDE)	Two (2) each
				Timing Gears	One (1)
				Suction & discharge valves	Two (2) each
				<u>LP STAGE OF COMPRESSOR</u>	
				LP element	One (1) Set
				Graphitic ring shaft seals for compressor chamber or white metal	Four (4) Sets

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Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				Packing Set	Four (4) Sets
				Axial thrust Bearing	Two (2) Sets
				Bearing for male & female rotors (DE & NDE)	Two (2) each
				Timing Gears	One (1)
				Suction & discharge valves	Two (2) each
				Main Bearing	Two (2) each
				Set up gear/pinion	One (1)
				Air intake filter element with gaskets	Eight (8)
				Oil filter element with gaskets & seals	Eight (8)
				Safety valve springs & gaskets	Four (4)
				One set of inbuilt automatic drain valve	Four (4)
				Gear case breather filter element	One (1)

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Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				Drain valve kit	One (1)
				<u>COMPRESSORS COOLERS</u>	
				Gaskets & seals for inter cooler and after cooler	Four (4)
				Inter cooler drain check valve	One (1)
				<u>OIL PUMP/MOTOR</u>	
				Oil pump complete assembly	One (1)
				Pump impeller / rotor with shaft	One (1)
				Set of bearings	Two (2) Sets
				Oil pump motor bearing	Two (2)
				<u>SHAFT DRIVEN OIL PUMP</u>	
				Drive gear with shaft	One (1)
				Driven gear with shaft	One (1)
				Drain tap elements	Four (4)
				Moisture tap	Four (4)

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		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				elements	
				Oil cooler gaskets and seals	Four (4)
				Seal Washer	Two (2)
				Mass flow Meter	One (1)
	Note: In case the bidder choose to offer centrifugal compressors, necessary mandatory spares based on the bidders judgment shall be considered, listed and included in the offer. The list however shall be subject to Owner’s review and approval.				
49.	II, Sec-9/341 of 555 /10.0	Annexure A - Mandatory Spares List (Mechanical)	---	<u>To be added:</u> Basket Type Strainers: 20% of population of each type and size	
50.	II, Sec-9/349 of 555 /(new)	Annexure A - Mandatory Spares List (Mechanical)		<u>Note:</u> In case, Bidder desires to supply VVFD for EOT Crane, following mandatory spares for the same shall be supplied	
				• Thysrister	Twelve (12)
				• Ignition Transformer	Twelve (12)
				• Firing card	Four (4)
				• Control	Two (2)

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Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				Transformer • Auxiliary contactor	Two (2) each
51.	II, Sec-9/350 of 555 /2.0	Annexure A - Mandatory Spares List (Mechanical	ELECTRIC HOISTS	Note : In addition, other applicable spares for Hoist as mentioned elsewhere shall also be supplied	
52.	II, Sec-9/351 of 555 /3.2	Annexure A - Mandatory Spares List (Mechanical)		<u>Elevators for Boiler Area</u> To be added 3.2.22 Bushing (for door front) – Two (2) sets 3.2.23 Pinion - Two (2) sets of each type	
53.	II, Sec-9/357 of 555 /4.11.6	Annexure A - Mandatory Spares List (Mechanical)		Pl. supply following items also (a) Rope guide and rope tighter – One (1) of each type	
54.	II, Sec-9/ 347 of 555 /(new)	Annexure A - Mandatory Spares List (Mechanical)	----	<u>To be added</u> <u>Spares for Stack Elevator</u> <u>BRAKE</u>	

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Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				Brake Disc	One (1)
				Magnet Coil (SEW)	One (1)
				Pressure Plate (SEW)	One (1)
				<u>WORM GEAR</u>	
				O Ring (Type - I)	Two (2)
				O Ring (Type - II)	Two (2)
				Sealing Ring (Type - I)	Two (2)
				Sealing Ring (Type - II)	Two (2)
				Worm Wheel	One (1)
				<u>DOOR FRONT</u>	
				Bearing	Two (2)
				Bushing	Two (2)
				Roller	Two (2)
				<u>LIMIT CAMS</u>	
				Sensor	One (1)
				Switch	Two (2)
				Switch Arm	Two (2)
				<u>CAB</u>	

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Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				Guide Roller	Six (6)
				Switch	One (1)
				<u>SLIDING DOOR</u>	
				Roller (lower)	Five (5)
				Roller (upper)	Five (5)
				<u>MACHINERY</u>	
				Counter roller	Two (2)
				Groove Ring	Six (6)
				Pinion	One (1)
				Rubber Inserts (Spider Rotex)	One (1)
				<u>CABLE TROLLEY</u>	
				Ball Bearing	Two (2)
				Cable trolley Guide Roller	Four (4)
				<u>ELECTRICAL</u>	
				Motor for each type and rating	One (1)
				Auxiliary Transformer	One (1)
				Battery Charger	One (1)

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Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
				Contactor (Control)	One (1)
				Contactor (Power)	One (1)
				Emergency Stop Button	Two (2)
				Isolator Switch	One (1)
				Limit Switch Type - I	Two (2)
				Limit Switch Type - II	Two (2)
				Push Button with Element (R,Y,B)	Two (2)
				Rectifier	One (1)
				Relays (Over load)	One (1)
				Three Phase Switch	One (1)
				Timer	Two (2)
				Tone Frequency Receiver (TFR)	One (1)
				Tone Frequency Transmitter (TFT)	One (1)
55.	II, Sec-9/ 385 of 555/ /10.1	Battery	Battery Cell - 5 Nos.	Battery cell – Two (2) for each battery.	

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Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
56.	II ,Sec-9/ 385 of 555/ /10.2	Battery	Cell container of each type - 5 Nos.	Cell container of each type – Two (2) for each battery.	
57.	II ,Sec-9/ 385 of 555/ /10.3	Battery	Level Indicators- 2 Nos.	Level Indicators – One (1) for each battery.	
58.	II ,Sec-9/ 385 of 555/ /10.4	Battery	Vent Plugs- 5 Nos.	Vent Plugs - Two (2) for each battery.	
59.	II ,Sec-9/ 385 of 555/ /10.5	Battery	Intercell connector - 5 Nos.	Intercell connector - Two (2) for each battery.	
60.	II ,Sec-9/ 385 of 555/ /10.6	Battery	Set of nuts, bolts & washer - 5 Nos.	Set of nuts, bolts & washer - Two (2) for each battery.	
61.	II ,Sec-9/ 385 of 555/ /10.7	Battery	Teakwood cable clamps with hardware - 6 Nos.	Teakwood cable clamps with hardware – Three (3) for each battery	
62.	II ,Sec-9/ 386 of 555/	Battery Charger	Electronic cards of each type & rating (With all components	Electronic card of each type & rating (With all components mounted) - 1 set for each battery	

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Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
	/11.1.1		mounted)-1 set.	charger.	
63.	II ,Sec-9/ 386 of 555/ /11.1.3	Battery Charger	SCR for each type & rating-2 Nos.	SCR for each type & rating Two (2) for each battery charger.	
64.	II ,Sec-9/ 386 of 555/ /11.1.4	Battery Charger	Blocking diode of each type & rating-1 No.	Blocking diode of each type & rating – One (1) for each battery charger.	
65.	II ,Sec-9/ 386 of 555/ /11.1.5	Battery Charger	Potentiometer of each type & rating (Pulse Transformer) - 1 No.	Potentiometer of each type & rating (Pulse Transformer) - One (1) for each battery Charger.	
66.	II ,Sec-11/ 549 of 555/5.0 Sr No 1.0	List of Approved Vendors (Civil)		<u>Approved Vendors for FILL</u> <u>To be added</u> (g) M/s Hewitech GMBH & CO., Germany	
67.	II ,Sec-11/ 549 of	List of Approved Vendors	Aviation Warning Lights	Aviation Warning Lights	

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Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
	555/5.0 Sr No 11.0	(Civil)	(a) FLASH TECHNOLOGY (b) USA (c) AVAIDS TECHNOVATORS PVT LTD (d) GURGAON OR EQUIVALENT.	(a) FLASH TECHNOLOGY, USA (b) AVAIDS TECHNOVATORS PVT LTD, GURGAON	

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CORRIGENDUM TO BID SPECIFICATIONS

VOLUME-III A

STEAM GENERATOR AND AUXILIARIES

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Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
1.	III-A/67 of 223 /5.17.2	Mill reject system	Two mill reject ----- storage capacity.	Two mill reject ----- storage capacity. Radio frequency level transmitter shall be provided for each silo.	
2.	III-A/68 of 223 /5.17.6	Mill reject system	----	<u>To be added :</u> (p) Capacity : 125 % of Mill reject generated with worst coal at 100% BMCR condition	

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CORRIGENDUM TO BID SPECIFICATIONS

VOLUME-III C

COAL HANDLING SYSTEM

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Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
1.	III-C/10 of 245 /2.0	Coal Handling System	However, it is to be specifically noted --- -- industry practices.	However, it is to be specifically noted ----- industry practices subject to approval of Owner / Owner's Consultants	
2.	III-C/10 of 245 /2.1.1	Coal Handling System	Indigenous Coal of (-) 300 mm size and imported Coal of (-) 50 mm size shall be received at Bhusawal site by Box -N type wagons and -----side arm chargers.	Indigenous Coal of (-) 300 mm size and imported Coal of (-) 50 mm size shall be received at Bhusawal site by Box/Box -N type wagons and -----side arm chargers	
3.	III-C/10 of 245 /2.1.2	Coal Handling System	Coal from W.T. Hopper-1 & 2 shall be ----- in TP-1 through Apron Feeder fitted below respective W.T. Hopper.	Coal from W.T. Hopper-1 & 2 shall be ----- in TP-1 through Apron Feeder and Rack & Pinion gates fitted below respective W.T. Hopper.	
4.	III-C/10 of 245 /2.1.3	Coal Handling System	Conveyors 1A & 1B (1W+1S) shall convey coal to TP-2 and feed either to Conveyor 2A or 2B through chutes & flap gates.	Conveyors 1A & 1B (1W+1S) shall convey coal to TP-2 and feed either to Conveyor 2A or 2B through chutes and Rack & Pinion gates.	

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Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
5.	III-C/15 of 245 /3.1.14	Coal Handling System	-	<u>To be added:</u> One portable oil filtration machine to filter oil of two (2) microns and minimum Eight (8) lpm capacity shall be provided for conveyors .	
6.	III-C/16 of 245 /3.2	Coal Handling System	Belt Conveyor and Accessories: The following ----- --- push buttons in local control stations etc.	Belt Conveyor and Accessories: The following ----- push buttons in local control stations, EHT brakes for Horizontal Conveyors etc.	
7.	III-C/16 of 245 /3.2	Coal Handling System	Monorail beam with suitable approach ----- gravity take up tower	Monorail beam with suitable approach ----- gravity take up tower. Suitable foundation /anchoring arrangement for motorised winch shall be provided at each vertical gravity take up location.	
8.	III-C/17 of 245 /3.3.6	Coal Handling System	Crusher house building with one number operator's room of adequate size at crusher floor level.	Crusher house building with operators' room (of transparent Glass) of adequate size at crusher floor level.	
9.	III-C/17 of 245 /(new)	Coal Handling System		<u>To be added</u> 3.3.10 Facility of Toilet block, drinking water along with water cooler, UV Purifier and soundproof cabin for operator	

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Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
10.	III-C/18 of 245 /3.5.4	Coal Handling System	One (1) portable hydraulic press type -----supplied. The machine shall be suitable for vulcanising 2200 mm belt used in the plant and ----.i.e. belt feeder.	One (1) portable hydraulic press type ----- supplied. The machine shall be suitable for vulcanising 2000 mm belt used in the plant and ---- .i.e. belt feeder.	
11.	III-C/19 of 245 /3.9.7	Coal Handling System	Necessary Pay loader.	Necessary Pay loader (Minimum 4) of adequate capacity along with Two (2) sets of mandatory spares	
12.	III-C/22 of 245 / 4.13	Coal Handling System	Supply of all lubricants -----till successful completion of trial operation	Supply of all lubricants and consumables----- till successful completion of COD .	
13.	III-C/22 of 245 / 4.14	Coal Handling System	Supply of consumables and chemicals required - ---- up to successful completion of trial operation	Supply of consumables and chemicals required ----- upto successful completion of COD .	
14.	III-C/23 of 245/ 4.19	Coal Handling System	Any other services, although not specifically called for such a vital contract of the size and nature indicated in this specifications.	Any other services, although not specifically called for such a vital contract of the size and nature included in this specifications.	

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15.	III-C/25 of 245 / 5.1.7 (c)	Coal Handling System	All rollers of similar type of idlers shall be complete with heavy duty antifriction bearing,----- etc.	All rollers of similar type of idlers shall be complete with heavy duty antifriction Split case type bearing,-----etc.	
16.	III-C/28 of 245 / 5.1.9 (c)	Coal Handling System	All drive pulleys shall be lagged ----- ---neoprene rubber.	All drive pulleys shall be lagged -----neoprene rubber and all tail pulleys shall be lagged with 12 mm thick herring bone /diamond (shore hardness - 60) grooved neoprene rubber.	
17.	III-C/28 of 245 / 5.1.9	Coal Handling System		<u>To be added</u> (k) The clearance between pulley structure and wall shall be at least 1500 mm.	
18.	III-C/42 of 245 / 5.3.2 (a)	Coal Handling System	----- Walkways shall be chequered plate construction.--- -----	----- Walkways shall be constructed with chequered plate of 6 mm thick. -----	
19.	III-C/42 of 245 / (new)	Coal Handling System		<u>To be added</u> 5.3.1(f) Facility of Toilet block, drinking water along with water cooler, UV Purifier and soundproof cabin for operator	
20.	III-C/46 of 245 / (new)	Coal Handling System		<u>To be added</u> 5.4.14 Facility of Toilet block,	

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				drinking water along with water cooler, UV Purifier and soundproof cabin for operator	
21.	III-C/49 of 245 / 5.7	Coal Handling System	Side Arm charger The side arm charger ----- of materials. It shall be used for pushing/pulling a rake of fully loaded wagons and locating wagons one by one on tippler.	Side Arm charger The side arm charger ----- of materials. It shall be used for pushing/pulling a rake of 60 fully loaded wagons and locating wagons one by one on tippler.	
22.	III-C/56 of 245 / 5.9.8	Coal Handling System	The slewing movement ----- shall be around + 105 deg.	The slewing movement ----- shall be around +/- 105 deg.	
23.	III-C/69 of 245 / 5.20.1	Coal Handling System	Steel grating shall be provided over wagon tippler hopper, sump pits, - ---- and boiler bunkers. All the grating ----- civil construction.	Steel grating shall be provided over wagon tippler hopper, sump pits, ----- boiler bunkers . The grating over grizzly/reclaim hopper shall be designed for movement of three (3) pay loaders. All the grating -- ----- civil construction.	
24.	III-C/77 of 245 / 5.24.1.2	Coal Handling System	Service air required for ----- by providing 2x100% compressors. The bidder should	Service air required for ----- by providing 2x100% compressors. The bidder should include air receiver and oil separator ----- cleaned and dry air.	

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			include air drier , air receiver and oil separator ----- cleaned and dry air.		
25.	III-C/79 of 245 / 5.24.1.7	Coal Handling System	Plain Water Type Dust Suppression System : a) The crushed coal -----concrete pillar 5.0 m height	Plain Water Type Dust Suppression System : a) The crushed coal ----- concrete pillar 5.0 m height. The rate of Water sprinkling shall be 6.25 lit/hr/tonne of coal.	
26.	III-C/91 of 245 / 5.24.3.2 (c)	Coal Handling System	The CHP ----- windows. Roof extractor ----- ventilation. CHP Control building shall be provided with exhaust fans (Minimum 12 nos.) of adequate capacity for ventilation purpose.	The CHP -----windows. Roof extractor -----ventilation. CHP Control building shall be provided with exhaust fans with louvers (Minimum Twelve) of adequate capacity for ventilation purpose.	
27.	III C/95 of 245 /5.25.1	Coal Handling System	Stationery Auger sampler shall be ---- -- from BOX/BOXN wagons	Two (2) Stationery Auger samplers with 360 ⁰ movement shall ----- from BOX/BOXN wagons. Each sampler shall be suitable for collection of samples from wagons on both railway tracks (inhaul side of Wagon	

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				Tippler)	
28.	III-C/101 of 245 / 5.34	Coal Handling System	Annunciation	<u>To be added</u> Hydraulic motor driven conveyors.	
29.	III-C/107 of 245 / 7.4	Coal Handling System	After the trial is carried out ----- signed between Chief General Manager (Gen. O&M) Mahagenco, Bhusawal TPS, General Manager (gen. Proj.) Bhusawal Project ---- -- and the Contractor.	After the trial is carried out ----- signed between Chief Engineer , (O&M), MAHAGENCO, Bhusawal TPS, Chief Engineer (Proj.), Bhusawal Project ----- and the Contractor.	
30.	III-C/108 of 245 / 8.1.2	Coal Handling System		<u>To be added</u> (c) Flow Path 3: From Coal Stock Pile to Bunkers for both Indigenous and Imported coal.	
31.	III-C/109 of 245 / 8.1.9	Coal Handling System	Bidder shall guarantee the performance requirement of all coal handling paths for designed capacity of 1500	Bidder shall guarantee the performance requirement of all coal handling paths for specified capacity of 1500 TPH for each ---- --- as applicable	

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			TPH for each ----- as applicable.		
32.	III-C/117 of 245 / Note: (5)	Coal Handling System	Breaker ply shall be provided for belt handling ROM coal.	Breaker ply shall be provided for belt handling ROM coal and all belt feeders.	
33.	III-C/117 of 245 / Note: (6)	Coal Handling System	Power requirement and belt tensions shall be calculated for design capacity on the basis -----to Owner's approval.	Power requirement and belt tensions shall be calculated for rated capacity on the basis ----- to Owner's approval	
34.	III-C/120 of 245 / 16	Coal Handling System	Type of bearing Anti-friction double –row spherical roller (Refer note 6.0)	Type of bearing Split case bearings.	
35.	III-C/121 of 245 / Note. 6	Coal Handling System	All underground conveyors pulleys shall have Split case bearings.	All conveyors pulleys shall have split case bearings.	
36.	III-C/129 of 245 / 8.4	Coal Handling System	Type of Bearing : Antifriction Ball/Roller	Type of Bearing : Split case	
37.	III-C/133 of 245 / 1.5	Coal Handling System	Belt Width - 1800 mm/2000 mm	Belt Width – as applicable	

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38.	III-C/133 of 245 / 1.6	Coal Handling System	Maximum Moisture Content - 15 %	Maximum Moisture Content - 20 %	
39.	III-C/133 of 245 / 2.1	Coal Handling System	Material Crushed coal – Electric /Sail hard	Material Crushed coal – Tiscral /Sail hard	
40.	III-C/137 of 245 / 1.10	Coal Handling System	Moisture content: 15 % (Max.)	Moisture content: 20 % (Max.)	
41.	III-C/141 of 245 / 1.3	Coal Handling System	Belt Width and speed - 1800 mm; 3.0 m/sec	Belt Width and speed – as applicable; 3.0 m/sec	
42.	III-C/142 of 245 / 2.5	Coal Handling System	Quantity of separator: Two(2) for each stream	Quantity of separator: Two (2) for each stream + One (1) on Conveyor 7	
43.	III-C/145 of 245 / 1.2	Coal Handling System	Material handled : Coal	Material handled : Uncrushed / crushed Coal	
44.	III-C/145 of 245 / 1.3	Coal Handling System	Lump size : 20 mm	Lump size : 300 mm (Indicative)	
45.	III-C/149 of 245 / 2.5	Coal Handling System	Bearing Antifriction ball/roller	Bearing Split case type	
46.	III-C/150 of 245 / 4.3	Coal Handling System	Plate thickness : 10 mm	Plate thickness : 16 mm	

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Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
47.	III-C/150 of 245 / 4.4	Coal Handling System	Liner required : Yes , as per data sheet	Liner required : No	
48.	III-C/150 of 245 / 4.5	Coal Handling System	Liner material : As per data sheet	Liner material: Not required.	
49.	III-C/151 of 245 / 1.6	Coal Handling System	Belt Width – 1800 mm	Belt Width – 1200 mm	
50.	III-C/151 of 245 / 1.7	Coal Handling System	Capacity: 1200 TPH	Capacity: 1500 TPH	
51.	III-C/151 of 245 / 2.5	Coal Handling System	Bearing Antifriction ball/roller	Bearing Split case type	
52.	III-C/152 of 245 / 4.4	Coal Handling System	Plate thickness : 10 mm	Plate thickness : 16 mm	
53.	III-C/152 of 245 / 4.5	Coal Handling System	Liner required : Yes , as per data sheet	Liner required : No	
54.	III-C/152 of 245 / 4.6	Coal Handling System	Liner material : As per data sheet	Liner material: Not required.	
55.	III-C/161 of 245 / 9.0	Coal Handling System	Hoist speed: 4 m/min (min)	Hoist speed: 3 m/min	

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Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as			
56.	III-C/161 of 245 / 10.0	Coal Handling System	Carriage Travel speed: 10m/min (min)	Carriage Travel speed: 15 m/min (min)			
57.	III-C/166 of 245 /	Coal Handling System	Note: ** Electric or Manual to be decided based on capacity (All hoist above 3T shall be electrically operated).	Note: ** Electric or Manual to be decided based on capacity (All hoist above 2T shall be electrically operated).			
58.	III-C/173 of 245 / 8	Coal Handling System	Material Temperature : 50° C Max. and 5° C Min.	Deleted			
59.	III-C/175 of 245 / 1.5	Coal Handling System	Material Temperature : 50° C Max. and 5° C Min.	Deleted			
60.	III-C/181 of 245 / 4.5.1	Coal Handling System	Belt Width – 1800 mm	Belt Width – 1200 mm			
61.	III-C/189 of 245 / (new)	Coal Handling System	Sump Pump Schedule Datasheet A	<u>To be added:</u>			
				Sr No	Location	Capacity (m³/hr)	Quantity
				4	Grizzly Hopper area	30	2 (1W + 1S)

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Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
62.	III-C/192 of 245/ (new)	Coal Handling System		<u>To be added:</u> Note 6 – Rail stop shall be provided on inhaul and outhaul sides of Wagon Tippler	
63.	III-C/198 of 245 /	Coal Handling System	Total dry film thickness of primer & finish paint shall not be less than 20 microns or 500 microns.	<u>Note:</u> Total dry film thickness of primer & finish paint shall not be less than 500 microns	
64.	III-C/203 of 245/9.0	Coal Handling System	Belt width : 1800 mm	Belt width : 1200 mm	
65.	III-C/207 of 245/8.0	Coal Handling System	Material Temperature : 50° C Max. and 5° C Min.	Deleted	
66.	III-C/211 of 245/1.0	Coal Handling System	DE-1 & DE-2 : Function/ Location: Crusher House. To extract dust from discharge pulley of Conv. 2A/B, Feed point WF and crusher, feed & Discharge point of RBF-1,2,3,4,5 &6 and feed & discharge point of conv. 7	DE-1 & DE-2 : Function/ Location: Crusher House. To extract dust from discharge pulley of Conv. 2A/B, Feed point WF and crusher, feed & Discharge point of RBF-1,2,3,4 belt feeder and feed & discharge point of conveyor 7	

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Sr. No.	Vol. No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
67.	III-C/218 of 245/5.0	Coal Handling System	VE -2	VE-2, VE-3	
68.	III-C/219 of 245/6.0	Coal Handling System	VE-5	VE-4, VE-5	
69.	III-C/223 of 245/3.0	Coal Handling System	MOC & Thickness of Main Plate MS & 8 mm thickness.	MOC & Thickness of Main Plate Tiscral /Sail Hard, 16 mm thick.	
70.	III-C/223 of 245/4.0	Coal Handling System	MOC & Thickness of liner Liner shall be Tiscral /Sail Hard, 3mm thick	MOC & Thickness of liner : Not required.	

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CORRIGENDUM TO BID SPECIFICATIONS

VOLUME-III D

ASH HANDLING SYSTEM

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		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page no./ Cl. No.	Equipment	Existing Particulars	To be read as	
1.	III-D/12 of 175/3.3.1	Ash Handling System	Fly ash is ----- rail wagons). Ash in pressure ----- with the aid of Four (4) (2W+2S) screw type / Centrifugal type conveying compressors. For conveying ash from HCSD silos to remote silo, One(1) compressor shall be provided..	Fly ash is ----- rail wagons). Ash in pressure ----- with the aid of Two (2) (1W+1S) screw type/Centrifugal type conveying compressors For conveying ash from HCSD silos to remote silo, Two (2) (1W+1S) compressor shall be provided.	
2.	III-D/ 18 of 175 / 3.5.4	Ash Handling System	For tendering purpose, Bidder shall consider estimated slurry discharge pipe length from pump end to farthest disposal point as 12 Km considering piping required around dyke for distribution of the slurry.	For tendering purpose, Bidder shall consider estimated slurry discharge pipe length from pump end to farthest disposal point as 12 km considering piping required for garlanding around dyke with offshoots for uniform distribution of the slurry. Bidder shall supply the discharge pipe length of 12 km (minimum). In case the disposal pipe length is more than 12 km, then the same shall be arranged by the bidder within contract price.	

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		CORRIGENDUM - I			
Sr. No.	Vol. No./ Page no./ Cl. No.	Equipment	Existing Particulars	To be read as	
3.	III-D/26 of 175/ (f)	Ash Handling System	Total Five (5) [Two working and two stand by] oil free non lubricated water cooled type screw compressors for pneumatic ash conveying. Two compressor shall be dedicated for transfer of ESP ash to HCSD silo and one for transport of ash from HCSD silo to remote silo	Total Four (4) [Two working and two stand by] oil free non lubricated water cooled type screw type/centrifugal type compressors for pneumatic ash conveying. One compressor shall be dedicated for transfer of ESP ash to HCSD silo and one for transport of ash from HCSD silo to remote silo	
4.	III-D/ 30 of 175 / 4.4.3	Ash Handling System	There shall be Two (2) ----- considered at El 281 M. The pipe line at rail/road crossing shall be on pipe rack keeping minimum height of 6.5M or culvert as required shall be provided.	There shall be Two (2) ---- -- considered at El 281 M. The pipe line at rail/road crossing shall be on pipe rack keeping clear head room of 8.5 M (minimum) or culvert as required shall be provided.	
5.	III-D/ 33 of 175 / 4.19	Ash Handling System	All the cross country ash pipelines including bottom ash slurry lines as well as HCSD pipelines up to ash disposal area which is about 12 Km shall be in the scope of the bidder.	All the cross country ash pipelines including bottom ash slurry lines as well as HCSD pipelines up to ash disposal area which is about 12 Km shall be in the scope of the bidder and bidder shall supply the discharge pipe length of 12 Km (Minimum) . In case the	

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Sr. No.	Vol. No./ Page no./ Cl. No.	Equipment	Existing Particulars	To be read as	
				disposal pipe length is more than 12 Km , then the same shall be arranged by the bidder within contract price.	
6.	III-D/ 44 of 175 /5.3.5	Ash Handling System	Lift of Hoists and cranes ----erection and maintenance, but the capacity of the crane for handling HCSD pumps shall be kept 105% of the total weight of the pump assembly.	Lift of Hoists and cranes -----erection and maintenance, but the capacity of the crane for handling HCSD pumps shall be Min. 25T or 125% of the total weight of the equipment to be handled whichever is more.	
7.	III-D/75 of 175/ 8.1.5	Ash Handling System	-----	(After 3 rd Paragraph, please add) – On receiving permission from (HCSD) silo area HCSD control panel, HCSD can be controlled from AHP MCP.	
8.	III-D/77 of 175/ (i)	Ash Handling System	(i) Operation of Bottom Ash (ii) Operation of Coarse Ash and APH hopper ash (iii) Operation of Fly Ash pressurised conveying ----- remote Dry Fly Ash silo.	(i) Operation of Bottom Ash (ii) Operation of Coarse Ash and APH hopper ash (iii) Operation of Stack Ash (iv) Operation of Fly Ash pressurised conveying --- remote Dry Fly Ash silo.	

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Sr. No.	Vol. No./ Page no./ Cl. No.	Equipment	Existing Particulars	To be read as	
9.	III-D/77 of 175/ (v) of Cl. (i)	Ash Handling System	(i) Operation of sludge pumping series and number of pumps operating.	Shall be deleted	
10.	III-D/138 of 175/ 10.1.2	Ash Handling System	Number – Five (5) (3W+2S) 2no's working for ESP to HSSD silo, 1 no working for HCSD silo to remove silo.	Number – Four (4) (2W+2S). One (1) is working for ESP to HSSD silo, One (1) is working for HCSD silo to remote silo. One (1) each standby for ESP to HSSD silo and HCSD silo to remote silo. Capacity and pressure shall be as per requirement	
11.	III-D/140 of 175/ 10.2.1	Ash Handling System	Type Centrifugal Compressor	Centrifugal Compressor (Oil Free Non Lubricated)	
12.	III-D/140 of 175/ 10.2.7	Ash Handling System	Motor rating : By Bidder	By Bidder as per specification	
13.	III-D/141 of 175/ 10.2.10	Ash Handling System	Quantity: -	Four (4) (2W+2S) One working for ESP to HCSD silo, One working for HCSD silo to remote silo	

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14. Volume III D, page 129 of 175 – Datasheets for Ash Handling Systems shall be appended as under:

Sr No 30, page 170 - Minimum Rating for various equipments in Ash Handling System:

The minimum ratings to be offered for various equipments/pumps which are not covered in the specification is covered in this amendment. Final selection of various equipment rating shall be substantiated by the contractor by detail design calculations. The same shall be subjected to the owner's approval. In case design calculation indicates requirement of higher rating, the same shall be provided by the contractor without any financial implication to the owner.

(a) HP Ash Water Pump

- (i) Numbers : Two (2) (1W+1S)
- (ii) Capacity : 800 m³/hr
- (iii) Head : 120 Mwc
- (iv) Type : Horizontal centrifugal

(b) B.A.LP Ash Water Pump

- (i) Numbers : Two (2) (1W+1S)
- (ii) Capacity : 300 m³/hr
- (iii) Head : 30 mWC
- (iv) Type : Horizontal centrifugal

(c) Refractory Cooling Water Pump

- (i) Numbers : Two (2) (1W+1S)
- (ii) Capacity : 500 m³/hr
- (iii) Head : 30 mWC
- (iv) Type : Horizontal centrifugal

(d) LP Ash Water Pump (for HCSS)

- (i) Numbers : Two (2) (1W+1S)
- (ii) Capacity : 350 m³/hr
- (iii) Head : 25mWC
- (iv) Type : Horizontal centrifugal

(e) LP Seal Water Pump

- (i) Numbers : Two (2) (1W+1S)
- (ii) Capacity : 25 m³/hr
- (iii) Head : 125mWC
- (iv) Type : Horizontal centrifugal multistage

(f) HP Seal Water Pump

- (i) Numbers : Two (2) (1W+1S)
- (ii) Capacity : 25 m³/hr
- (iii) Head : 250 mWC

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(iv) Type : Horizontal centrifugal multistage

(g) Bottom Ash Overflow Transfer Pump

(i) Numbers : Two (2) (1W+1S)

(ii) Capacity : 500 m3/hr

(iii) Head : 25 mWC

(iv) Type : Horizontal centrifugal

(h) Sump Drainage Pump (for AHS Pump house area)

(i) Numbers : Two (2) (1W+1S)

(ii) Capacity : 50 m3/hr

(iii) Head : 15 mWC

(iv) Type : Vertical centrifugal

(i) Sump Pump (near remote dry fly ash silo area)

(i) Numbers : Two (2) (1W+1S) vertical drain pumps and One (1) ejector type jet pump

(ii) Capacity : 50 m3/hr for vertical drain pumps (minimum)

(iii) Head : 25mWC for vertical drain pumps (minimum)

(j) Sump Pump (near HCSS silo area)

(i) Numbers : Two (2) (1W+1S) vertical drain pumps and One (1) ejector type jet pump

(ii) Capacity : 50 m3/hr for vertical drain pumps (minimum)

(iii) Head : 25mWC for vertical drain pumps (minimum)

(k) Fly Ash Unloader Conditioning Pump

- (i) Numbers : Two (2) (1W+1S)
- (ii) Capacity : 70 m³/hr
- (iii) Head : 50 mWC
- (iv) Type : Horizontal centrifugal

(l) Emergency flushing Pump for HSCC

- (i) Numbers : Two (2) (1W+1S)
- (ii) Capacity : (bidder to decide) m³/hr
- (iii) Head : to suit maximum pressure requirement for HCSS
- (iv) Type : Triplex Reciprocating type High Pressure pump

(m) As per Tender specification (Volume III D, 154/175, Sr No 17.5), the minimum capacity of Ash Slurry pump is indicated as 1115 m³/hr which shall be corrected as 1215 m³/hr. The capacity considered is for maximum ash slurry concentration of 20%. However if the bidder agrees to provide Ash slurry pump suitable for handling upto 25% slurry concentration, the minimum capacity of ash slurry pump shall be 950 m³/hr.

(n) Minimum crane capacities (for pump houses/buildings in Ash Handling System)

- (i) HCSD Pump House : Minimum 25 T main hoist EOT crane or equal to 1.25 times the maximum weight to be handled, whichever maximum.

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(ii) Ash Slurry pump house : 7.5 T single girder EOT crane (iii) Ash compressor house : 7.5 T single girder EOT crane (iv) Ash water Pump house : 6.0 T single girder EOT crane (v) Remote silo utility building : 3.5 T under slung crane (vi) HCSC Silo utility building : 3.5 T under slung crane (o) Ash water pump : (i) Capacity : 1000 m3/ hr (ii) Head : bidder to estimate.			

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VOLUME III E1

WATER TREATMENT SYSTEMS

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		CORRIGENDUM - I			
Sr. No.	Vol.No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
1.	III-E1/ 94 of 313/ Sr No 1.2.19	Water Treatment Systems	Voltage, Phase & Frequency (± % Variation) : 415 V (+10%), 3 Phase, 50 HZ	Voltage, Phase & Frequency (± % Variation) : Please refer Volume II or Volume IV A.	
2.	III-E1/ 227of 313 / 3.1.1 (a) (i)	Water Treatment Systems	Maximum permissible Noise level for Air Compressors and Blowers : 95 dB (A)	Maximum permissible Noise level for Air Compressors and Blowers : 85 dB (A)	
3.	III-E1/ 246 of 313/ 7.1.11	Water Treatment Systems	The tubes/plates shall be inclined by 50 – 600 Angle to the horizontal.	The tubes/plates shall be inclined by 60 ⁰ to the horizontal.	
Note : The item at Sr No 1 above is applicable to all motors mentioned in this Volume III E1					

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VOLUME III E2

MAIN & AUXILIARY COOLING WATER SYSTEM

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		CORRIGENDUM - I			
Sr. No.	Vol.No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
1	III-E2, Sec-1/16 of 113/3.1.8	Main & Auxiliary Cooling Water System	The velocity of water in CW and ACW system shall not exceed 3.0 and 2.5 m/sec respectively.	The velocity of water in CW and ACW system shall not exceed 2.5 m/sec.	

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VOLUME III F

PIPING SPECIALTIES & THERMAL INSULATION

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Sr. No.	Vol.No./ Page No./ Cl. No.	Equipment	Existing Particulars	To be read as	
1.	III-F, Sec-3/101 of 158/5.1.1(b)	Piping Specialties & Thermal insulation	Condenser CW discharge : 3.0 m/s	Condenser CW discharge : 2.5 m/s	

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VOLUME III H

FIRE PROTECTION AND DETECTION SYSTEM

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		CORRIGENDUM - I		
Sr. No.	Vol.No./ Page No./ Cl. No.	Existing Particulars	To be read as	
1.	III-H/ 9 of 123 / 3.1	Hydrant System	To be added: s) Stores	
2.	III-H/ 29 of 123 / 5.1.21	One (1) Solar Blind Infra detector with inbuilt air purging unit for conveyor	Three (3) Solar Blind Infra detector with inbuilt air purging unit for each conveyor	
3.	III-H/ 32 of 123 / (new)		To be added: 5.1.32 Transformers of 220 KVA and above shall be provided with Nitrogen Injection based Fire Protection System in addition to HVW Spray system.	
4.	III-H/ 89 of 123 / 6.0	Drive: Electric motor & V-Belt drive	Drive: Electric motor	
5.	III-H/ 98 of 123 / (D) 3.0	Flow: 2500-2700 liter/min at 7 Kg/cm ²	Flow: 2700 litre/min at 7 Kg/cm ²	
6.	III-H/ 98 of 123 / (D) 5.0	Throw of monitors a) Horizontal = 25-30 M b) Vertical = 25-30 M	Throw of monitors a) Horizontal = 30 M b) Vertical = 30 M	

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VOLUME III I

MATERIAL HANDLING AND MISCELLANEOUS

EQUIPMENTS (STORAGE TANKS)

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		CORRIGENDUM - I		
Sr. No.	Vol No./ Page No./ Cl. No.	Existing Particulars	To be read as	
1.	III-I/19 of 328/4.1.1	4.1.1 The safe working load (Y) for E.O.T. cranes shall be computed as $Y = 1.25 a$ Where a = Weight of single heaviest equipment expected to be handled. (Excluding ----- of 130 Tonnes for EOT crane at TG Hall)	4.1.1 The safe working load (Y) for E.O.T. cranes shall be computed as $Y = 1.25 a$ Where a = Weight of single heaviest equipment expected to be handled.	
2.	III-I/26 of 328/5.5.3	Every platform shall be provided with steel chequered plate top and be secured fenced with one to two meters high double tier hand rails of 32 mm diameter GI pipe and toe boards.	Every platform shall be provided with steel chequered plate of 8 mm thick top and be securely fenced with 1.2 meters high double tier hand rails of 32 mm diameter GI pipe and toe guards . Vertical posts shall not be spaced more than 1.5 m.	
3.	III-I/48 of 328/3.1(a)	Duty Class : Mechanism class: Class 2 as per IS- 3177 and IS-807	Duty Class : Mechanism class: M:5 as per IS- 3177 and IS-807	
4.	III-I/48 of 328/3.1(b)	Duty Class : Electrical Service Class : Class 4 as per IS- 3177	Duty Class : Electrical Service Class : M:8 as per IS- 3177	
5.	III-I/48 of 328/3.2	Operation : Cabin with Pendant Station or Radio Remote Control for Crane at Sr. No.1 in	Operation : Cabin with Pendant Station and Radio Remote Control for Crane at Sr. No.1 in Annexure-I,	

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Sr. No.	Vol No./ Page No./ Cl. No.	Existing Particulars	To be read as	
		Annexure-I, Pendant station for cranes at sr. No. 2 to 13 in Annexure-I.	Pendant station for cranes at Sr. No. 1 to 13 in Annexure-I.	
6.	III-I/99 of 328/4.1.1	Capacity of each hoist shall be 1.2 times the maximum working load.	Capacity of each hoist shall be 1.25 times the maximum working load.	
7.	III-I/99 of 328/4.1.2	Hoists of capacity up to 3 tonnes shall be manual hoists.	Hoists of capacity up to 2 tonnes and height not exceeding 5.0 m shall be manual hoists.	
8.	III-I/99 of 328/4.1.3	Hoists of capacity equal & above 3 tonnes shall be electric hoists.	Hoists of capacity up to 2 tonnes and height not exceeding 5.0 m shall be manual hoists.	
9.	III-I/201 of 328/3.1.1	Two (2) Potable Water tanks shall be installed on the roof of deaerator floor.	One (1) Potable Water tank shall be installed on the deaerator floor.	
10.	III-I/201 of 328/3.1.2	Two (2) Service Water tanks shall be installed on the roof of deaerator floor.	One (1) Service Water tank shall be installed on the deaerator floor.	
11.	III-I/211 of 328/ Annexure I, Sr No 4	Service Water Tank – Capacity – 75 m ³ , Numbers - 2	Service Water Tank with partition of 75 m ³ each. Total Capacity – 150 m ³ , Number - 1	
12.	III-I/211 of 328/ Annexure I, Sr No 5	Potable Water Tank – Capacity – 25 m ³ , Numbers - 2	Potable Water Tank – Capacity – 50 m ³ , Number - 1	
13.	III-I/308 of 328	Annexure-I List of Recommended	Annexure-I List of Mandatory Spares High	

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Sr. No.	Vol No./ Page No./ Cl. No.	Existing Particulars	To be read as	
		Spares for Two years of operation of High Volume Sampler.	Volume Sampler.	
14.	III-I/309 of 328	Annexure-I List of Recommended Operational Spares for Stack Monitoring Kit	Annexure-I List of Mandatory Spares for Stack Monitoring Kit	

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VOLUME - V

CONTROL & INSTRUMENTATION

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Sr. No.	Vol. No./ Page No./ Cl. No.	Existing Particulars	To be read as	
1.	V/22 of 718 / 4.3	Suggestive control system Architecture for the DCS is schematically shown in Drawing No. PE-189-IN-Sk-8001/ P0 .	Suggestive control system Architecture for the DCS is schematically shown in Drawing No. PE-189-IN-Sk-8001/ P1 .	
2.	V/37 of 718 / 5.1	The offered model of DCS, Microprocessor based control system must have been successfully supplied, erected, tested and commissioned as complete station Control & Instrumentation system for at least two units of capacity not less than 600 MW supercritical Thermal Power Station(s) with reheat type pulverized coal fired boiler. Further, these units should be in successful operation for a minimum period of two (2) years	The offered model of DCS must have been successfully supplied, erected, tested and commissioned as complete station Control & Instrumentation system for at least one unit of capacity not less than 500 MW Thermal Power Station(s) with reheat type pulverized coal fired boiler which is in successful operation for a minimum period of one year as on date of opening of Bids.	
3.	V/72 of 718/ 1.3.10	Proposed DCS control system architecture is illustrated in drawing no. PE-189-IN-Sk-8001/ P0 .	Proposed DCS control system architecture is illustrated in drawing no. PE-189-IN-Sk-8001/ P1 .	
4.	V/80 of 718/ 1.5.3/(ii)	CCTV scheme drawing ,specification & datasheet : Schm. & Speac.-A, Datasheet-I	CCTV scheme drawing, specification & datasheet : Schm. & Speac.-A, Datasheet-A	

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Sr. No.	Vol. No./ Page No./ Cl. No.	Existing Particulars	To be read as	
5.	V/80 of 718/ 1.5.3/(jj)	Telephone system scheme drawing, specification & datasheet : Schm. & Spec.-A, Datasheet-I	Telephone system scheme drawing, specification & datasheet : Schm. & Spec.-A, Datasheet-A	
6.	V/81 of 718/ 1.5.3/(pp)	UPS & 24 V DC battery & battery charger scheme drawing, specification & datasheet : Schm. & Spec.-A, Datasheet-I	UPS & 24 V DC battery & battery charger scheme drawing, specification & datasheet : Schm. & Spec.-A, Datasheet-A	
7.	V/403 of 718/ 7.3.7/(c)/(i)	Key Board (i) Type : Flat spill proof membrane type or positive depression type	Key Board (i) Type: Flat spill proof membrane type.	
8.	V/480 of 718/ 6.1/(h)/(ii)	(ii) Type of battery for emergency supply : 24V/Ah, Plant A type	(ii) Type of battery for emergency supply : 24V /Ah, Plante type with 12 Hr. back-up	
9.	V/480 of 718 / 6.2/(a)	<u>MAIN DISTRIBUTION FRAME(MDF)</u> (a) Make & Type : To be decided by the Bidder	<u>MAIN DISTRIBUTION FRAME(MDF)</u> (a) Make & Type: from approved vendor list.	
10.	V/481 of 718/ 6.3/(a)	(a) Make & Type : To be decided by the Bidder	(a) Make & Type: from approved vendor list.	
11.	V/481 of 718/ /6.4/(a)	(a) Make & Type : To be decided by the	(a) Make & Type: from approved vendor list.	

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Sr. No.	Vol. No./ Page No./ Cl. No.	Existing Particulars	To be read as	
		Bidder		
12.	V/486 of 718/ /7.5.1	Heavy duty, flush mounting, indoor type, 2 pin sockets shall be furnished in Control Equipment Rooms ANNEXURE-D through matching plugs.	Heavy duty, flush mounting, indoor type, 2 pin sockets shall be furnished in Control Equipment Rooms, Unit Control Rooms & other areas / control rooms & various rooms of Technical Office Building as indicated in ANNEXURE-A to this section. Concealed type conduit wiring for each telephone set for above areas/ rooms shall be terminated to the 2 pin socket to which the respective telephone set shall be connected through matching plugs.	
13.	V/486 of 718/ /7.5.2	Heavy duty, wall/ column mounted, ... ANNEXURE-D to this section.	Heavy duty, wall/column mounted, outdoor weatherproof type 2 pin sockets, metal clad, gasketted construction, screwed metal cover tied to it by a metal chain, 20mm conduit entry, suitable for both indoor & outdoor installation shall be furnished in areas as indicated in ANNEXURE-A to this section.	
14.	V/492 of 718/ /8.11.9	Distribution of communication system in Unit Control Rooms, ... ANNEXURE-D	Distribution of communication system in Unit Control Rooms, Control Equipment Rooms, DAS Rooms, Shift Charge Engineer	

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Sr. No.	Vol. No./ Page No./ Cl. No.	Existing Particulars	To be read as	
		shall be connected with matching plugs.	Rooms, SWAS Rooms, ESP Control Rooms, other areas /Control Rooms and various rooms of Technical Office Building, all as indicated in ANNEXURE-A to this section shall be through concealed cabling which may be effected by running telephone cables through PVC pipes concealed in the walls. The telephone cabling & wiring in each such rooms & areas shall be terminated to two pin sockets, to which respective telephone sets shall be connected with matching plugs.	
Additionally bidder shall consider the following as clause no. 13 in Section-5, Volume V (page 440/718). <u>SPECIAL REQUIREMENTS OF INSTRUMENTATION BASED ON ENERGY AUDIT PROGRAMME</u> 13.1 <u>INTRODUCTION</u> Measurement of important parameters which affect the input costs like coal, oil, water need to be measured and not estimated. Both receipt and consumption need to be separately monitored and reconciled through computerized system. There must not be human intervention in the measurement and recording systems of coal, fuel oil and water resources which affect the station input costs. Supply chain optimization of raw material inputs through modernization of technology needs to be taken up. Transit loss, specific fuel consumption and GCV are interlined and realistic quantification of these will only be possible if a fuel monitoring system is in place.				

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The system should aim at procurement of digital instrumentation which can be seamlessly integrated into a DDCMIS. Intelligent Electronic Devices (IEDs) must be the preferred Instrumentation Systems. Information and communication system needs to be got audited for obtaining a holistic picture of its structure and efficiency.

13.2 COAL

13.2.1 Station Coal Measurement (Coal Receipt Measurement)

Fully automated pitless in motion weigh bridges with digital interface and provision for data communication to control room shall be envisaged. These must act as Intelligent Electronic Devices (IEDs) and seamlessly communicate with the overall plant automation. Besides, fully automatic rail signature at the receiving end shall have provision for acting as IEDs to communicate with the plant automation.

13.2.2 Unit Coal Measurement (Coal Consumption Measurement)

- (a) The coal entry into the boilers shall be measured. The various technologies for coal measurement are given in clause no. 13.6 of this section.
- (b) An online process (without any human intervention) which would give the online coal consumption with uncertainties of $\pm 1.0\%$ shall be envisaged and the technology for the same must be well proven and established. The conventional stacking method can be used for reconciliation of data/cross verification only and not for coal consumption measurement.
- (c) The stacking inventory procedure shall not be used for measurement of coal for declaring the station heat rate. Instead the use of fully automated, tamper-proof modern instrumentation without human intervention for on-line coal inflow and consumption shall be envisaged.
- (d) The difference in belt weighers/gravimetric feeders and receiving end coal measurements must not exceed more than 0.06 kg/kWh

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(0.03 kg/kWh for increase in moisture from tripling to bunkering, stones weights and 0.03 kg/kWh for handling loss). (e) Based on an assessment of the different technologies the following are recommended: (i) Installation of Belt Weighers for all coal conveyors. The offered system shall monitor the time elapsed by a belt over a given bunker and which involves integration of the output of the Belt Weighers over the total bunkers of the unit in a given period of time. The bidder must come out with a viable and innovative scheme for monitoring the bunker wise coal from the belt weigher data. (ii) Microwave or Ultrasonic Bunker Level Monitoring System with digital data output, communication of data to system server or control room is required. (iii) Coal flow for the plant shall be monitored by gravimetric feeders which provide accurate and authentic coal flow measurements, in addition to belt weighers. The differences in the two are to be within 0.5%. The data from the belt weighers and the gravimetric feeder can be cross verified, calibrated and reconciled. Necessary signal exchange shall be considered by the bidder. (iv) Necessary software shall be included in the offer for online coal energy management in the plant. The software shall take input data from the various field instruments for coal receipt from various sources and coal consumption at various bunkers. (v) Computation of unit coal consumption. This is purely from the reading of the belt weigher and bunker monitoring system. This coal consumption is to be used for computation of unit and station heat rate for normal and cycling operations. In all the above instruments, the following must be considered:		

- (i) The instruments must function as Intelligent Electronic Devices (IEDs) by digitally communicating with DDCMIS/ control room through down loading of data continuously.
- (ii) The instruments must have provisions for communication of digital data.
- (iii) The instruments and the digital conversion systems must have a very high reliability in terms of SAIFI (System Average Interruption Duration Index) of 0.5 interruptions per year and SAIDI (System Average Interruption Frequency Index) of 4 hours per year.

By this process the coal consumption will depend on the unit performance and not vice-versa.

13.3 FUEL OIL (Receipt and Consumption Monitoring)

13.3.1 Oil Receipt Measurement

The following are to be considered:

- (a) Pitless in-motion weighbridge shall be envisaged for measurement of oil in tankers.
- (b) Fully automatic ultrasonic level indicators with provision for conversion of signals into digital signals and communication through a media to DDCMIS shall be installed for all oil tanks. The digital signals must be downloadable into a data base on a continuous basis.
- (c) A fuel oil monitoring software package is to be in place for on line calculation and logging of the oil receipts, etc.

13.3.2 Oil Consumption Measurement

The following are to be considered:

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(a) Differential pressure orifice plate or nozzle type or mass based oil flow meters with provision for continuous digital data transfer shall be installed. (b) The oil gun on-off operation data must be recorded through a time based system automatically to give a time trace of when the guns are on and when the guns are not in service. This will be useful for performance optimization group to study the operator to operator variations, coal to coal variations, variation in different seasons, etc. 13.3.3 Integrated Fuel Oil Receipt and Consumption Monitoring A Fuel Oil Monitoring software Package shall be provided. When ultrasonic level measurement for tanks is used, the software package shall calculate the oil receipts. 13.3.4 DM Water and Associated Water Systems On-line monitoring of DM water flow and unit make up with integrators shall be envisaged to control the energy efficiency as the make up is directly proportional to the steam lost from the system and affects the unit heat consumption and heat rate. Hence, it is envisaged to go in for fully automatic on line measurement of water consumption for both production and consumption measurement of raw water, DM water, soft water and drinking water. The following are to be considered for DM (De-mineralized) and associated water systems: (a) Both DM water production and DM water consumption must be separately measured and audited. (b) Installation of differential pressure orifice plate or nozzle type flow meters with digital output, communication media to relay the data to the DM control room computer and provision for downloading the data into a data base for on line monitoring of make up especially during cycling operations. On line monitoring would help in control of unit heat rate as well as give an accurate account of the chemicals consumed for DM water production.		

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(c) Water Monitoring Software Package shall be provided. The package must have capability to draw inputs from the various field instruments and make an on-line continuous data base grid of the information for generation various types of information such as consumption per shift, consumption during cycling operations, operator-wise consumption, etc. to enable the performance optimization group to take control action on the areas of wastage and excessive consumption. Consumption and production shall be separately monitored.

13.4 SPECIFICATIONS OF IN-MOTION WEIGH BRIDGES

13.4.1 Particulars Of Pit-Less In-Motion Weigh Bridges

(a) The system is basically in-motion rail dual in-weigh sensors with analog electrical signals which are digitized and communicated to a control room through communication media where it is recorded. The record shall be in a usable format of a data base with a tie stamp.

(b) Accuracy : ±0.5% or better for individual wagon and ±0.2% for the entire rake.

(c) Power Supply : 700W

(d) Reliability Index : SAIDI (System Average Interruption During Index) : 48 hours / year or better
SAIFI (System average interruption frequency index): 2 times / year or better.

Further details and latest amendments can be obtained from Research Design Standards Organization (RDSO) of Indian Railways (www.rdso.gov.in).

13.5 METHODS OF MEASUREMENT OF COAL USED IN THE BOILERS

13.5.1 Particulars Of Pit-Less In-Motion Weigh Bridges

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(a) Belts weighment at the entrance of the raw coal bunkers. (b) Bunker level calibration and flow measurement based on bunker level. (c) Volumetric measurement based on raw coal feeder speed. (d) Volumetric measurement based on pulverized coal feeder speed. (e) Gravimetric measurement at outlet of raw coal feeder. (f) Pressure drop across pulverized coal pipe leading to the burner through fixed geometry devices. (g) Variable orifice dampers. (h) Dirty pitot tube measurement in the coal pipe leading to the burner. (i) Passive Electrostatic Sensors (j) Screw-in Microware Sensor. (k) Passive Acoustic Sensors (l) Laser through beam or retro reflex sensors (m) Calibration of mills as a function of their power input. 13.6 <u>SPECIFICATIONS OF BELT WEIGHER</u> 13.6.1 Particulars Of Belt Weighers (a) Micro Processor based electronic belt weighers with communication facility to continuously transmit the data to a control room as well as local reading. (i) Type : Electronic, Multi-idler type		

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(ii) Location : Refer mechanical specification of Coal Handling Plant (iii) Belt Speed : Refer mechanical specification of Coal Handling Plant (b) Coal Properties and Capacity (i) Bulk density : Refer mechanical specification of Coal Handling Plant (ii) Capacity : Refer mechanical specification of Coal Handling Plant (c) Duty Conditions (i) Moisture : Refer mechanical specification of Coal Handling Plant (ii) Dust : Refer mechanical specification of Coal Handling Plant (iii) Rain and high RH : Refer mechanical specification of Coal Handling Plant (d) Accuracy : $\pm 0.25\%$ or better of actual flow rate (dynamic). Weigh idler deflection less than 0.025 mm at full load. (e) Reliability Index : SAIDI (System Average Interruption During Index) : 48 hours/year or better SAIFI (System average interruption frequency index): 2 times/year or better. (f) Overload Capacity : Up to 25% with 100% overload protection (g) Capacity range of accuracy : 0 to 100%			

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(h)	Electronic Components	: Electronic digitiliser / monitors, cable, totalizer, sub- totalizer, tacho generator, printer, transmission of the impulse of flow rate as well as total quantity conveyed to control room through communication media. Fully digital with microprocessor and battery back-up memory.	
(i)	Mode of weighment primary sensors	: Super precision stainless steel strain gauge load cell applied in tension for highly accurate load measurement.	
		Hermetically enclosed measuring device, compact designed, suitable for all customary belt widths.	
		Speed measurement: Brushless digital tacho provides accurate measurement of speed.	
(j)	Outputs	: Electronic signals to control room and to local instrument display.	
		Status Annunciator for set points.	
(k)	Printout weigh, total and error reports	: Provision for zero setting on empty belt and further calibration. Special electronic calibration facility for frequent calibration checks without handling standard weights.	
(l)	Special trunion bushes to absorb normal shocks and transverse forces.		
(m)	Fully automatic tare and span calibration.		
(n)	Self-checking diagnostics for fault indications.		



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VOLUME –VI A

CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS

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Sr. No.	Vol. No./ Page No./ Cl. No.	Building/Area	Existing Particulars	To be read as	
1.	VI-A/Sec-1/42 of 639/3.1(xi)		Construction of ROB, Bridges, concrete or UCR Retaining wall & concrete drains, culvert, pitched drains, concrete apron etc.	Construction of ROB, Bridges, concrete or UCR Retaining wall & concrete drains, culvert, pitched drains, concrete apron and Seven (7) 300 dia NP3 RCC Hume pipes at railway crossing as per site requirement.	
2.	VI-A /Sec 1/ 140 of 639/ 4.9.1 (d)	Raw water treatment plant	Pretreatment chemical house ---- with Acid/Alkali proof tile lining.	Pretreatment chemical house ----- with Acid/Alkali proof tile lining. Chemical lab shall consist arrangement of storeroom with racks, lab sinks, cupboards, storing compartments with shutters below testing platform (Granite top) along with provision of toilet block.	
3.	VI-A /Sec 1/ 142 of 639/ 4.9.3 (a)	DM plant	Dimension and height ----- rating as per TAC.	Dimension and height ----- rating as per TAC. Chemical lab shall consist arrangement of storeroom with racks, lab sinks, cupboards, storing compartments with shutters below testing platform (Granite top) along with provision of toilet block.	

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Sr. No.	Vol. No./ Page No./ Cl. No.	Building/Area	Existing Particulars	To be read as	
1.	VI A / sect 4 / 400 of 639 / 2.15 (i)		The Multiwall ----- a temperature of 1000C.	The Multiwall ----- a temperature of 100 °C.	
2.	VI-A/Sec-5/577 of 639/9.6.14.1		Measurements The span length shall not vary more than 50 mm as measured along the appropriate rail. The cumulative error of measurement of all spans in a kilometer shall be not more than 1000 mm.	deleted	

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This refers to Volume VI A, Section 1, page 136, clause 4.7.20.18 (pp) of the bid specification. The details under Sr No (i), (ii) of the clause stand replaced as under:

(pp) The valves shall generally meet the following requirements:

(a) Butterfly Valves:

(i)	Type	:	Manually operated Double flanged Butterfly Valve
(ii)	Standard	:	AWWA C – 504/ BS: 5155
(iii)	POD (Proof of Design) Test	:	AWWA C – 504. Bidder to submit for reference.
(iv)	Operating Fluid	:	Water at 40 °C to 45 °C
(v)	Design Pressure	:	5.0 Kg./Sq.cm.
(vi)	Max. differential pressure	:	5.0 Kg./Sq.cm.
(vii)	Head loss	:	Max. 0.3 MWC
(viii)	Body	:	Cast Iron conforming to IS: 210 Grade FG 260 or Fabricated steel conforming to IS:2062/ IS:2002
(ix)	Shaft	:	Stainless Steel AISI 410
(x)	Bearing type	:	Self lubricated type
(xi)	Disc seat	:	Nitrile Rubber
(xii)	Body Seat	:	SS – 316
(xiii)	Internal Hardware	:	Stainless Steel
(xiv)	External Hardware	:	High Tensile Steel
(xv)	Fasteners	:	SS – 304 / SS – 316

(xvi)	Gland Packing	:	Teflon
(xvii)	Gaskets, Rings, etc.	:	Nitrile Rubber
(xviii)	Accessories	:	2 Nos. of 2NO + 2NC limit switches 'OPEN' & 'CLOSE.

All the butterfly valves shall be complete with graduated position indicator, arrow indicating the flow direction. The valves shall be suitable for erection in any position (Horizontal/Vertical, etc.). The operating mechanism shall be mounted directly on or supported from valve body. All the butterfly valves shall be provided with hand wheel. Butterfly valves of size 350 NB and above shall be provided with reduction gear units. Valves shall close in clockwise direction. The hand controls shall be dimensioned to guarantee an easy manoeuvre under most severe conditions. The hand controls shall be provided with locking systems to avoid the disk assuming a not desired position during operation. The pulling force required on the hand wheel-rim shall not exceed 30 Kg. when operating the valve under full flow and operating pressure. The reduction units shall be watertight, complete with lubrication and position indicator. Only one type of valve shall be provided, either cast or fabricated type. Mixing of two types of valves is not considered acceptable.

(b) Ball Valves

(i)	Standard	:	IS: 9890
(ii)	Type	:	Threaded
(iii)	Pattern and Construction	:	Full bore in single piece
(iv)	Nominal size	:	As specified elsewhere
(v)	Design pressure	:	5 Kg./sq.cm.
(vi)	Material of construction	:	Carbon Steel Valves confirms to IS: 9890

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(The contents of the following table shall be considered in continuation to the requirements specified under Volume VI A, section 4, clause no 6.0)		

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TABLE- I
Schedule of Internal Finishes for different Pump Houses with Permanent Housing

Sr. No.	Description	Insulation Specified in Data Sheets	Flooring	Skirting	Plastering/ Painting			Roof	Lifting Arrange-ment
					Internal Wall	Ceiling	External Wall		
1.A	Water Treatment System								
1.0	Sludge Transfer Pumps	Not Specified	Heavy Duty, 25mm Thick Steel crete Tiles over concrete / grade slab	150 mm high Steel crete tiles	Oil bound distem-per over 12 mm thick internal plaster With neeru finish	Oil bound distem-per over 6 mm thick ceiling plaster With neeru finish	Water proof exterior acrylic paint over 20 mm thick external plasters over brick work	R.C.C. Roof	Required
2.0	Thickened Sludge Transfer Pumps	Class “B” insulation IPW55	-do-	-do-	-do-	-do-	-do-	-do-	-do-

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Sr. No.	Description	Insulation Specified in Data Sheets	Flooring	Skirting	Plastering/ Painting			Roof	Lifting Arrange-ment	
					Internal Wall	Ceiling	External Wall			
1.B	DM plant									
1.0	DM Plant Supply Pumps	Not Specified	-do-	-do-	-do-	-do-	-do-	-do-	-do-	
2.0	Degasser Air Blowers	-do-	-do-	-do-	-do-	-do-	-do-	-do-	-do-	
3.0	Acid Unloading Pumps	-do-	-do-	-do-	-do-	-do-	-do-	-do-	-do-	
4.0	Caustic Unloading Pumps	-do-	-do-	-do-	-do-	-do-	-do-	-do-	-do-	
5.0	Neutralized Effluent disposal Pumps	-do-	-do-	-do-	-do-	-do-	-do-	-do-	-do-	
1.C	Effluent Treatment Plant									
1.0	Backwash Waste Water Transfer Pumps	-do-	-do-	-do-	-do-	-do-	-do-	-do-	-do-	
2.0	Boiler Blow Down Transfer Pumps	-do-	-do-	-do-	-do-	-do-	-do-	-do-	-do-	
3.0	Oily Waste Transfer Pumps						-do-			
(a)	Fuel Oil Storage Area	-do-	Heavy Duty, 25	150 mm high Steel	Oil resistant	Oil bound	-do-	-do-	-do-	

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Sr. No.	Description	Insulation Specified in Data Sheets	Flooring	Skirting	Plastering/ Painting			Roof	Lifting Arrange-ment
					Internal Wall	Ceiling	External Wall		
			mm Thk Steel crete Tiles over concrete / grade slab	crete Tiles	paint over 12mm thick internal plaster With neeru finish	distem- per over 6 mm thick ceiling plaster With neeru finish			
(b)	Power House Area	-do-	-do-	-do-	-do-	-do-	-do-	-do-	-do-
(c)	Transformer Area	-do-	-do-	-do-	-do-	-do-	-do-	-do-	-do-
4.0	Common Oily Water Transfer Pumps	-do-	-do-	-do-	-do-	-do-	-do-	-do-	-do-
5.0	Oily Water Separator Treated Effluent Transfer Pumps	-do-	-do-	-do-	-do-	-do-	-do-	-do-	-do-
6.0	CPI Sludge Transfer Blowers	-do-	Heavy Duty, 25 mm Thk Steel crete Tiles over	150 mm high Steel crete Tiles	Oil bound distem- per over 12 mm	Oil bound distem- per over 6	-do-	-do-	-do-

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Sr. No.	Description	Insulation Specified in Data Sheets	Flooring	Skirting	Plastering/ Painting			Roof	Lifting Arrange-ment
					Internal Wall	Ceiling	External Wall		
			concrete/ grade slab		thick internal plaster With neeru finish	mm thick ceiling plaster With neeru finish			
7.0	CPI Sludge Transfer Pumps	-do-	-do-	-do-	-do-	-do-	-do-	-do-	-do-
8.0	Decanted Water Transfer Pumps	-do-	-do-	-do-	-do-	-do-	-do-	-do-	-do-
9.0	Clariflocculator Sludge Transfer Pumps	-do-	-do-	-do-	-do-	-do-	-do-	-do-	-do-
10.0	Air Blower for Clariflocculator sludge Pit	-do-	-do-	-do-	-do-	-do-	-do-	-do-	-do-
2.	Roof Treatment	As per clause -2.24, section IV of architectural specification							
3.	Door	Provide 40 mm thick hollow metal pressed steel door to all above pump houses							
4.	Windows	Provide aluminium powder coated windows- openable windows at operating level, fixed windows at high levels to all above pump houses							

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Note:

Interior Finish Schedule for Buildings:

Sr. No.	Vol. No./Sec/ Page No./ Cl. No.	Building/Area	Existing Particulars for flooring/skirting/dado	To be read as
1.	VI-A/Sec 4/ 45 of 639 / 6.0	Flooring/ Skirting/Dado for Building Areas indicated at Sr No k), l), p), q), r), u), v), w), ee), ff), gg) of the clause.	Overall 40 mm thick heavy duty concrete floor with metallic hardener	Heavy Duty, 25 mm thick Steel crete Tiles over concrete/grade slab

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<u>DOORS/WINDOWS SCHEDULES:</u>					
Sr. No.	Vol. No./Sec/ Page No./ Cl. No.	Rooms/Area	Existing Particulars	To be read as	
1	VI-A/Sec 4/462 of 639/ 6.1 (DOORS/ WINDOWS SCHEDULE)	Windows for Rooms indicated at Sr No a), b), e), j), k), m), n),p) of the table in clause	Aluminium powder coated windows ----.	Aluminium powder coated windows ---- with M.S safety grill of weight not less than 20 kg/sqm.	
2	--do--	Windows for Room indicated at Sr No c) of the table in clause	Aluminium powder coated fixed windows	Aluminium powder coated fixed windows with M.S safety grill of weight not less than 20 kg/sqm.	
3	--do--	Windows for Rooms indicated at Sr No d), f), l), o), r) of the table in clause	Aluminium powder coated openable windows	Aluminium powder coated openable windows with M.S safety grill of weight not less than 20 kg/sqm.	
4	--do--	Windows for Room indicated at Sr No h) of the table in clause	M.S openable windows -----.	M.S. openable windows ----- with M.S. safety grill of weight not less than 20 kg/sqm.	
5	--do--	Windows for Room indicated at Sr No s) of the table in clause	Steel framed glazed window and ventilator.	Steel framed glazed window and ventilator with M.S. safety grill of weight not less than 20 kg/sqm.	

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VOLUME VI A

SECTION – 6

ROB WORK AT RAILWAY CROSSING

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CLAUSE NO.	PARTICULARS	
1.0	SCOPE OF WORK	
2.0	DESIGN CRITERIA FOR FLYOVER/ ROB	
3.0	SPECIFICATIONS FOR BITUMINOUS BOUND MACADAM (BBM)	
4.0	SPECIFICATIONS FOR RETRO-REFLECTIVE SHEETING	
5.0	SPECIFICATION FOR ELECTRIFICATION OF ROAD OVER BRIDGE	
6.0	TRAFFIC SAFETY MEASURES	

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1.0 SCOPE OF WORK:

The following items & shall be executed in accordance with design criteria as stated:

- (a) Obtaining necessary approvals/permission/clearances of railway authorities before and during execution as well as after completion of railway works as per requirements of Railway department / Mahagenco /local bodies like panchayat, PWD,/or any other department required for commissioning well in advance so as to start the railway traffic in schedule time frame.
- (b) Design and Construction of ROB within Railway Boundary with launching scheme including footpath and wearing coat.
- (c) Design and Construction of ROB viaduct in non-railway and railway area including wearing coat.
- (d) Design and Construction of ROB approach ramps including required earthwork, GSB, WBM and BT works etc.
- (e) Design and Construction of Anti-crash Barrier for entire ROB, friction slab for approaches as required.
- (f) Drainage arrangement for entire ROB including GI spouts, down take pipes, water collection chambers of 450 x 600 size near piers and abutments, RCC-NP3, 450 mm dia pipe connection from collection chambers to road side drain or Nalla.
- (g) RCC pier protection in viaduct portion on either side in Non-Railway and Railway area.
- (h) Painting to entire ROB structure including approach ramp and staircases by waterproof cement paint.
- (i) Maintenance of existing slip/service roads during construction till completion of work.

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(j) Any other works not specified but required for completion of scheme. (k) Providing suitable and required ducts / conducts / openings / boxes / slots etc. for electrical and streetlight installations in Bridge concrete structure at appropriate location as per electrical installation scheme. (l) Designing of electrical and street lighting system/circuitry for entire work and obtaining necessary approval from the Maharashtra State Power Transmission Company Ltd /Electrical Inspector as required. (m) Construction of roadside drains along the diversion road. (n) Providing and fixing aluminium cat-eye-stud as required. (o) Providing and fixing cautionary / warning signboards / information signboard. (p) Providing and laying thermoplastic road marking material as per Specification. (q) Construction of diversion road as per required section provided. General Details of Work to Be Executed Under Total Contract 1.1 <u>WIDTH AND CROSS SECTION:</u> Width of the Road Over Bridge and the requirements of carriageway shall be as per requirement. 1.1.1 <u>LENGTH OF BRIDGE :</u> (a) Railway Bridge Portion : Two span of 20 to 25 M Total length of Bridge in Railway portion is approximately 50 M. (b) Non-Railway Bridge Portion : 10 spans of 25.00M each i.e. @ 250.00 meters.		

Total length of viaduct in Non-Railway portion is 250.00 M.

1.1.2 APPROACHES:

- (a) Solid ramp on both ends with gradient 1:30
- (b) Diversion cum service road with drain approximate: 950 M

1.1.2.1 Carriage Width:

- (a) In Railway Portion : 5.5M + 1.5M footpaths on both Sides + 0.50M anticrash barriers on both sides +125 mm parapet both side
Total width =9.75 M
- (b) In non Railway Portion : 5.5M + 0.5M anticrash barriers on both sides
Total width=6.5 M

1.1.3 LENGTH OF ROB AND VIADUCT:

The contractor's proposal shall provide the length of the Road Over Bridge, viaduct and approaches strictly as per standard specifications / drawings to suit the requirements of minimum horizontal i.e. clear span and vertical clearance i.e. rail top to soffit of superstructure as indicated for Railway Bridge portion and viaduct as per specified gradient not steeper than required specifications for Railway portion is obligatory. The contractor shall provide the Road Over Bridge to confirm to these requirements and including properly designed vertical and horizontal curves for a design speed of 80 km/h (Summit curve in the central portion and valley curve on either ends). Valley curves are to be provided at either ends of the Road Over Bridge. In the inner half portion of the valley curve-retaining structure shall be continued. In the outer half portion of the valley curve, crash barrier shall be provided upto the point where height of fill is more than 10 cms above the existing road level.

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1.1.4

CAMBER AND SUPER ELEVATION:

Minimum camber to be provided to the carriageway shall be 2.5%. Super elevation where required shall be as per actual design (subject to a maximum of 4% if super elevation needs to be provided in structural portion).

1.1.5

TRAFFIC DIVERSION:

The contractor may adopt a suitable scheme of construction, which shall be got approved from Railway Authorities, Traffic (Police) Department. The responsibility of obtaining the permissions for scheme to be adopted from concerned authorities e.g. Railways, Traffic (Police) shall be that of the contractor. No extra cost will be paid on account of such diversion.

In situ staging for construction of superstructure is not permitted over the Railway span. End launching or any other method (acceptable to Railway) shall only be permitted. Precast RCC shuttering slab for PSC girder is not permitted.

1.1.6

Programme of construction of railway bridge portion shall be arranged in such a way that it is complete in the shortest time period.

1.1.7

Interim support at minor bridges/CD works on the existing road shall not be allowed for construction superstructure.

1.2

SITE CLEARANCE / SETTING OUT:

1.2.1

Making out the center line of the ROB and various components and complete lining out with masonry and concrete pillars for proper lines and levels with precision theodolite survey including constructing theodolite stations, bench marks etc., as directed. This includes all the allied works like clearing the road side line removing and stacking of the existing kerb stones, obstructing bushes, trees etc. The surveying instrument used on the works shall be modern electronic equipment.

1.2.2

Providing all documentation such as audio/video cassettes or CDs/photographs, record drawings etc.

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1.3

FOUNDATION :

1.3.1

Open Foundation – In case of open foundation, taking foundations through all strata upto required foundation level including embedment as per specification/design criteria. Rock levels/line as per Geo-tech report.

1.3.2

Pile Foundation – In case of pile foundations providing MS liners of (i) 8mm thick for the Railway bridge portion (foundation covering span over the railway boundary) and (ii) 6mm thick for rest of the foundation including coal tar epoxy anticorrosive paint of zinc rich epoxy primer and two coats of coal tar epoxy paint (total dry film thickness = 50 + 80 + 80 = 210 micron) to the mild steel liners on surface in contact with earth. The bottom shoe of liner of 12 mm thick shall attain minimum height provided and placed in position prior to driving 8mm / 6mm thick MS liner. These MS liners are to be provided up to top of rock or refusal level as approved by the Engineer.

1.3.3

Load test on pile (Initial) – Providing and casting test pile and carrying out load test as per design criteria for initial load test. **Only by STATIC method of testing.**

1.3.4

Load test on pile (Routine) – Carrying out routine load test on pile conforming to design criteria. Only STATIC method of testing shall be adopted.

Pile Cap – Providing RCC pile cap : The top of the pile caps shall be atleast 0.5m below ground level.

1.3.5

The foundation level/depth for pile foundation of structures for bridge portion shall be as per design data.

1.4

SUBSTRUCTURE:

Providing sub structure of piers, abutments, returns etc., as per design criteria with suitable RCC caps.

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1.5

SUPER STRUCTURE:

Providing superstructure and decking shall be conforming to the design criteria suitable for roadway particulars footpaths, central median etc. as shown in the departmental drawings. Only prestressed concrete superstructures are allowed. Steel and composite superstructures are not allowed. For Railway portion only precast prestressed girders are allowed as per GAD approved by Railways.

1.6

RAILING, KERBS, BEARINGS, EXPANSION JOINTS, WEARING COAT ETC.:

1.6.1

Providing necessary bearings, pedestals for bearings, expansion joints water spouts, mastic layer on the deck wearing coat, road kerbs, anti crash barriers etc., as per design criteria. Anti crash barrier for the ROB & viaduct portion shall be as per section indicated in MORTH Specification of concrete grade of deck slab. For approaches same section shall be provided with suitable friction slab, design with suitable length & keys. The design shall be approved by the Engineer.

1.6.2

Drainage:

Providing minimum 150mm GI water spouts CIMS grating and 150mm GI runner pipes and down take pipes at each pier and abutment location. The GI pipes shall be painted with oil paint in three coats. Chambers shall be provided at the pier and abutment locations and 150 mm dia down take pipes to connect to these chambers. These chambers shall be connected by 300 mm dia. NP-3 Class RCC pipes to take the collected water upto near by nallah or adjoining existing drain as directed by Engineer.

1.7

APPROACHES

Providing approach structures as follows:

1.7.1

Providing vertical retaining structure with outer face in plumb for embankment of approaches in ramps at either ends of ROB proper comprising RCC retaining wall resting on strata of required bearing capacity and as per provisions of design criteria. Providing granular filling

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in RCC retaining wall as per specifications and as approved by the Engineer including CC kerb drains of 250mm wide adjacent to crash barrier and intermediate down take arrangement.

1.7.2 Providing Rubble filling behind the abutment and returns for 0.6m width. The height of rubble filling shall be up to the bottom of rubble matt/crust.

1.7.3 Providing Rubble matt of 900mm thickness, below the road crust between the returns for a length of 4 m on either sides of the ROB.

1.7.4 The details of the crust for solid approach ramp of ROB and approach Road from the end of solid Ramp to the junction point on either side is as under:

(a) Granular Sub base : 150 mm thick.

(b) WBM with stone screening with grade I metal layer compacted by vibratory roller : 150 mm (Two layers each 75mm thick)

(c) WBM with stone screening with grade II metal layer compacted by vibratory roller : 150 mm (Two layers each 75 mm thick)

(d) Bituminous Bound macadam 75mm thick with 250 Kg/100 sqm vibratory roller including tack coat @ 5kg per 10 Sq.m. of bitumen grade 60/70. : 75mm thick Bituminous Bound macadam (Bitumen grade 60/70)

(e) Bituminous Macadam 50mm thick with 60/70 grade With 5% bitumen with vibratory roller including tack coat @ 5kg. per 10sqm. of asphalt : 50mm (Bitumen grade 60/70)

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grade 60/70.

(f) Asphalting concrete : 15mm thick Asphalting concrete
15mm thick with 6.5% (Asphalt grade of 60/70).
Bitumen with vibratory
roller including tack coat
@ 5kg. per 10 sqm. of
asphalt grade 60/70.

1.7.5 Providing wearing coat over the bridge superstructure as follows:

(a) Dense Bituminous : 50 mm average thickness
Macadam as per job mix (Asphalt Grade 60/70)
design with minimum 5%
bitumen by wt. including
tack coat @ 5Kg per
10sqm.with vibratory
roller

(b) Mastic Asphalt : 15 mm thick (Grade 10/20)

Profile correction for camber, super elevation and vertical curve shall be provided in deck, itself.

1.7.6 All known overhead utility services if any like electric poles & lines, the telephone poles & lines and known underground service pipe lines, cables etc., falling in the alignment of ROB proper, solid ramp, approach Road shall be shifted by contractor at appropriate locations.

1.7.7 Cross Drainage:

Providing cross drainage in drawing if required and as directed by the Engineer.

1.7.8 SOIL INVESTIGATION:

Soil investigation shall be carried out as required for designing and to confirm the soil investigation report attached and as directed by Engineer in charge.

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1.8

WIDENING – ROAD WIDENING FOR TRAFFIC DIVERSION:

1.9

ANTICORROSIVE TREATMENT, PAINTING, FIXTURES ETC.

1.9.1

Painting/ Anticorrosive Treatment

Providing protective painting to the concrete surface for foundation by bituminous paint and the substructure and superstructure etc., shall be painted with three coats of water proof cement paint. Median verge shall be painted with three coats of oil paint as approved by the Engineer.

1.9.2

Fixtures

Fixing the fittings and fixtures, instrumentation as may be supplied by the corporation and railways at specified location on bridge structure for certain amenities such as lighting arrangement on ROB and providing items as per design criteria.

1.10

PIER PROTECTION, ROADSIDE KERBS:

1.10.1

Providing pier protection to all the piers as directed by Engineer by constructing RCC pardi of 25 cm thick (M-20) finished with cement plaster in CM 1:4 to exposed faces around piers for a height of 1.25m above G.L. with a gap of one meter between pier and pardi filling the gap with moorum inside and 150mm rubble soling over laid by PCC of M-15 grade of 100 mm thick. The vertical reinforcement of 16mm dia at 200mm center to center and 10mm dia. at 200mm center to center as distribution steel shall be provided on the outer face and nominal steel on inner face 10 mm dia. at 200 mm. at center to center both ways in the RCC pardi. Providing foundation for pardi of minimum size 0.45m x 0.50m in M-15 over rubble soling of 0.15m Pier protection is required only to RCC pier column.

1.10.2

Providing and fixing continuous precast **RCC kerbs stones in cement concrete M-20 of size 1000mm x 300mm x 600mm embedded 300 mm in ground along the bridge adjacent** to the solid ramp portion on both sides upto the end of ramp @ 300 mm clear distance from R.E. Walls with 150 mm dia drainage spouts @ 2000 mm c/c including oil painting of approved colour and shade by Engineer.

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These kerb stones shall be provided on roadside parallel to the retaining wall or reinforced earth structure to protect it from damages and to channelize the traffic running on side roads.

1.11 LABORATORY:

1.11.1 Providing and maintaining an adequately equipped field laboratory as required for site control on the quality of material and the works. It shall have adequate area for the entire equipment and working as directed by the Engineer.

1.11.2 The field laboratory of adequate floor area shall be located on the site as shown or as directed and approved by the Engineer. It shall be provided with all amenities like water supply, electric supply etc.

1.12 BLASTING OF ROCK:

Blasting of Rock/Boulder etc., is not permitted. Only chiseling should be resorted to.

1.13 DOCUMENTATION:

Providing documentation such as videocassettes, CDs, photographs as built drawings etc., as specified in the tender. All drawings shall be on Auto CAD of latest version.

1.14 CONSTRUCTION PHASING:

The contractor has to prepare detailed work plan with his bid which shall take into account, the traffic position, milestones specified in the tender, and availability of men, material, machinery and shuttering material with him. He has to indicate how he intends to divert the traffic during construction.

1.15 Waterproof cement based paint shall be provided to the finish surface of the Road Over Bridge, viaduct and approaches as approved by the Engineer.

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1.16

AESTHETICS:

Aesthetics aspects like smooth profile of soffit, precast fascia, geometric profile, grooves, crash barriers etc., which may lead to enhance overall look of bridge and area is desirable. Precast RCC Fascia of minimum M-25 grade with minimum 80 mm thick and 1500 depth below RTL with necessary grooves / pattern shall be provided if proposed by the contractor for viaduct portion to match the overall aesthetics of the bridge.

1.17

Thermoplastic road marking – Yellow and white continuous lane marking at 3 locations per lane carriage as directed by the Engineer for entire length of the work including markings for junction developments as approved by the Engineer.

1.18

Sign, caution, informatory board, and hazard markers of Retro reflective type as approved by the Engineer.

1.19

Cat-eyes as approved by Engineer.

1.20

ROB – BRIDGE WITHIN RAILWAY BOUNDARY

All the structural designs for all components including foundations substructures, Bearings, Expansion Joints, Superstructures, Railway/ Crash barriers, Footpaths, Stair cases etc., shall have to be got approved by the contractor from the Railway authorities. Nothing extra will be paid on this account to the contractor.

2.0

DESIGN CRITERIA FOR FLYOVER/ ROB

2.1

SPECIFICATIONS FOR DESIGN AND CODES TO BE FOLLOWED :

2.1.1

The design of structural components shall conform to the criteria laid down in the latest editions of the following codes of Practice and Standard specifications published up to the last date of receipt of tender and subject to the departures stipulated.

2.1.1.1

Standard Specifications and Codes of Practice for Road Bridges. :

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(a)	Section - I	:	I.R.C. 5 (1998) General features of design. (Reprint April-2002)
(b)	Section -II	:	I.R.C. 6 (2000) Loads and stresses. (Reprint April-2002)
(c)	Section -III	:	I.R.C.21 (2000) Cement concrete plain and Reinforced (Third Revision). (Reprint November-2002)
(d)	Section - V	:	I.R.C.24 (2001) Steel road bridges.(Second revision) (Reprint October-2003)
(e)	Section -VI	:	I.R.C.22 (1986) Composite construction (Reprint November-2002)
(f)	Section -VII	:	I.R.C.78 (2000) Foundation and substructure. (Second revision) (Reprint April-2002)
(g)	Section -IX	:	I.R.C.83 (1999) Metallic Bearings (Part-I). (First revision December-1999) (Reprint May-2003)
(h)	Section -IX	:	I.R.C.83 (2002) POT, POT CUM PTFE, PIN AND METALLIC GUIDE BEARINGS. (Part-III)
(i)	I.R.C: 18-2000	:	Design criteria for prestressed concrete Road Bridges (Post tensioned concrete). (Reprint Sept-2002)
(j)	I.R.C. -38-1988	:	Guidelines for Design of Horizontal Curves for Highways and Design Tables. (First revision Sept. 1989)
(k)	I.R.C. -89-1997	:	Guidelines for Design & Construction of River Training & Control Works for Road

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Bridges. (First revision) (l) I.R.C. –SP- 23 – : Vertical Curves for Highways 1983 (Reprint Sept. 1989) (m) I.R.C. –SP- 37 – : Guidelines for Evaluation of Load 1991 Carrying Capacity of Bridges. (Year 1991) (n) I.R.C. –SP-51 – : Guidelines for Load Testing of Bridges 1999 (o) I.S.- 1893 – 1984 : Criteria for Earthquake Resistant Design of Structures. (First Reprint - July-1999) (p) I.S.- 13920 – : Ductile Detailing of Reinforced Concrete 1993 Structures subjected to Seismic Forces (Reaffirmed Code of Practice. 1998) Edition 1.2 (2002-03) 2.1.1.2 Any I.R.C. standard specifications and codes of practice or criteria for road bridges other than "2.1.1.1" above 2.1.1.3 For any item not covered by 2.1.1.1 & 2.1.1.2 above, specification for Road and Bridge works published by I.R.C. for Ministry of Road Transport and Highways, Government of India. 2.1.1.4 For items not covered by any of the 2.1.1.1, 2.1.1.2 & 2.1.1.3 above, Standards and Specifications Provisions of IS codes of practice. 2.1.1.5 For Precast Segmental Construction B.S: 5400. 2.1.1.6 For Pretensioned Construction B.S:5400 2.1.1.7 For any item not covered by any of the above codes and specifications, the relevant provisions from B.S./ AASHTO (LRFD) Codes.			

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2.1.1.8

For items not covered by any of the above Standards and Specifications, Sound Engineering practice and provisions relevant Codes of other nation shall be referred.

2.1.1.9

In case of ROB/RUBs involving the bridges over/under railways, the relevant provisions of railway codes/railway authorities shall supercede the provisions in this criteria in the portion of bridge where these are applicable.

2.2

DESCRIPTION OF WORK AND OBLIGATORY PROVISIONS

2.2.1

Alignment and Location :-

Alignment and location of the FLYOVER/ROB shall be as shown in the Departmental drawings.

2.2.2

The Length Of Flyover/Rob And Viaduct :-

The length of the FLYOVER/ROB and via-duct shall satisfy the following criteria.

(a)

Maximum height at abutment location shall not be more than those shown in departmental drawing.

(b)

Longitudinal gradient shall not be steeper than those shown in departmental drawings.

(c)

Restrictions on terminal points if specially mentioned in departmental drawings.

(d)

Any other criteria shown on the departmental drawings / supplementary data.

(e)

Overall length of bridge proper i.e. FLYOVER/ROB and Viaduct shall not be less than the length shown in departmental drawing.

(f)

The minimum vertical and horizontal clearances under the Railway Bridge Portion shall not be less than those shown in drawing.

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2.2.3

Road level on the flyover/rob and roadway particulars:

(a)

Roadway particulars and carriageway widths shall be as per relevant drawing.

(b)

The vertical geometry of the finished surface of deck slab and wearing course shall be in the form of a smooth curve where change in gradient occurs. The design of curves shall be got approved from the Engineer. The design of curves shall comply relevant IRC Codes / Guidelines. The design speed on curve shall be as stipulated in **Design Data**.

2.2.4

Supplementary data for design shall be as per Design Data.

2.3

DESIGN LOADS: -

2.3.1

Live loads :

2.3.1.1

The bridge shall be designed for Loading(classAA) as per IRC: 6-2000. During construction a construction load of 300kg/sqm shall be considered. The Bridge shall also be designed for Service Loads as specified in Design Data.

2.3.1.2

For Railway portion – As per IRC:6-2000 Or as approved by Railway Authority whichever produces worst effect.

2.3.2

Wind Forces:-

Wind forces shall be considered for the design.

2.3.2.1

Temperature-Range :-

For calculation of thermal forces effect of 'E' value of concrete should be taken as 50 % of the instantaneous value so as to account for effects of creep on thermal strains.

2.3.2.2

Earth Pressure:

The abutment shall also be designed to be safe for a back fill with dry density of soil 1.8 t/cum, saturated density 2.00 t/cum, $\phi = 30^\circ$ and $C = 0$.

2.4 FOUNDATIONS :

2.4.1 Piers/ Abutments:

2.4.1.1 The details of the borings with levels & their locations are in the drawing/tender document for general guidance of the bidder only. The contractor shall have to take borings by double tube boring machine at the final location of each pier and abutment prior to the commencement of the work to ascertain the rock levels/quality at the location of the foundations and this shall form part of the contract and no payments will be made by the Department for boring, soil sampling and testing etc.

2.4.2 Ramp/Retaining Walls :-

2.4.2.1 The solid ramp portion of the Flyover/Road Over Bridge shall be a retaining structure. The retaining structure resting on strata other than rock shall not be accepted, unless they are of R.C.C. wall. The foundation of retaining structure shall be rested at least 1.0 metre below the ground level on strata other than rock.

2.4.2.2 For foundation of Retaining structure if design requires to increase SBC at foundation level by any soil stabilization method or any type of additional foundation arrangement, treatment etc is required, the same shall be included in the tendered amount. No payment will be made separately for the same.

2.4.3 Pile Foundations:

2.4.3.1 Minimum embedment into rock and S.B.C. of the strata shall be considered as follows

Sr. No.	Type of strata	Min. Embedment in rock	S.B.C. of rock
(a)	Hard rock	1.5 x diameter of pile	400 t/m ²

		1.0 x diameter of pile	300 t/m ²
(b)	Soft rock	3.0 x diameter of pile	250 t/m ²
		2.0 x diameter of pile	200 t/m ²
		1.5 x diameter of pile	150 t/m ²

The values of S.B.C. given above consider the effect of embedment in rock and global behavior of the pile and hence friction resistant of pile shall not be further added.

2.4.3.2 Only end bearing bored cast in situ piles drilled with rotary rig or regular tripod rigs will be accepted.. Design with single row of piles per Substructure shall not be accepted. Annular piles filled or not filled shall not be accepted.

2.4.3.3 Minimum 6mm thick permanent M.S. Liner for piles shall be provided, for piles up to top of rock. For Railway bridge portion the minimum thickness of permanent M.S. Liner for piles shall be as per the requirements of railway codes/authorities.

2.5 SUBSTRUCTURE:

2.5.1 For continuous spans, pier with fixed bearing shall be designed to take all the horizontal forces

2.5.2 The thickness of counter-fort shall not be less than 400 mm and that of any other element shall not be less than 300 mm.

2.5.3 Dead man anchors or friction slabs shall not be accepted behind abutment for relieving moments

2.5.4 Scope for accessibility for inspection and arrangement for lifting of the superstructure for future replacement of bearings shall be provided for in the design of substructure. The positions of jacks shall be distinctly marked on the drawing and also on the structure.

2.5.5 The height of pedestals shall be limited to 500 mm and shall not be less than 300mm.

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2.6

SUPERSTRUCTURE:

2.6.1

Deck slab thickness shall not be less than 300 mm and not less than 200 mm at tip of cantilever, irrespective of the provisions elsewhere.. The slab shall be checked for punching shear. The cantilever projection of slab in transverse direction shall not be more than 1.8m.

2.6.2

In case of voided slab structure, analysis & design shall be based on the provisions of B.S-5400. The minimum thickness of concrete around the void of deck shall be 300 mm.

2.6.3

Minimum thickness of intermediate diaphragm where provided shall be 300 mm and that of end diaphragm shall be 500 mm for the cast in situ work. Manholes shall kept at a spacing not more than 150m with arrangement for access inside the box.

2.6.4

In the absence of rigorous analysis for torsional and distorsional moments and forces due to warping torsion at ends, the design live load moments and shear force in the longitudinal direction shall be increased by 20% and transverse reinforcement by 5%.

2.6.5

For pre-stressed Superstructure with box girders, the cross diaphragms shall be minimum one each at supports and at each abrupt change in soffit geometry.

2.6.6

The provision for imparting 20% of design prestress at a future date shall be made in the deck and suitable anchorages, bulkheads, deviator blocks etc. shall be constructed for the purpose. Arrangement for external prestressing shall be got approved.

2.6.7

In addition to post tensioning as per I.R.C. codes, precast segmental construction as well as pre-tensioned construction are also permitted as per B.S.:5400.

2.7

BEARINGS BELOW SUPERSTRUCTURE :

2.7.1

Type of bearings shall be permitted: - POT PTFE.

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2.7.2	The bearings shall be easily accessible for inspection.
2.7.3	Scope for lifting the superstructure for future replacement of bearings shall be provided for in the design of bearing.
2.8	<u>EXPANSION JOINTS:</u>
2.8.1	Expansion joints shall conform to MORT&H specifications. The detailed working drawing for the joint shall be in conformity with overall geometry of deck. Geometrical profile shall be achieved by adjusting the dimensions of superstructure.
2.8.2	The expansion joints should generally be spaced at not less than 100 m. except in case of unavoidable circumstances.
2.9	<u>CRASH BARRIERS :</u> Anti crash barriers having a typical cross section as shown in Departmental Drg shall be provided for FLYOVERS/ROBs with footpaths / without footpaths.
2.10	<u>WATER SPOUTS:</u> Water spouts as per MOST Type design No.SD/303 shall be provided. However, the dia of pipe shall be 150 mm. Waterspout shall be connected to runner pipe of suitable diameter (Minimum 150 mm) on either side of roadway and taken down by down take pipes of suitable diameter at approved locations.
2.11	<u>WEARING COAT :</u> A wearing coat of uniform thickness shall be provided for riding surface. The configuration of wearing coat shall be as per the Design Data .
2.12	<u>ANTICORROSIVE TREATMENT:-</u>

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Anti-corrosive protective paint as mentioned below and approved by the Engineer shall be provided. This paint shall be got tested from the approved laboratory and shall be of approved quality, colour and shade. The protective coating shall consist of: 2.12.1 Mild steel liner to piles: One coat of Zinc-rich Epoxy Primer and two coats of coal tar epoxy.(Total dry film thickness 50 + 80 + 80 = 210 microns) 2.12.2 Reinforcement steel shall be cleaned with sand blasting before placing in position. 2.12.3 Part of substructure exposed to atmosphere - Water proof cement based paint of approved quality and colour in three coats. 2.12.4 Part of substructure in contact with earth upto GL – one coat of primer and two coats of coal tar epoxy. 2.12.5 The superstructure shall be treated with following protective coatings. (a) <u>Parapets/ Railings / Crash Barriers</u> Waterproof cement based paint of approved quality and colour in three coats. (b) <u>Deck/Girder/box and inside of RCC/PSC Box</u> Waterproof cement based paint in three coats of approved quality and colour. (c) <u>Steel Structures</u> The anti – corrosive protective paint shall be provided as approved by Railways. 2.13 <u>LOAD TEST :</u> 2.13.1 In case a structure or a component of structures proposed by the contractor, in the opinion of the Engineer is of unusual nature, then the Engineer shall		

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	have the right to call upon the contractor to carryout model testing and/or load testing of the structure or component to prove its suitability. The cost of such test shall be borne by the contractor only.	
2.13.2	Any defect noticed in the structure or any damage done to the bridge at the time of testing, which affects or is likely to affect the strength of the bridge shall be rectified by contractor at his own cost by remedial measures or replacement as approved by the Engineer.	
2.13.3	The test shall be carried out in the presence of Engineer.	
2.14	<u>DOCUMENTATION, INSTRUMENTATION :</u>	
	The following items shall be deemed to be included in the tendered cost.	
2.14.1	All final drawings and Microfilms and Compact Discs of all approved drawings and “as built” drawings and calculations shall be supplied by the Contractor free of cost.	
2.14.2	Three DVD of 180-minute duration each of the bridge covering the different phases of construction from start to finish shall be supplied by the Contractor free of cost.	
2.14.3	A “Maintenance Manual” describing access arrangements, important obligatory precautions from the point of view of structural safety, and procedure for minor and major repairs of each component of the bridge, renewals of finishes and periodical treatments shall be supplied by the Contractor free of cost.	
2.14.4	A “Quality Assurance Manual” covering all aspects of designs and drawings, mix-designs, materials, testing, soil and rock properties, statistical quality control, etc. shall be prepared by the Contractor free of cost well before starting the work.	
2.14.5	A “Construction manual” covering various aspects of construction methods, difficulties faced and how they were overcome during execution etc. shall be supplied by the contractor free of cost at the time of finalization of work.	

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2.14.6	The Contractor shall install fixtures and fastenings provided by the Department for housing any instrumentation that may be useful for the Employer at his cost.	
2.14.7	Fixing arrangement for internal and external lighting shall be got approved from competent authority and executed.	
2.15	<u>PROCEDURE FOR CHECKING DETAILED CALCULATIONS WORKING DRAWINGS:</u>	
2.15.1	Within one month of the receipt of work order, the contractor shall submit a program of submission of designs. The program of submission of designs of various components should be consistent with the program of work prepared by the contractor and approved by the Engineer.	
2.15.2	The consultant shall have the latest official version of the software being used for design and same shall be made available for scrutiny of design to the Engineer if demanded.	
2.15.3	Detailed calculations and working drawings of all the component parts of the Bridge shall be submitted well in advanced of the execution, in accordance with the above program. Two sets of such design calculations and Three sets of drawings accompanied by complete information and sufficient data shall be submitted to the Engineer for checking the design calculations. The designs and drawings for various component parts shall be submitted progressively. If computer is used for design or analysis, the contractor shall submit with design, the detailed description of method of analysis with explanatory notes and manually done sample calculations for adequate number of typical cases & soft copy. The Computer Program as submitted will be further tested by comparison with solutions of worked examples. The Contractor should submit along with his tender note giving his design approach and construction scheme conforming to the basic requirements which should be approved by the authorities while awarding the work so as to avoid the possibility of major changes being required in the design at a later date.	
2.15.4	Drawings and designs shall be in metric units. Calculations shall be neat and clear and supplemented by full explanatory notes and sketches	

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wherever required. The drawings of initial submissions and final approval shall be stenciled and in 420 mm x 297 mm size only. It is entirely the responsibility of the contractor to submit the design in a good time to enable the Engineer to approve them in time. No claim shall be granted on account of late approval to the design and consequent delay in the execution. Schedule of reinforcement and rate reinforcement Per Cum. Of Concrete quantity (and also percentage with respect to gross cross sectional area of the component) should also be shown on each drawing.		
2.15.5	Nine sets of approved working drawings along with one soft copy in the form of Compact Disk and four sets of approved designs calculations shall then be supplied by the Contractor which will be formally authenticated by the Engineer. These drawings shall be submitted in the plastic folders for each set and calculations in plastic files & bags.	
2.15.6	After completion of each stage of work, three sets of records plans based on the work as actually executed on site, shall be supplied by the Contractor, to the Engineer.	
2.15.7	Approval to drawings and designs and design calculations by the Engineer shall not in any way relieve the Contractor of his responsibility for their correctness and soundness, structural stability and safety of the structure.	
2.15.8	The approved drawings and the design calculations of the bridge shall be the property of the Employer.	
2.15.9	The Contractor’s designer or consultant shall attend all the design review meetings conducted by Employer Personnel from time to time, without any extra cost.	
2.15.10	For the Railway Bridge portion the structural designs and drawings with Temporary Arrangement Drawing for launching Scheme along with supporting designs and calculations shall have to be proof checked by approved structural consultants approved by Railways and further approval by the concerned Railways Authorities with lout any extra cost.	

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<u>DESIGN DATA</u>			
Sr No.	<u>ITEMS</u>		
1.0	<u>CARRIAGEWAY WIDTH:</u>		
1.1	Railway Portion	:	5.5 Mtrs Each
1.2	Viaduct Portion	:	5.5 Mtrs Each
1.3	Approaches	:	5.5 Mtrs Each
2.0	Width of Footpath		1.50 Mtr at both end (In Railway Portion only)
3.0	Overall Width of Bridge		
3.1	Railway Portion		9.75 Mtrs.(outer to outer parapet wall)
3.2	Viaduct Portion		6.5 Mtrs
3.3	Approaches		6.5 Mtr.
4.0	Width of Median Verge		Not applicable.
5.0	Seismic Effects		
5.1	Seismic Zone		III
5.2	Basic Horizontal Seismic Coeff. (α)		As per IRC-6-2000
5.3	Importance Factor (λ)		1.50
6.0	Design Speed of Vehicles		80 kmph.
7.0	Longitudinal Gradient		1:30
8.0	Exposure Condition (Moderate or Severe)		Moderate
9.0	Loading due to service		As mentioned in Design Criteria
10.0	Temperature range		Max. Temp. = 50 ⁰ C, Min. Temp. = 13 ⁰ C

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Sr No.	ITEMS		
11.0	Underground Water Table for design of the structures		Shall be considered 1.0 M below ground level for design purpose.
12.0	For Design of Temperature effects, atmospheric Exposure condition		Moderate
13.0	Live load on Footpath		500 kg/m ²
14.0	Configuration of wearing coat		
14.1	For ROB/Viaduct		50 mm thick DBM + 15 mm thick Mastic asphalt
14.2	For Approaches		BBM 75mm + 50mm thick DBM with 5% bitumen + 15mm thick asphalt concrete with 6.5% bitumen.
15.0	Clear headroom above rail top		6.25 Mtr / as required by railway authorities.

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SPECIFICATIONS

The General Technical Specifications comprise of the "Specifications for Road and Bridge Works" (Fourth Revision – August 2001) by Ministry of Surface Transport Roads Wing, Government of India and Published by the Indian Roads Congress, New Delhi, Specifications for Road & Bridge Work (Fourth revision – 2001) of M.O.R.T & H and Indian Railway Standard Code of Practice for plain, Reinforced and pre-stressed concrete for General Bridge construction (Concrete Bridge Code), second revision 1997 issued by Ministry of Railways, which are not reproduced here. The contractors shall obtain their copies of the specifications directly from IRC and Railways.

Full text of all modifications, amendments and additions to MOST Specifications are reproduced here below and will override or supplement the respective provisions of MOST specifications.

SECTION 100

GENERAL

105.1 Scope of Work

107.1

The work to be carried out under the Contract shall consist of the various items as generally described in the tender document under the heading Scope of Work

SECTION 107

CONTRACT DRAWINGS

Sub-Section 107.2

The drawings provided in the tender are the drawings showing proposal of the Employer. Since the offers are invited on the basis of contractor's own design, the drawings submitted by the contractor along with his tender shall be treated as contract drawings subject to conditions laid down in the contract. The Contractor

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should visualize the nature and type at work contemplated and ensure that price quoted by him have due consideration of qualitative and quantitative variations, as may be found at the site and complexities of work involved during actual execution/construction

Sub-Section 107.3

The contractor shall submit a programme of submission of designs as per the stipulations made in the design criteria. The program of submission of designs of various components shall be consistent with the programme of work prepared by the contractor and approved by the Employer.

Detailed design calculations and working drawings of all the component of the bridge including launching scheme shall be submitted well in advance of execution, in accordance with the above programme. Three sets of such design calculations and drawings accompanied by complete information and sufficient data shall be submitted to the Engineer after getting the same proof checked by approved structural consultant approved by Railways for checking. The designs and drawings shall be submitted progressively. If computer is used for design or analysis, the contractor shall submit with design, the detailed description of method of analysis with explanatory notes and manually done sample calculations for adequate number of typical cases. The Computer Programme as submitted will be tested by comparison with solutions as worked examples.

Drawings and designs shall be in metric units. Calculations shall be neat and clear and supplemental by full explanatory notes and sketches wherever required. The drawings of initial submission and final approval shall be stenciled and in A-1 size only.

If during the scrutiny of detailed design calculations and drawings including temporary arrangements for launching, any changes therein are found necessary in the opinion of Engineer, they shall be incorporated without altering the Lump-sum price quoted. It will be entirely the responsibility of the contractor to submit properly prepared designs and drawings in good time to enable the competent authority to approve them in time.

Schedule of reinforcement and the rate of reinforcement per cum of concrete quantity (and also percentage with respect to gross cross sectional area of the component) should also be shown on each drawing.

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Eight sets at approved working drawing including one set on reproduction tracing film and 4 sets at approved design calculations shall then supplied by the contractor which will be formally authenticated by the Engineer (5 copies of drawings and one set of design calculations for field officers, one set to be returned to the contractor and three to be retained by Engineer). These drawings shall be submitted in approved plastic folders and calculations in approved plastic files free of cost.

Sub-Section 107.4

After completion of each stage of work, 3 sets of record plans and one set of final design calculations based on the work actually executed including one soft copy on CD compatible to window 98, office 2000 & AutoCAD 2000I or 2002, shall be supplied by the contractor to the Engineer / MSPGCL as directed.

Approval to drawings and designs by the Engineer shall not in any way relieve the contractor of his responsibility for the correctness, soundness, stability and safety of the structure.

The approved drawings and design calculations of the bridge shall be the property of the Employer.

SECTION 110**PUBLIC UTILITIES****Sub-Section 110.1**

Drawings showing the affected services like electric lines, telephone lines, water pipes, sewers, oil pipelines, cables, gas ducts etc. owned by various authorities including Public Undertakings and Local Authorities are indicated on the drawings. The contractors alternative proposal shall be such that the shifting of utilities is not required. If during the course of execution such utilities are encountered then the contractor shall shift the utilities and will be reimbursed as per the estimate prepared by the concerned department and approved by Employer. The work shall be carried out under the supervision of the concerned department. In case in the opinion of the Engineer it is not possible to divert the



utilities, the Contractor shall make necessary modifications in the structure at no extra cost to the Employer.

SECTION 112

ARRANGEMENT FOR TRAFFIC DURING CONSTRUCTION

Sub-Section 112.7

The Contractor shall have to prepare a detailed traffic diversion plan as per the requirement of traffic authorities. The Contractor shall have to carry out the modifications in the traffic diversion plan at various stages of work as required. The Contractor will have to maintain liaison with the traffic police and Railways authorities so as to ensure smooth flow of traffic at all stages of the work without causing inconvenience to the traffic.

Traffic Rotary - The Contractor shall provide traffic rotary showing traffic direction made up of four blinkers mounted on M.S. Frame of 50 × 50 × 6 m size 250 Hz frequency electrically operated at both ends of the cordoned area to help and guidance of the road use. Necessary arrangement for supply of electricity shall be made by the contractor.

Road delineator - Road delineators as per IRC- 79 and as per relevant drawings and as directed by Engineer shall be fixed at suitable intervals to have a suitable guidance to the road users at the night time to follow the passage. Delineators shall be fixed firmly in the ground. Also red flags, cat eye reflectors shall be fixed on the barricades. Alternate arrangement shall also be kept ready in case of failure of electricity.

SECTION 809

KERBS, CRASH BARRIERS

Concrete crash barriers, curbs, medians shall be laid preferably with machine.

SECTION 1000

REINFORCEMENT

**Sub-Section 1009.3****Reinforcement /Untensioned Steel**

- (a) Cutting, bending of all reinforcement shall be allowed with bar bending machine and also by manually. But heating shall not be permitted.
- (b) All reinforcement steel shall be HYSD.

SECTION 1100**PILE FOUNDATIONS****Sub-Section 1102.**

Add following to the specifications

- (a) Only large diameter bored cast in situ piles constructed using of hydraulically operated rotary drilling machines similar to Bauer B.G. Series piling machines will be preferred, other kind of machine for boring shall also be permitted. Regular tripod rigs also shall be allowed.
- (b) The liner to piles shall be of mild steel conformity to IS 226/IS 2062 weldable quality. The methodology and equipment for providing M.S. Liner shall be got approved. The liner shall be fabricated truly in cylindrical shape with inner dia equal to diameter of pile. The bottom shoe of liner of 12 mm thick shall attain minimum height provided and placed in position prior to driving 6 mm thick M.S. Liner. The M.S. Liner shall be painted with one coat of Zinc rich primer and two coats of Coal for epoxy. Care shall be taken that the shape of liner does not change while driving.

SECTION 1500**FORM WORK****Sub-Section 1502**

The form work used shall be made preferably of marine ply wood properly stiffened, such as DOKA /PERI type form work

**Sub-Section 1510.1**

The form for piers shall be provided such that concreting of piers from 0.5m below ground upto pier cap bottom shall be done for full height in one pour without any construction joint. Form Work shall be properly designed. The formwork shall be such that it either requires no supports or supports do not protrude outside permissible working area and provided within the carriageway.

For pier cap also the shuttering shall be such that it is possible to erect it as a single piece with the help of crane in very short time. It also shall be supported only from the already constructed pier below it.

SECTION 1700**STRUCTURAL CONCRETE**

The work shall consist of forming and placing of concrete. All concrete preferably shall be ready mixed concrete except for railway portion. For railway portion necessary approval to use of RMC from the railway authorities shall have to be sought by the contractor if he proposes so.

SECTION 1702**Materials**

No creek sand shall be allowed in concreting. Only crushed sand and or river sand from approved source shall be allowed. The suspicious aggregates shall be dealt in accordance with IS 2386 (part VII) for alkali aggregate reactivity.

SECTION 1705**ADMIXTURES**

Calcium/Chloride shall not be used, Air entraining, agents workability aids retarding agents may be used if permitted by the Engineer.

SECTION 1707

**EQUIPMENT**

The Equipment for production, Transportation and compaction of concrete shall be as under

- (a) For Production of concrete
 - (i) Deleted
 - (ii) For all concrete work – batching and mixing Plant fully automatic with electronic controls or Mini mobile batching plant with adequate capacity as approved by the Engineer. Ready Mixed Concrete if RMC is used.
- (b) For concrete Transportation – Transit truck, mixer, concrete distributor booms, tremies, cranes etc if RMC is used.
- (c) Weigh - Batching for concrete mixed at site is compulsory if RMC is not used.

SECTION 2000**BEARINGS**

The bearings shall be only Pot PTFE with cast steel plates. The bearings shall be procured only from manufactures approved by MSPGCL/MOST.

SECTION 2300**SUPERSTRUCTURE**

Only following type of superstructure shall be allowed.

Superstructure with precast / prefabricated /cast in situ elements in pre/post tensioned Box/ Voided Slab/ Prestressed girders with cast-in-situ slabs for obligatory and not obligatory spans.

RCC Superstructure is not permitted.



For Railway portion superstructure shall be provided as approved by Railway authority.

SECTION 2309

Protective Coating to the faces of superstructure shall be as per design criteria and scope of work

SECTION 2600**EXPANSION JOINTS**

The Expansion Joints shall be strip seal /modular strip seal as per requirement and shall conform to latest MOST specifications and shall be procured only from manufactures approved by MSPGCL/ MOST.

3.0 SPECIFICATIONS FOR BITUMINOUS BOUND MACADAM (BBM)

Item: Providing and laying 50/75 millimetre thick bituminous bound macadam road surface including supplying all materials, preparing the existing road surface, spreading 40 mm. stone metal layers, heating and spraying the bitumen, spreading 12 mm. size chips compacting with vibratory roller etc. complete.

- (a) Including picking of existing W.B.M./W.M.M. surface.
- (b) Including applying tack coat at the rate of 50 Kg/100 Sqm. on existing bitumen surface.

3.1 GENERAL

The work consists of supply of materials and labour required for providing and laying bituminous bound macadam surface for compacted thickness of 50/75 mm. This item includes preparing the existing road surface to receive the bituminous bound macadam course i.e. picking the existing W.B.M./W.M.M. surface or application of tack coat on existing B.T. surface spreading of 40 mm size metal layer in required thickness with compaction with vibratory roller heating and spraying bitumen with sprayer etc. spreading key aggregates 12 mm chips and final compaction with vibratory

roller etc. complete and finishing in accordance with the requirement in close conformity with grades lines, cross sections and thickness as per approved drawings etc. complete.

3.2 DIVERSIONS

Temporary diversions shall be constructed and maintained by the contractor at his own cost. Diversion shall be watered if dust is likely to blow onto the road being bituminised.

3.3 MATERIALS

3.3.1 Aggregates

The aggregates for providing B.B.M. surface shall comply with specification Nos. Rd-41 for 40 mm. and 12 mm. size metal, and shall normally comply with the following regarding size and quantity of aggregates and grade and quantities of bitumen.

Description	Rate of application for 100 sqmt.			
	75 mm.		50 mm.	
	On asphalt surface	On W.B.M. surface	On asphalt surface	On W.B.M. surface
(a) 40 m. size crusher broken metal	9.00 cum	9.00 cum	6.00 cum	6.00 cum
(b) 12 mm. size chips.	1.8 cum	1.8 cum	1.2 cum	1.2 cum
(c) Bitumen for grouting I.S. Grade	200 kg.	200 kg.	175 kg.	175 kg.
S 35 with 30/40 penetration or S 65 with 60/70				

penetration				
(d) Tack coat for existing bituminous surface	50 kg.	--	50 kg.	--

3.3.2 Bitumen

The bitumen shall be paving bitumen of suitable penetration grade within the range S 35 to S 65 & A 35 to 65 (30/40 to 60/70) as per Indian Standard Specification for "Paving bitumen" IS: 73-1992.

3.4 PREPARING THE BASE

Any pothole in the existing bituminous road surface and broken edges shall be patched well in advance and the surface shall be brought to correct level and camber with additional metal and bitumen as required which will be paid separately. Before starting the work the bituminous surface shall be swept clean of all the dirt, mud cakes, animal droppings other loose foreign material.

If so required by the Engineer, the contractor shall keep the side width & nearby diversion watered to prevent dust from blowing over the surface to be bituminised.

Existing W.B.M./W.M.M. surface shall be picked for and surface loosened for a depth of 2.5 cm. and the picked surface shall be brought approximately to the correct camber and section. Edge line shall be correctly marked by dog belling the surface to form a continuous notch.

There shall always be sufficient length of prepared surface ahead of the bituminous surfacing operations as directed by the Engineer to keep these operations continuous.

3.5 TACK COAT ON BITUMEN SURFACE

Applying tack coat for existing B.T. surface only at the rate of 50 Kg./100 m² as per specification No. Rd-47.3.3.

3.6 PICKING OF EXISTING W.B.M./W.M.M. SURFACE

Picking of existing W.B.M. surface for receiving Bituminous Bound Macadam as per Rd-33.

3.7 SPREADING AND COMPACTION.
3.7.1 Spreading of 40 mm. Size metal

40 mm. size metal shall be spread only at the specified rate of 9 cubic meter/6 cubic meter per 100 square meter of area so as to form a layer over the width of road with correct camber/super-elevation as required. Any foreign matter, organic matter, dust, grass etc. shall be removed immediately. The sections shall be checked with camber board and straight edge batten etc. Any irregularities shall be made good by adding aggregates in case of depressions and removing aggregates from high spots checked with camber board and straight edge batten etc. Any irregularities shall be made good by adding aggregates in case of depressions and removing aggregates from high spots.

3.7.2 Compaction of 40 mm. Size metal.

The surface of 40 mm. size metal layer after bringing it to necessary grades and sections shall be rolled with the use of vibratory roller. Rolling shall commence from the edges and progress towards center longitudinally except on super elevated portion where it shall progress from the lower to upper edge parallel to the centerline of pavement. When the roller has passed over the whole area any high spots or depressions, which become apparent shall be corrected by removing or adding aggregates. The rolling shall then be continued till the entire surface has been rolled to desired compaction such that there is no crushing of aggregates and all roller marks have been eliminated. Each pass of roller shall uniformly overlap not less than one third of the track made in the preceding pass.

3.8 APPLICATION OF BITUMEN.

Bitumen of I.S. grade S. 35 or S. 65 supplied for the work shall be heated to temperature of 177⁰ Celsius to 191⁰ Celsius (350⁰ F. to 375⁰ F.) in a bitumen boiler and temperature shall be maintained at the time of actual application.

The hot bitumen shall be applied through a pressure sprayer on the road surface uniformly at the rate of 200 Kg./100 Sqmt. or 175 Kg./100 Sqmt. The road surface shall be divided into suitable rectangles marked by chalk so as to ensure correct rate of application of the bitumen.

3.9 KEY AGGREGATES

On completion of bitumen application, 12 mm size key aggregate shall be spread immediately at a uniform rate of 1.8 cubic meter/1.2 cubic meter per 100 square meter of area when entire surface is in hot condition. Brooms shall be used to ensure even, distribution of key aggregates.

3.10 FINAL COMPACTION

Immediately after spraying of bitumen and spreading of key aggregates, the surface shall be rolled with a vibratory roller to obtain full compaction and to force the blindage of key aggregates into the interstices of the coarse aggregate. The rolling shall continue till the asphalt surface hardens and key aggregates stop moving under roller.

3.11 SURFACE FINISH AND QUALITY CONTROL.

The surface finish shall confirm to requirements of clause 902 of specification for Road and Bridges by Ministry of Surface Transport. Quality Control Test and their frequencies shall be as per table below.

Sr. No.	Test	Frequency
(a)	Quality of binder.	Two samples per lot to be subjected to all or some test as directed by the Engineer.
(b)	Aggregate Impact Value.	One test per 200 cubic meter of aggregate.
(c)	Flakiness Index and Elongation Index.	One test per 200 cubic meter of aggregate.

(d)	Stripping value	Initially one set of three representative specimen for each source of supply, subsequently when warranted by changes in the quality of aggregate.
(e)	Water absorption of aggregates.	Initially one set of three representative specimen for each source of supply, subsequently when warranted by changes in the quality of aggregate.
(f)	Aggregate grading.	One test per 100 cubic meter of aggregate.
(g)	Temperature of binder at application.	At regular close intervals.
(h)	Rate of spread of binder.	One test per 500 square meter of area.

3.12 ITEM TO INCLUDE

3.12.1 Diversions unless separately provided in the tender.

3.12.2 Preparing the road surface.

3.12.3 Applying tack coat on existing B.T. or Picking the existing W.B.M./W.M.M. surface.

3.12.4 Supplying, spreading and compaction of 40 mm size aggregates.

3.12.5 Supplying, heating and spraying bitumen.

3.12.6 Supplying, spreading and compaction of 12 mm size chips.

3.12.7 All labour, materials, including bitumen and aggregates, use of tools, plants and equipment for completing the item satisfactorily.

4.0 SPECIFICATIONS FOR RETRO-REFLECTIVE SHEETING

4.1 GENERAL REQUIREMENTS

The retro-reflective sheeting used on the sign shall consist of the white or coloured sheeting having a smooth outer surface, which has the property of retro-reflection over its entire surface. It shall be weather – resistant and show colourfastness. It shall be new and unused and shall show no evidence of cracking scaling, pitting, blistering, edge lifting or curling and shall have negligible shrinkage or expansion. A certificate having tested the sheeting for these properties in an unprotected outdoor exposure (stating retained reflection of 80%) facing the sun for three year and its having passed these tests shall be obtained from a reputed independent test laboratory, by the manufacturer of the sheeting of the sheeting and the same should be submitted while taking up the actual work.

The retro reflective sheeting shall be of wide-angle prismatic lens type of ASTM Type-IX.

4.2 The retro reflective sheeting shall be of wide angle Prismatic lens type, consisting of cube corner lenses and pressure sensitive adhesive and should be applied to the sign substrate at room temp 18°C, transparent, waterproof of plastic having smooth surface. The coefficient of retro reflective as determined in accordance with STM standard E-810 shall give the minimum values as indicated in table given below.

TABLE – 1

**Minimum coefficient of Retro-reflection for retro-reflective sheeting
Prismatic lens type candelas / lux / sq.m)**

Observation Angle (in deg.)	Entrance Angle (in deg.)	White	Yellow	Green	Red	Blue
0.1	-4	660	500	66	130	30
0.1	+30	370	280	37	74	17

0.2	-4	380	285	38	76	17
0.2	+30	215	162	22	43	10
0.5	-4	240	180	24	48	11
0.5	+30	135	100	14	27	6
1.0	-4	60	60	8	16	3.6
1.0	+30	45	34	4.5	9	2

When totally wet, the sheeting shall not show less than 90% of the values of retro reflectance indicated in Table 100-1. At the end of 7 years, the sheeting shall retain at least 75% of the original retro reflectance.

4.3 MESSAGES / BORDERS

The messages (legends, letters, numerals etc.) and borders of cautionary / regulatory signboards shall be screen – printed, Screen – printing shall be processed and finished with materials and in a manner specified by the sheeting manufacturer and shall be bonded with the sheeting in the manner specified by the manufacturer. The message (Legends, letters, numerals etc.) and borders of information signs, shall be of cut letters made in transparent overlay film pasted over the base sheeting with pressure sensitive adhesive or as instructed by the manufactures or as directed by the Engineer.

4.4 For screen-printed transparent coloured areas on white sheeting the coefficient of retro-reflection shall not be less than the values of corresponding colours in Tables.

4.5 Cut-out message and borders, wherever used, shall be made in transparent film applied on base sheeting with pressure sensitive adhesive with the coefficient of retro reflection shall not be less than the valued of corresponding colour in Tables-1. For background colour of the sign the coefficient of retro reflection shall not be less than the specified in table no. 1 for the respective colours.

4.6 COLOUR

Colour shall be as specified and shall conform to the requirements of table II. Conformance to colour requirements shall be determined spectrophotometrically in accordance with STM E 1164, with instruments utilizing either 45/0 or 0/45 illumination/viewing conditions or tolerances as described in ASTM E 1164 for retro-reflective materials.

Article I. Table-II

								Reflectance Limit (y)		
Colour	X	y	x	y	x	y	x	y	Min	Max
White	.30	.3	.35	.35	.33	.37	.28	.32	40.0	
Yellow	.48	.42	.54	.45	.46	.53	.42	.48	24.0	45.0
Red	.69	.31	.59	.31	.56	.34	.65	.34	3	15
Blue	0.7	.17	.15	.22	.21	.16	.13	.03	1.0	10.0
Green	.03	.39	.16	.36	.28	.44	.20	.79	3.0	9.0

The four piers of chromaticity co-ordinates determine the acceptable colour in terms of CIE 1931 standard colorimetric system measured with standard illumination source D65 – these colures are equivalent to those listed in ASTM D4956 using source C.

The colour shall be durable and uniform in acceptable value when viewed in daylight or under Normal headlights at night.

4.7 ADHESIVES

The sheeting/firm shall have a pressure sensitive adhesive of the aggressive tack type requiring no heat, solvent or other preparation for adhesion to a smooth clean surface. The adhesive shall be protected by an easily removable liner (removable by peeling without soaking in water or other solvent) and shall be suitable for the type material of the base plate such that it shall not be possible to remove the sheeting from the sign base in one piece by use of sharp instrument. The adhesive shall form a durable bond to

smooth, corrosion and weather resistant surface of the base plate. In case of pressure sensitive adhesive sheeting, the sheeting shall be applied in accordance with the manufacturer's specifications reflective sheeting. If the surface is rough, approved surface primer may be used. After cleaning metal shall not be handled, except by suitable or clean canvas gloves, between all cleaning and preparation operation and application of reflective sheeting / primer. There shall be no opportunity for metal to come in contact with grease, oil or other contaminants prior to the applications of retro-reflective sheeting.

- 4.8 Complete sheets of the materials shall be used on the signs except where it is unavoidable, at splices; sheeting with pressure sensitive adhesives shall be overlapped not less than 5 mm. When screen-printing with transparent colours is proposed, only but jointing shall be used. The material shall cover the sign surface evenly and shall be free from twists, cracks and folds. The transparent overlay film in which cutout messages have been made shall be bounded with sheeting in the manner specified by the manufacturer.

4.9 **WARRANTY AND DURABILITY**

The contractor shall obtain from the manufacturer a seven year pre-qualification warranty for satisfactory field performance including stipulated retro-reflectance of the retro-reflective sheeting of Prismatic lens type and that of transparent film before taking up actual work. In addition, a seven year warranty for satisfactory in field performance of the finished signs with retro-reflective sheeting of Prismatic lens type, inclusive of the screen printed or cut-out letters/legends, transparent film and their bonding to the retro-reflective sheeting shall be obtained before taking up actual work. The contractor / supplier shall also furnish a certification that the signs and materials supplied against the assigned work meets all the stipulated requirements and carry the stipulated warranty.

Warranties should be given in original and should have legal jurisdiction in India. Warranties given by power of attorney holders will not be acceptable.

Processed and applied in accordance with recommended procedures, the reflective material shall be weather resistant and following, cleaning, shall show no appreciable discoloration, cracking, blistering or dimensional change and shall not have less than 50 per cent of the specified minimum

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reflective intensity value (Table 100-1) when subjected to accelerated weathering for 1000 hours, using type E or EH weatherometer (AASHTO Designation M 268)

Special Conditions of the Contract

* The contractor shall obtain from the manufacturer a seven year pre-qualification warranty for satisfactory field performance including stipulated retro-reflectance of the retro-reflective sheeting of Prismatic lens type and that of transparent film before taking up actual work.

* A certificate of having tested the sheeting for these properties in an unprotected outdoor exposure (stating retained reflection of 80%) facing the sun for three years and its having passed these tests shall be obtained from a reputed independent test laboratory, by the manufacturer of the sheeting and the same should be submitted to the Engineer before taking up actual work.

Customer Name :

Name of Work :

Due on :

CONSULTANT : PROCON ENGINEERS

PRE-QUALIFICATION WARRANTY

This is to certify that Micro-prismatic Retro-reflective Sheeting of ASTM type-IX supplied by ABC to M/s XYZ for Retro Reflective signboards as mentioned above will conform to published specifications. ABC and M/s XYZ the sign fabricators, jointly and severally agree to repair or replace at their option, warranted Retro reflective signboard fabricated by M/s XYZ, from Micro-prismatic Retro-reflective Sheeting of ASTM type – IX and supplied to you by M/s. XYZ, provided:

- 1) The sign is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions by a driver with a normal vision, and
- 2) The coefficient of retro-reflection at the end of 7 years is less than 75% of values as specified in the following table:

Observation Angle (in deg.)	Entrance Angle (in Deg.)	White	Yellow	Green	Red	Blue
0.1	-4	660	500	66	130	30
0.1	+30	370	280	37	74	17
0.2	-4	480	285	38	76	17
0.2	+30	215	162	22	43	10
0.5	-4	240	180	24	48	11
0.5	+30	135	100	14	27	6
1.0	-4	60	60	8	16	3.6
1.0	+30	45	34	4.5	9	2

All measurements shall be made after cleaning according to sheeting manufacturer's recommendations.

ABC LIMITED

XYZ

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4.10

ARRANGEMENT FOR TRAFFIC:

The contractor shall at all times carry out work on the road in manner creating least interference to the flow of traffic while consistent with the satisfactory execution of the same. The contractor shall in accordance with directions of Engineer provide and maintain, during execution a clear passage for traffic along part of the existing carriageway or along a temporary diversion as directed if it is found necessary. When the traffic can be allowed on the roadside berms without much inconvenience to the traffic or impediment to the work, this shall be provided by the contractor at his own cost.

4.10.1

Traffic safety and control:

The contractor shall take all necessary measure for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, marking, flags, lights and flagmen as may be required by Engineer for information and protection of traffic approaching or passing through the section of pavement under improvement. The sign set up shall be of approved design and of refractory type, temporary warning lamps shall be installed at the barricades during the hours of darkness and kept light at all times, during these hours.

4.10.2

Maintenance of diversion and traffic control devices:

Signs, lights, barricades and other traffic control devices as well as the riding surface of diversions shall be maintained in satisfactory condition till such time they are required by the Engineer. The temporary travelled way shall be kept free of dust by frequent application of water if necessary.

4.11

PRECAUTIONS WHILE WORKING IN THE VICINITY OF TRACK:

4.11.1

When the work is required to be done along or near existing railway track, the contractor(s) shall take steps as are necessary for the safety of the track labour working at site. He / They will also be required to make Programme of his/their work so as not to interfere with the movement of trains. No extra payment shall be allowed for these precautions and also for crossing track/tracks required during execution of the work. It should be ensured

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that the ballast of the railway track(s) is not spoiled or mixed with earth or disturbed.		
4.11.2	In addition to the precautions taken by the contractor for the safety of the track and labour, it may be necessary to post flagmen in some locations as an additional safety measure. The contractor(s) shall be fully responsible for any damage to or trespass caused by his/their men to surrounding structure, MSPGCL bears no liability whatsoever on this account.	
4.11.3	Instruction given by Railway Authority regarding safety shall be strictly followed during execution of work.	
4.12	<u>SAFETY PRECAUTIONS :</u>	
4.12.1	The Contractor/s shall at all times adopt such safe methods to work as will ensure safety of structure, equipment and labour. If at any time the MSPGCL finds the safety arrangements unsafe, the contractor/s shall take immediate corrective action as directed by the MSPGCL in the matter. This shall in no way absolve the contractor/s of his/their sole responsibility to adopt safe working methods.	
4.12.2	The Contractor/s shall design and execute temporary works such as formwork and supports, so as to ensure absolute safety of contractor/s personnel as well as Consultant/MSPGCL staff and personnel engaged on the work. The Contractor/s should indemnify the MSPGCL against damages and injury to workmen. MSPGCL reserves the right to enforce safety regulations on the contractor/s and recover any cost, which may be incurred for the purpose.	
4.12.3	Whenever a lorry or any other form of road transport is required to ply along or in the vicinity of a running line or any other railway track where railway Engines or trains are scheduled to move, the contractor shall inform the Engineer in writing of such requirement specifying the locations and the duration of time over which such specified road vehicles have to operate in the area (for loading, leading or unloading of earth, ballast or any other material, plant or equipment) without any obstruction or dislocation to the running of trains. The contractor also should furnish the particulars of vehicles and the name and photograph of drivers and attendants retained for each legal to enable the engineer to issue necessary along the holder to	

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	operate the vehicles, with such restrictions regarding the durations and / or locations as are considered necessary. Such permit shall be returned to the engineer as soon as the work for which it is issued is over.	
4.12.4	The contractor shall execute a bond undertaking to ply to road vehicles in a safe and satisfactory manner and strictly in accordance with the stipulations and other conditions specified by the engineer and to engage and retain only the permit holder to be the contractor agent in charge of the vehicles, while driving or a rest. The person in charge of the vehicles in the attendant shall at all times be vigilant and on the look out for signals from the look out men, flagmen or other personnel available at site with a view to stop for regulate the road movement so as to ensure adequate margin of safety for the timely passage of an approaching train or railway engine, without any delay or detention.	
4.12.5	The contractor shall also be bound by the provision of this agreement, to ply the road vehicles only with adequate margin of safety, well clear of the fixed structure profile of infringement, as stipulated in the rules made under the Indian Railway Act and to seek and be guided by the signal and other directions of any lookout men for other personnel retained for the purpose of ensuring safety, and to ensure care and vigilance while turning, reversing or moving the road vehicle in any other manner, at an inclination to the running railway track or the siding, as the case may be.	
4.12.6	The contractor also undertakes to make good at his own cost any inconvenience, loss, damage, or other expenses caused to or incurred by the railway administration and to pay such amount as determined by the engineer to be recoverable from the contractor as penalty or damage for any omission, negligence, careless, oversight or accidents on the part of any of the contractor's agents, drivers or attendant or any person to whom the services of the holder of the permit (issued by the Engineer) has been lent other wise made accessible or available.	
4.12.7	Any breach of these conditions by the contractor and/or his agent affecting the safety of movements of trains, engines or other rolling stock of the Railway shall constitute a breach of contract by the contractor entailing liability for termination of contract for default on the part of the contractor.	

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4.12.8	The Tenderer/s will be permitted to make use of the level crossing for crossing the track after observing the standard railway safety precaution. If such precautions are not taken these will be enforced by the railway by adequate arrangements and the cost thereof shall be recovered from the contractor.
4.12.9	The contractor/s shall inspect the proposed site of work and acquaint himself / themselves with site conditions working hours storing spaces for materials, approach road / pathway available etc. and all relevant items connected with the execution of work. No. claim shall be entertained from contractor/s and shall make his own arrangements for approach/approach roads from out side railway land and contractor will bear entire expenses such as road taxes payment on right of way etc. to outsiders.
4.13	<u>PROTECTION AT THE WORKS SITE :</u>
4.13.1	On Railway track where the train traffic will be operational during the execution of the contract work, the protection of the works site as considered appropriate and adequate shall be arranged by the contractor at his own cost.
4.13.2	Notwithstanding the aforementioned protection at the works site provided by the Engineer's representative, the contractor shall be responsible for providing appropriate and adequate system for warning the contractor's workmen about the train traffic on or in the vicinity of the site of work. The decision of the Engineer's representative whether the facilities provided by the contractor in this regard are appropriate and adequate or not, shall be final and conclusive. In case of non-following of instruction issued by Railway/MSPGCL by the third party quality audit agency, the MSPGCL shall have the right to terminate the agency and direct the contractor to appoint another agency duly approved by the Railway.
4.14	<u>WORKS DURING BLOCK PERIOD</u> For excavation nearer to the Railway track proper shoring and strutting shall be used, shoring and strutting arrangement shall be approved by the Railways.

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4.15	Incase of any accident during construction due to which the Railway undergone monetary or structural losses, it is the responsibility of the contractor to bear such losses. Any assessment made by the Railway shall be binding on the contractor.
4.16	Supervision of the works within the Railway boundary shall be done by the Railway as well. Any instructions given by the Railways regarding the works shall be binding on the contractor. Contractor shall arrange for the necessary conveyance for the officers of Railways for the supervision/inspection of the portion of works within the Railway boundary.
4.17	Precast concrete panel for shuttering below the deck slab is not permitted for the works within the Railway boundary. Necessary removable shuttering shall be provided by the contractor. Arrangements for shuttering for deck slab shall be planned and designed by the contractor by providing sleeve holes into the web of the girder.
4.18	<u>BLOCK DURING LAUNCHING & ANY OTHER ACTIVITY :</u>
4.18.1	It is the responsibility of contractor to arrange necessary blocks from Railways during launching operation or any other activity requiring blocks. Necessary assistance however shall be provided by MSPGCL. The necessary charges payable to Railways in this regard as required and demanded by Railway authority shall be borne by the Contractor.
4.18.2	The contractor shall ensure that block period sanctioned is not violated. The contractor shall be liable for penalty for each block bursting for an amount if claimed by Railways towards bursting of block. So, also, prolongation of caution order than the agreed programme will be liable for penalty if claimed by the Railways. Any expenditure on this account shall have to be borne by the Contractor.

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5.0

**SPECIFICATION FOR ELECTRIFICATION OF ROAD OVER BRIDGE
(SPECIFICATION FOR THE ELECTRICAL WORK)**

5.1

THE FOLLOWING WORK SHALL BE CARRIED OUT BY THE CONTRACTOR.

5.1.1

415 Volts Feeder Pillar:

Feeder Pillar panel rated for 415 Volts, 3 phase, 4 wire, 50 HZ, supply, pedestal/bracket mounting, cubical type weather proof, suitable for outdoor installation, complete with double door, canopy arrangement and including civil foundation. Internal painting shall be milky white, external Opaline green. Sheet steel enclosure shall be fabricated out of 14 SWG thick sheet. Suitable gland plates and stud type terminations shall be provided at top/bottom for entry and exit of following cables.

Incoming - 3 1/2C x 50 sqmm.

Outgoing - 4C x 16 sqmm.

The feeder pillar shall be mounted over a suitable civil foundation with a clear height of 500 mm from finished ground level. Rate quoted shall included associated civil works.

5.1.2

Feeder Pillar - 1&2

Incoming feeder shall have 1 No.4 pole, 40 Amps MCB with shunt release, 1 No. core balance CT with earth leakage relay setting range from 0.5 - 2 amps, 3 Nos. current transformers - ring type ratio 25/5 Amps, 15VA, accuracy class-1, 1 No. Ammeter with Selector Switch - digital type, 1 No. Voltmeter ith selector switch - digital type, 1 No.25 Amps, 3 pole AC - 3 duty contactor, 1 No.16A time switch with running reserve time 100 Hrs. MDS - Legrand make, type - MaxiRex Qt (24 Hrs)-49754. 3 Nos. current transformers - ring type ratio 25/5 Amps, 15VA accuracy class - 1 for KWH meter. Provision for mounting 1 No.KWH meter and 3 Nos. CT's in a separate sealable compartment.

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	Outgoing feeder consisting of 1 No.25 Amps, 4 pole MCB, 3 Nos.20 Amps TPN MCB's, 2 Nos. 20 Amps TPN MCB as spare, 2 Nos. On/Off push buttons.	
5.1.3	Luminaire	
	Street Light Luminaire complete with polyester filled copper wound ballast, electronic ignitor, capacitor, mains connector and earthing terminal. Luminaire to be provided with 1x250 Watts HP Mercury Vapour Lamp. Philips make-Type CRP 330/250W or equivalent.	
5.1.4	Octagonal Poles	
	Poles with 9M mounting height galvanized octagonal pole (of fixture from road level) with double and decorative brackets as per Deg.No.E&PBU-SL-WR-015-00IR. Poles to be fixed on Median verge only.	
5.1.5	M.S.Sleeve	
	MS Sleeve of 160mm ID and 1000mm height provided with base plate 12mm thick 400mm square MS plate suitably anchored to the crash barrier.	
	Note :	
	The light poles shall be inserted in to MS sleeves and suitable anchored with fasteners. The lighting poles shall have a 75mm diameter opening at sides to receive the cables from its associated junction box through a inclined rigid PVC pipe. An earth strip of 25x3mm GI – 150mm length shall be provided for each pole as shown in the drawing. 4 core cables for street light poles shall be terminated with loop in and loop out facilities/termination proper. Generally the spacing between poles to be maintained at 25 mtrs. and quality of poles are indicative and may marginally vary depending on site conditions.	
5.1.6	Junction Box / Light Controls Mcb Box	
	Weather proof junction box for road lighting luminaries for road above flyover mounted/embedded into crash guard /concrete pedestal, fabricated out of 14 SWG sheet steel consisting of one number 6 way terminal suitable	

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	for entry/exit of upto 4x16 sqmm. AI Conductor Cable and 1 No. 20 Amps DP MCB and earth terminal with suitable termination / looping in and looping out of its associated phases and neutral conductors.	
5.1.7	1.1 KV Grade Pvc Insulated Armoured Aluminium Conductor Cables And Terminations. Supply and laying 1100 volts grade, PVC insulated aluminium conductor, steel wire armoured power cable. The cable shall be laid indoor/outdoor. The rate shall include laying as per specification. Brick sand backfilling etc., for outdoor laying. Cable shall be clamped at regular intervals using clamps and fasterers. (Length of the cable indicated is approximate. Exact length of the cable shall be ascertained as per the site condition before supplying the same to site.) 3 1/2 x 50 sqmm – incoming cable, 4 x 16 sqmm (These cables shall be run through 75mm dia PVC pipes laid in crash battier.	
5.1.8	Codes & Standards The design manufacture, testing and supply of the cables under this specification shall comply with the latest revisions including amendments of the following standards. (a) IS : 7098-I - XLPE insulated heavy duty cables for working voltages upto 1100 volts. (b) IS : 3961-II - Recommended current ratings for cables. (c) IS : 8130 - Conductors for insulated cables. (d) IS : 5831 - XLPE insulation and outer sheath of electric cables. (e) IS : 7098-I - Test Procedures for cables. (f) IS : 10418 - Specification for drums for electric cables. (g) IS : 3975 - Mild steel wire, strips, and tapes for armouring of cables.	

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5.1.9 Technical Requirements: 5.1.9.1 All XLPE Aluminium / Copper Power Cables shall be 1100 volts grade, multi core constructed as IS : 7098 Part-I of 1988 as follows : (A) Standard Aluminium / Copper conductor in case of 10 sq.mm and above and solid conductor in case of 10 sq.mm and below. (b) All Aluminium / Copper XLPE cables insulation shall be of high grade Cross-linked Polyethylene from insulation for extrusion process. (c) Cores laid-up. (d) The inner sheath should be bounded over with termo-plastic material for protection against mechanical and electrical damage. (e) Armouring should be provided over the inner sheath to guard against mechanical damage. Armouring should be galvanized steel wires or galvanized steel strips. (In single core cables used in A.C system armouring should be non-magnetic hard aluminium Wires / Strips. (f) The outer sheath should be specially formulated heat resistant black PVC compound conforming to the requirement of type ST2 of IS : 5831-1984 extruded to form the outer sheath. 5.1.10 Conductor shall be of electrolytic Aluminium / Copper conforming to IS : 8130 and are compact circular or compact shaped. 5.1.10.1 Insulation shall be of XLPE type as per latest IS general purpose insulation for maximum rated conductor temperature 70 degree centigrade. 5.1.10.2 In inner sheath laid up core shall be bounded over with thermoplastic material for protection against mechanical and electrical damage. 5.1.10.3 Insulation, inner sheath and outer sheath shall be applied by extrusion and lapping up process only.		

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5.1.10.4 Armouring shall be of galvanized steel wire / flat.

5.1.10.5 Repaired cables shall not be used.

5.1.10.6 Current ratings of the cables shall be as per IS : 3961.

5.1.11 XLPE Cables:

 The XLPE insulated cables shall conform to latest revision as read along with this specifications.

 The Conductor shall be stranded Aluminium / Copper circular / sector shaped and compacted.

 In multi core cables the core shall be identified by red, yellow, blue and black colouring of insulation.

 The XLPE insulated 1100 volts grade power cables shall conform to latest IS and shall be suitable for a steady conductor temperature of 70 degree centigrade.

 The conductor shall be stranded Aluminium / Copper as called for in the Schedule of Quantities.

 The outer sheath shall be as per the requirement of type ST-2 of IS:5831 of 1984.

5.1.12 Supply and Laying Of Cables

 The cables shall be suitable for laying in racks, ducts, trenches, conduits and underground buried installation with uncontrolled back fill and chances of flooding by water.

 Progressive automatic in line sequential marking of the length of cables in meters at every one meter shall be provided on the outer sheath of all cables. Cables shall be supplied in non returnable wooden drums as per IS : 10418.

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Both ends of the cables shall be properly sealed with PVC / Rubber caps so as to eliminate ingress of water during transportation, storage and erection.

5.1.13 Test and Test Reports

Cables shall be subjected to type tests, acceptance tests and routine tests as per 7098 Part-I. Four (4) copies of all test reports shall be submitted for approval to the Engineer.

5.1.14 Drawings and Data

The contractor shall furnish technical particulars of cables type, make and catalogue for the approval of Engineer.

5.1.15 The product should be coded as per IS – 7098 Part-I and the codes shall be as follows:

Aluminium Conductor	A
XLPE Insulation	2X
Steel round wire armour	W
Steel strip armour	F
Steel Double round wire armour	WW
Steel Double strip armour	FF
Non-magnetic (A1) round wire armour	Wa
Non-magnetic (A1) strip armour	Fa
PVC outer sheath	Y

5.1.16 End Termination

Cable and terminations for 1.1 KV grade PVC insulated armoured heavy duty aluminium conductor cables complete with double compression type brass cable glands, crimping type aluminium lugs, necessary insulation type etc., complete in all respects.

5.1.17 Installation of MV Cables

5.1.17.1 General

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(A) MV Cables shall be inspected prior to laying, laid tested and commissioned in accordance with drawings, specifications, relevant Indian Standards Specifications and cable Manufacturer's instruction. The Cable shall be delivered at site in original drums with manufacturer's name drum No. length and size of cable clearly written on the drum. (b) The recommendations of the cable manufacturers with regard to jointing and sealing shall be strictly followed. 5.1.17.2 Inspection (a) All cables shall be inspected upon receipt at site and checked for any damage during transit. (b) While selecting cable routes, corrosive soils, ground surrounding sewage effluent etc., shall be avoided; where this is not feasible, special precautions as decided by the Engineer-in-charge, shall be taken. Street lighting and Service line to each area have separate route. 5.1.17.3 Proximity to communicate Cables Power and communication cables shall as far as possible cross at right angles. Where power cables are laid in proximity to communication cables the horizontal and vertical clearances shall not normally be less than 60 cms. 5.1.17.4 Laying Methods (a) Cables shall be laid direct in ground, in pipes/closed ducts, in open ducts or on surface depending on environmental and site conditions. (b) During the preliminary stages of laying the cables, consideration should be given to proper location of the joint position so that when the cables are actually laid the joints are made in the most suitable places. As far as possible water logged locations, carriage ways, pavements, proximity to telephone cables, gas of water mains, inaccessible places, ducts pipes racks etc., shall be avoided for joint position.		

5.1.17.5 Laying direct in ground

General

This method shall be adopted where the route is through open country, along roads/lanes etc., and where no frequent excavations are encountered and where re-excavations is easily possible without affecting other services.

5.1.17.6 Trenching

Width of Trench

The width of the trench shall first be determined on the following basis :

- (a) The minimum width of trench for laying single cable shall be 35 cm.
- (b) Where more than one cable is to be laid in the same trench in horizontal formation, the width of trench shall be increased such that the inter-axial spacing between the cables, except where otherwise specified shall be atleast 20 cm.
- (c) There shall be a clearance of atleast 15 cm. between axis of the end cables and the sides of the trench.

5.1.17.7 Depth of Trench

The depth of the trench shall be determined on the following basis

- (a) Where cables are laid in single tier formation, the total depth of trench shall not be less than 75 cm for cables upto 1.1 KV and 1.20 m for cables above 1.1 KV.
- (b) When more than one tier of cables is unavoidable and vertical formation of laying is adopted, depth of trench in above shall be increased by 30 cm. for each additional tier to be formed.

5.1.17.8 Laying of Cables in Trench

- (a) At the time of issue of cable for laying the cores shall be tested for continuity and insulation resistance.
- (b) When the cable has been properly straightened, the cores are tested for continuity and insulation resistance and the cable is then measured. The ends of all lead sheathed cables shall be sealed with solder immediately. In case of PVC cables suitable moisture seal tape shall be used for this purpose.
- (c)
 - (i) Cable laid in trenches in a single tier formation shall have a covering of clean dry sand of not less than 17 cms above the base cushion of sand before the protective cover is laid.
 - (ii) In the case of vertical multi-tier formation after the first cable has been laid, a sand cushion of 30 cms shall be provided over the initial bed before the second tier is laid. If additional tiers are formed, each of the subsequent tiers also shall have a sand cushion of 30 cms. as stated above. The top most cable shall have a final sand covering not less than 17 cms. before the protective cover is laid.
- (d) At the time of original installation, approximately 3m of surplus cable shall be left on each end of the cable and on each side of underground joints (straight through/Tee/Termination) and at entries and places as may be decided by the Engineer. The surplus cable shall be left in the form of a loop. Where there are long runs of cable length, loose cable may be left at suitable intervals as specified by the Engineer.
- (e) Unless otherwise specified, the cables shall be protected by second class bricks of not less than 20cm x 10cm x 10cm (nominal size) protection covers placed on top of the sand, (bricks to be laid breadth wise) for the full length of the cable to the satisfaction of the Architect/Consultant. Where more than one cable is to be laid in the same trench, this protective covering shall cover all the cables and project atleast 5cm. over the sides of the end cables.

5.1.17.9 Back Filling

- (a) The trenches shall be then back filled with excavated earth free from stones or other sharp edges debris and shall be rammed and water, if necessary, in successive layers not exceeding 30 cm. Unless otherwise specified, a crown of earth not less than 50 mm in the center and tapering towards the sides of the trench shall be left to allow for hazard to vehicular traffic. The temporary reinstatements of roadways should be inspected at regular intervals, particularly during the wet weather, and any settlement should be made good by further filling as may be required. After the subsidence has ceased, trenches cut through roadways or other paved areas shall be restored to the same density and material as the surrounding area and repaved to the satisfaction of the Engineer.
- (b) Where road cutting, excavation in lawns kerb stones displaced etc., the same shall be repaired and made good except turfing/asphalting to the satisfaction of the Engineer and all surplus earth or rock removed to places as specified.

5.1.17.10 Route Marker

- (a) Route Marker shall be provided along straight runs of the cables at locations approved by the Engineer and generally at intervals not exceeding 100m. Markers shall also be provided to identify change in the direction of the cable route and also for location of every underground joint.
- (b) Route Markers shall be made out of 100mm x 100mm x 5mm GI/Aluminium plate, welded or bolted on to 35mm x 35mm x 6mm angle iron 60cm long. Such plates marker shall be mounted parallel to and 0.5m or so away from the edge of the trench.
- (c) The word 'cable' and other details such as voltage grading size etc., as furnished by the Engineer shall be inscribed on the marker.

5.1.17.11 Laying in Pipes/Closed Ducts

- (a) In locations such as road crossing, entry to buildings, on poles in paved areas etc., cable shall be laid in pipes or closed ducts.
- (b) Stone ware pipes, GI, CI or Spun reinforced concrete pipes shall be used for such purposes. In the case of new construction, pipes as required shall be laid along with the Civil works and jointed as per the instructions of the Engineer. The size of the pipe shall be decided by the Engineer and shall not be less than 10cm in diameter for a single cable and not less than 15cm for more than one cable.

These pipes shall be laid directly in ground without any special bed except for SW pipe which shall be laid over 10cm thick cement concrete 1 : 3 : 6 (1 cement : 3 coarse sand : 6 graded stone aggregate of 40mm nominal size) bed. No sand cushioning or tiles need be used in such situations. Unless otherwise specified, the top surface of pipes shall be at a minimum depth of 1m from the ground level when laid under roads, pavements etc., where steel pipes are employed for protection of single core cables feeding AC load, the pipe should be large enough to contain both cables in the case of single phase system and all cables in the case of polyphase system.

- (c) Pipes for cable entries to the building shall slope downwards from the building and suitably to prevent entry of water inside the building. Further, the mouth of the pipes at the building end shall be suitably sealed to avoid entry of water.
- (d) All chases and passage necessary for the laying of service cable connections to buildings shall be cut as required and made good to the original finish and to the satisfaction of the Engineer.
- (e) Cable grips/draw wires and winches etc., may be employed for drawing cables through pipes/closed ducts etc.

5.1.17.12 Laying of Open Ducts

- (a) Open ducts with suitable removable covers shall be preferred in sub stations, switch rooms, plant rooms, workshop etc.
- (b) The cable ducts should be of suitable dimensions so that the cables can be conveniently laid. If necessary, cables may be fixed with clamps on the walls of the such or taken in troughs in duct. The duct should be covered with removable slabs or chequered plates.
- (c) Ducts may be filled with dry sand after the cable is laid and covered as above or finished with cement plaster specially in high voltage applications.
- (d) Splices or joints of any type shall not be permitted inside the ducts.
- (e) As far as possible laying of cables with different voltage ratings in the same duct shall be avoided.
- (f) Where considered necessary, hooks or racks shall be provided for supporting the cables in masonry/concrete cable ducts, cable troughs. Otherwise cables shall be laid direct in the trench or trough etc. While deciding the layout of cables in such ducts, care should be exercised to ensure that unnecessary crossing of cables is avoided.

5.1.17.13 Laying on Surface

- (a) The cables may be laid in troughs or brackets at regular intervals or directly cleated to wall/ceiling. When laid over bracket supports, the cables shall be clamped to prevent undue sag.
- (b) Cable clamps shall be made from materials such as mild steel, porcelain, wood, aluminium etc., in case of single core cables the clamps shall be non-magnetic materials. A suitable non-corrosive packing shall be used for clamping unarmoured cables, to prevent damage to the cable sheath.

5.1.17.14 Cable Identification Tags

Wherever more than one cable is laid/run side by side, marker tags as approved, inscribed with cable identification details shall be permanently attached to all the cables in the manholes/open ducts etc. These shall also be attached to various cables laid direct in ground at suitable intervals as directed by the Engineer before trenches are filled up.

5.1.17.15 Jointing

- (a) Jointing work shall be carried out only by a licensed/experienced cable jointer.
- (b) At the preliminary stages of laying a cable, a proper jointing position should be selected.
- (c) Sufficient surplus cable shall be left on each side of joints as mentioned in clause 3.5.3.4.
- (d) Joints shall be staggered by 2 to 3 m when two or more cables are laid together in the same trench.
- (e) Jointing materials and accessories like conductors ferrules, solder, flux, insulating and protective tapes, filling compound, jointing boxes etc., of right quality and correct sizes, conforming to relevant Indian Standards, wherever they exist, shall be used. The design of the joint box and the composition of the filling compound shall be such as to provide an effective sealing against entry of moisture in addition to affording proper electrical characteristics to joints. Where special type of splicing connector kits or epoxy resin spliced joints are specified materials approved for such application shall be used and instructions of the manufacturer/supplier of such materials shall be strictly followed.
- (f) Insulation resistance of cables to be jointed shall be measured with 500 volts megger upto 1.1 KV grade and with 2,500/5,000 volts megger for cable of higher voltage. Unless the insulation resistance values are satisfactory, jointing shall not be done.

- (g) Cores of the cables must be properly identified before jointing.
- (h) Where a cable is to be jointed with the existing cable, the sequence should be so arranged as to avoid crossing of cores while jointing.

5.1.17.16 Jointing Procedure

- (a) While it would be best to follow strictly the instructions for jointing furnished by the manufacturers/suppliers of cable and joint boxes.
- (b) All outdoor jointing of PVC cable shall be done using best quality of compound and jointing materials. For indoor termination of PVC cables, joints with compression type glands shall be preferred.

5.1.17.17 Testing

- (a) All cables before laying shall be tested with a 500 volts megger for 1.1 KV grade or with a 2,500/5,000 volts megger for cables of higher voltages. The cable cores shall be tested for continuity, absence of cross phasing, insulation resistance to earth/sheath/armour and insulation resistance between conductors.
- (b) All cables shall be subjected to above mentioned tests during laying, before covering the cables by protective covers and back filling and also before the jointing operations.
- (c) In the absence of facilities for pressure testing, it is sufficient to test for one minute with 1,000 volts megger for cables for 1.1 KV grade with 2,500/5,000 volts megger for cables of higher voltages.

5.1.17.18 Completion Plan and Completion Certificate

The work shall be carried out in accordance with the drawings enclosed with the tender and also in accordance with the modifications thereto from time to time approved by the Engineer.

- (a) Layout of cable work.

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(b)

Length, size, type and grade of cables.

(c)

Method of laying i.e. direct in ground in pipes etc.

(d)

Location of each joint with jointing method followed.

(e)

Route marker and joint marker with respect to permanent land marks available at site.

(f)

Name of work, job number, accepted tender reference, date of completion, names of division and sub-division, names of contractor with their signature and scale of drawing.

5.1.18

Earthing

Earthing shall be as per IS:3043 standards for earthing of feeder pillar, street lighting poles, interconnections between earth electrodes. The rates to be quoted shall include all necessary clamps, saddles, hardware, fixing arrangements excavation, as required. 25 x 3mm GI flat. GI pipe type earth electrodes as per IS:3043 standards, complete with excavation, civil works, funnel, cast iron cover earth pit makers etc.

Note :

25x3mm GI flat along the side of the road above flyover shall be embedded in crash battier by the electrical contractor during the civil works.

5.1.19

Lighting Protection

Supply & fixing of GI pipe earth station conforming full to IS:3043, complete with brick masonry chamber, GI cover, water funnel etc.

Supply and running 40x6 GI strip as lightning conductor lead, clamped to structure.

Supply & installation of Air termination rod with 5 Nos. 10mm. dia solid copper spikes mounted on copper ball with 25 dia. long copper tube mounted on base plate with necessary clamp bolts, grouting etc., complete.

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5.1.20	The contractor shall carryout and completes the said work under this contract in every respect in conformity with the current rules and regulations of the local electrical authority, the Indian Standard Institution with the directions of and to the satisfaction of the Engineer-in-charge. The contractor shall furnish all the labour and install all materials, appliances, equipment necessary for the completion and testing of the whole electrical installation as specified herein and shown on the drawings. This also includes any material, appliances, equipment not specifically mentioned herein or noted on the drawings as being furnished or installed but which are necessary and customary to make complete installation in all respect as shown on the drawings or described in specification herein properly connected with electrical installation such as excavation of trenches and back filling, cutting / drilling and grouting for fixing of fixtures, equipment etc., further all the liaison work with the Supply Authorities for obtaining electrical load sanction, obtaining the released order from supply authority for release of supply and other bodies like compliances, drawings etc., shall be done by the contractor without any extra cost. No separate amount towards the same will be paid by the MSPGCL.	
5.1.21	Contractor has to submit detailed drawing to the Engineer-in-charge for approval before commencement of work. All the drawings to be prepared in AutoCAD (Latest release only).	
5.1.22	Further the contractor has to liaise with the supply authority for getting the load sanctions and release of L.T. supply to the premises and to individual owners. The MSPGCL will assist the contractor for giving the necessary dates for filling the form. The contractor shall be solely responsible for submission of application along with all necessary documents to supply authority. Further he shall be responsible for follow up the application and getting the release of the supply to lighting. The necessary cost involved for the said work is to be included in the cost of the work. No separate payments will be made by the clients towards the same.	
5.1.23	The contractor shall also be responsible for getting approvals from the various bodies such as Supply Authority, Electrical Inspector, PWD, MSEB, Government of Maharashtra and any other statutory bodies. The cost involved for getting the necessary approvals is to be included in the cost of	

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the overall work. No separate payment towards the same will be paid to the contractor. The owner will reimburse the official fees paid by the contractor to the various departments. The contractor will have to submit the original copies of the bills / challans and copy of the receipt of the payment made to the various departments.		
5.1.24	The contractor will have to carry out the entire electrical works to the satisfaction of the Engineer-in-charge. The brief description of the work is as follows :	
5.1.24.1	Main Cabling The Contractor will have to lay the LT XLPE armoured cables from the feeder pillar to street light poles, junction boxes, lighting fixtures etc. Before laying this cable the contractor will have to do necessary voltage drop calculations for each size of the cables and get it approved from Engineer-in-charge. The termination of the cables will be carried out using good quality heavy duty brass double compression glands of approved makes and heavy duty tinned copper crimping lugs. The cost of all the cables will be included in the scope of the contract. After laying of the cables all the cables will have to be neatly dressed using necessary clamps. The cable identification tags shall be provided at both ends and at every 15-20 meters.	
5.1.24.2	Feeder pillar : The Feeder Pillar for the said work is to be supplied by the contractor. The feeder pillar will be out door duty fabricated using minimum 14 SWG white CRCA sheets and the same shall be double door type and rain canopy fixed on top. The feeder pillar will under go the seven tank painting process. It will be painted using powder coated granule finish Siemens gray PAL 7032 colour shade Busbars used for the same will be tinned copper & with colour code heat shrinkable sleeve only, a separate compartment with necessary sealing arrangements for the energy meter. The Feeder Pillar shall have bottom cable entry and top copper bus bar chamber. The Feeder Pillar shall be installed on the concrete pedestal of minimum 500mm high from the finished road level. The contractor will have to submit the necessary drawings in detail to the Engineer-in-charge for his approval before fabrication work started. All the cost towards the supply, installation, testing and commissioning including all necessary civil work will be borne	

by the contractor. Before the Feeder Pillar dispatched to the site the same shall be inspected and tested at the manufacturing tests before the final commissioning.

- (a) Before erecting the Feeder Pillar at site, a thorough inspection shall be done by the Contractor and reported to the Engineer if any difficulties are envisaged for erection. Thereafter, an erection sketch shall be prepared, indicating the dimensions and the clearances between the Boards. A similar marking will also be made at site.
- (b) Feeder Pillar shall be tested for mechanical endurance. After checking wiring and cable connections the entire boards, shall be erected in places indicated and marked on the plan. All touching up work of points shall then be done and foundation bolts grouted. All necessary holes and civil works shall be done as per directions. The Feeder Pillar after duly testing shall be put to commission for trial.

5.1.24.3 Lighting fixtures :

All the fixtures shall be of good quality and of approved lighting make only. All the fixtures shall be provided with high frequency electronic ballast's. All the fixture shall be installed as per the G.I.pipe or G.I. pipe suspension using ball and socket and necessary G.I. hardware. The fittings shall be installed either on wall or ceiling mounted. The sample of each fitting should be submitted to Engineer-in-charge for approval prior to procurement of the fixtures.

5.1.24.4 Earthing system:

Prior to starting the earthing work the contractor will have to submit the detail earthing calculations for the approval of Engineer-in-charge. 2 nos. earthing with plate type of earthing to be provided for the feeder pillar. 1 No. pipe earthing system approach to Road Over Bridge to Kamptee side and 1 No. pipe earthing system approaches to Road Over Bridge to Bhandara side and necessary earth wire to be provided to earth street light poles. 1 No. pipe earthing system to be provided to high mast lighting tower. The earthing results should be less than 1.0 Ohms for grid. From earth pit to the feeder pillar, high mast tower and upto first street light pole 25 x 6 hot-dipped G.I. Strip is to be used.

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5.1.24.5 Earth Electrodes In Earth Pits

Plate electrodes of Copper shall be 600 x 600 x 6mm thick and 600 x 600 x 12mm thick for GI unless otherwise specified.

5.1.24.6 Earth Bus and Earth Continuity Conductor

(a) Earth bus is a copper strip or flat of specified size interconnecting all earth electrodes.

(b) Switchgears and Power Distribution Board's shall be earthed by a copper flat strip/Hot dipped Galvanized Iron strip wire.

(c) Panels, fused DBs and motors upto 30 KW rating shall be earthed by a continuity conductor, as specified. Minimum size of continuity conductor shall be 25 x 3mm bare copper strip, soft drawn.

(d) Road Lighting Poles shall be earthed with GI wire.

5.1.24.7 Earth Bus Station:

Earth Bus Station shall be provided to facilitate tapping of earth continuity conductor from earth bus/grid very conveniently it will comprise of a 400 mm long 50 x 6 mm bare copper strips / flat fixed with raw plugs / bolts securely on wall / column above floor level. Spacers of 20 mm to 25 mm shall be provided to keep the flat away from wall and facilitate connections of earth conductor for which 6 mm dia holes 8 to 10 numbers are provided with proper size proper size brass nuts, bolts and washers. Earth bus shall be connected to it.

5.1.24.8 Resistance to earth:

The contractor shall measure the resistance of the individual earthing pit and report to the Engineer-in-charge. The contractor will make after due consultation with Engineer-in-charge, No. of earth pits, such that, the overall resistance in the earth mat does not exceed 1.0 Ohm.

5.1.24.9 Earthing Station

Plate Electrode Earthing:

Earthing electrode shall consist of a tinned copper plate not less than 600 x 600 x 12 mm G.I. as called for in the drawings. The plate electrode shall be buried as far as practicable below permanent moisture level but in any case not less than 3 mtrs. below ground level. Wherever possible earth electrode shall be located as near the water tap, water drain or a down take pipe as possible. Earth electrodes shall not be installed in proximity to a metal fence. It shall be kept clear of the buildings foundations and in no case shall it be nearer than 1 meter from the outdoor face of the wall. The earth plate shall be set vertically and surrounded with 150 mm thick layer of charcoal dust and salt mixture. 20 mm G.I. pipe shall run from the top edge of the plate to the ground level. The top of the pipe shall be provided with a funnel and a mesh for watering the earth through earth. The main earth conductors shall be connected to the electrode just below the funnel, with proper terminal lugs and checks nuts. The funnel over the G.I. pipe and earth connections houses 300 mm wide and 300 mm deep. The masonry chamber shall be provided with a cast iron cover resting cover a C.I. frame embedded in masonry.

5.1.24.10 Guarantee:

At the cost of the work and before issue of final certificate of virtual completion by the Engineer-in-charge, the contractor shall finish a written guarantee indemnifying the owner against defective material and workmanship for a period of one year after completion. The contractor shall hold himself fully responsible of reinstallation or replace free of cost to the MSPGCL.

5.1.24.11 Completion Certificate:

On completion of the Electrical Installation a Certificate shall be furnished by the contractor, counter signed by a Licensed Supervisor, under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as required by the local supply authority. The

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contractor shall be responsible for getting the Electrical Installation inspected and approved by the Local Authorities concerned.

5.1.24.12 Test to be called for approval purpose:

- (a) The tenderer/bidder shall carryout in presence of Engineer’s Representative all tests. Such tests shall be carried out at the manufacturers or at works of the bidder.
- (b) The tenderer shall forward all the relevant copies of tests so performed in for the record of the Engineer-in-charge.
- (c) The tenderer shall give clear 15 days prior intimation in writing for all such tests to be carried out at relevant place of manufacture, works, sub-works etc. The cost incidental to such tests being carried out shall be borne by the tenderer. However, the expenditure for Engineer’s Representative making such visits for inspection only is borne by the Contractor.

5.2 GENERAL CONDITIONS OF SUPPLY OF ELECTRICAL EQUIPMENTS

5.2.1 The tenderer/bidder shall submit all technical data and catalogues of all relevant manufacturers he wishes to supply in his offer. However the supply and selection of materials and makes shall comply with the standards and approvals set herein only. If any deviations are noted, they shall be listed separately. The tenderer at his own discretion may list out any such reasons on quality/specifications/technical data for deviating from the approved makes. These shall then be appropriately considered. However all such deviations shall only be made by the bidder as alternate to the makes and materials specified If these are not indicated then the tenderer’s offer is likely to be rejected in to.

5.2.2 All tests to be performed prior to supply shall be indicated clearly by the tenderer. It is generally expected that all type and routine tests for all equipment required to be supplied under this tender shall complied to, however if the tenderer wishes to deviate for certain reasons all such reasons should be clearly brought out in the offer, specifically all tests shall be called for noted in this section.

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5.2.3	The successful tenderer before placing the orders or before supplying shall seek clearance in a meeting with the Engineer the final list of supply of materials at the time of signing of the contract by the Engineer and the successful tenderer/bidder. The successful bidder/tenderer shall then strictly adhere to these approved lists of makes and materials and proceed to supply the same. If any deviation and/or for any unforeseen reasons the makes or materials are to be altered, the successful tenderer shall obtain the proposal from Engineer in charge in writing and then only be may proceed to supply.	
5.2.4	The successful tenderer shall be entirely responsible for Guarantee of every equipment supplied performing in a continuous manner and mode acceptable to the Engineer.	
5.2.5	The successful tenderer shall submit minimum eight sets of all equipment, maintenance manuals, test certificates, guarantee of equipment etc., to the owner at the time of supply.	
	a) PREFERRED MAKES	
	Light fittings	- Philips, Crompton Greaves, Bajaj,
	Street light poles	- Bajaj/ Bombay poles KL Industries.
	Cables	- Asian/Fort Gloser/Finolex Industries/C.C.T. / Universal
	MCCBS	- L&T / ABB / GEC Alsthatham Crompton
	Timer	- L&T
	Contractor	- BCH, Siemens, C&W, L&T
5.3	<u>SAFETY MEASURES:</u>	
5.3.1	Scaffolds:	
	Suitable scaffolds shall be provided for workmen for all works that cannot be safely done from the ground, or from solid construction, except such period work as can be done safely from ladders. When a ladder is used, it shall be of rigid construction made either of good quality wood or steel. The steps shall have minimum width of 450mm and a maximum rise of 300mm. Suitable hand holds of good quality wood or steel shall be	

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	provided and the ladder shall be given an inclination not steeper than ¼ to 1 (1/4 horizontal and 1 vertical).	
5.3.2	Scaffolding or staging more than 4 meters above the ground floor, swing or suspended from an overhead support or erected with stationary support shall have a guard rail properly attached, bolted braced and otherwise secured atleast one meter high above staging and extending along the entire length of the outside and ends thereof with only such openings as may necessary for the delivery of materials. Such scaffolding or staging shall be so fastened to prevent it from swaying from the building structure.	
5.3.3	Working platforms gangways and stairways shallbe so constructed that they do not sag unduly or if more than 4 meters above ground level or floor level they shall be closely bordered, have adequate width and be suitable fenced.	
5.3.4	Every opening in a working platform shall be provided with suitable means to prevent falls of persons or materials by providing suitable fencing or railing.	
5.3.5	Whenever there are open excavations in ground, they shall be fenced of by suitable railing and danger signals installed at night so as to prevent persons slipping into the excavations.	
5.3.6	Safe means of access shall be provided to all working places, Every ladder shall be securely fixed. No portable single ladder shall be over 9 meters in length; width between side rails in rung ladder, shall in no case be less than 290mm for ladders upto and including 3 meters in length. For longer ladders this width shall be increased atleast 20mm for each additional meter of length.	
5.3.7	Adequate precautions shall be taken to prevent danger from electrical equipment. No material or any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or the public.	
5.3.8	Other safety measures:	
5.3.8.1	All personnel of contractor working within site shall be provided with safety helmets. All welders shall wear welding goggles while doing	

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welding work and all metal workers shall be provided with safety gloves. Persons employed on metal cutting and grinding shall wear safety glasses.

5.4 ELECTRIC SUPPLY AND MSEDCL CONNECTION:

Contractor shall arrange to provide electric supply from MSEDCL including required power meters. The necessary meter & connection charges and deposit to MSEDCL shall be paid by the contractor and the same will be reimbursed by MSPGCL on producing the MSEDCL receipts certified by the PMC.

5.5 HANDING OVER OF STREET LIGHTING SYSTEM:

Contractor shall hand over the entire lighting system erected for the project to the Executive Engineer (Electrical), after its completion and made operational through PMC / Engineer. An undertaking in prescribed format along with its enclosures in triplicate shall have to be given by the contractor within fifteen (15) days of its certification of its completion from PMC/Engineer. The contractor shall be responsible for handing over all installations of street lighting arrangement. The necessary co-operation if required will be extended by the Engineer and client.

5.6 DECLARATION:

I/ We hereby declare that I / We have read and understand the scope of the work for electrification and the detail technical specifications. I / We hereby declare that our offer also include all the materials required to complete the said job as per the requirements spelt out in the said Tender. I / We shall not claim any extra amount for completing the said work. Further we will supply and install all the material as required to complete the said work as per the entire satisfaction of the Engineer-in-charge and approving authorities for electrification work.

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6.0

TRAFFIC SAFETY MEASURES

6.1

TRAFFIC SAFETY MEASURES DURING CONSTRUCTION AND MAINTENANCE OF ROADS AND BRIDGES WHERE TRAFFIC IS TO BE PASSED OVER A DIVERSION

Providing Traffic Safety Measures on DIVERSION During Construction / Reconstruction of BRIDGE / C. D. WORKS comprising of Road Traffic Sign Boards and devices as per detailed design, drawing, specification and as directed by Engineer.

The Contractor will have to provide the traffic safety arrangements as per detailed drawing before allowing traffic on the diversion. The traffic safety arrangements will have to be got approved from Engineer by the Contractor before taking any construction activities for Bridge / C. D. Works.

The Engineer shall get himself satisfied about the traffic safety arrangement provided on the work site before commissioning of Diversion and a certificate to that effect shall be recorded.

6.1.1

The Sign No. 1 the board display the message “GO SLOW – WORK IN PROGRESS’ shall be placed at a distance of 120 m. away from the point where the Diversion begins. The signboard shall be of size 1.0 m x 1.0 m. having Red Background and messages in white colour.

6.1.2

The Sign No. 2 “SPEED LIMIT (20)” shall be placed at a distance of 100 m. away from the point where the Diversion begins. The board shall be of size 60 cm. Dia. having white background and Red Border and the numerals shall be in black colour as per IRC:67-1977. Distance between Sign No. 1 and Sign No. 2 shall be minimum 20 m.

6.1.3

Speed Breakers / Humps shall be provided and marked with black and white colour in checkered pattern in accordance with IRC:99-1988. Speed breaker shall be provided at a distance of at least 20 m. away from the point where diversion begins.

6.1.4

The Sign No. 3 – The cautionary signboard indicating “SPEED BREAKER” shall be placed on either side of the speed breaker at a distance of at least 40

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m. away from the Speed Breaker. The cautionary board shall be of an equilateral triangle of size 90 cm. having white colour background, retro-reflective border in red colour and non-reflective symbol in black colour. The definition plate shall be of size 60 cm. x 20 cm. having retro-reflective white colour background and message with non reflective black colour as per IRC:99-1988.

Retro-reflective “CAT – EYE” (Aluminium) shall also be provided on either side of the speed breaker as shown in the drawing.

6.1.5 The Sign No. 4 – DIVERSION board shall be placed at the point of detour. The signboard shall be of size 0.90 m x 0.60 m having red background and white retro-reflective messages.

6.1.6 Road marking for guiding the traffic (centerline / edge line marking) approaching the traffic where diversion begins shall be provided on the pavement with pavement marking paint in white colour as per IRC:35-1970.

Retro-reflective Cat – Eye made of aluminium body shall be placed along centerline marking before speed breakers as shown in the drawing. Sand filled plastic cones mounted with Retro-reflective Arrow Hazard Marker sign shall be placed as indicated in the drawing. Plastic cone shall be 73 cm. in height having 39 cm. square / hexagonal base.

6.1.7 Retro-reflective Strong Inviolable Stand Type Barrier painted black and having white Retro-reflective Strips for closer of traffic shall be placed on to cover the entire width of carriageway including shoulders as per drawing. The barricades shall be opened for the use of construction machinery only in the presence of responsible field person of the department. The Barricades shall not be removed unless the permission is given by the responsible officer of the rank not less than Resident Engineer. The Barricade shall have two plates of size 1.30 m x 0.20 m. painted Black and shall have White Retro-reflective Strips and mounted on angle Iron Stand of 1.0 m. height.

6.1.8 Yellow light flasher shall be kept lit from sunset to sunrise, three nos. at the point of detour and two nos. at barriers on both sides as indicated in the drawing.

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6.1.9 Informatory sign board indicating name of work, Amount of Contract, Completion period, Defect Liability period, Name of Contractor with Telephone No., Name of Executive Engineer with Telephone No. shall be provided between sign board No. 4 and the barricade. The sign board shall be having Blue Stove Enamel Paint background and white messages retro-reflective as per IRC:67-1977.

6.1.10 The sign No. 5 “RESTRICTION ENDS” sign shall be placed at 200 m. beyond the edge of work area. The size of sign plate shall be 60 cm. dia having white background retro-reflective and black band of non-reflective.

The Signs, Lights, Barricades and other traffic control devices shall be well maintained, till such time the traffic is commissioned on the New Bridge / C.D. Work. The size, shape and colour of all the sign and caution boards shall be as mentioned above as per detailed drawings in accordance with the relevant I.R.C. specifications and as per Ministry of Surface Transport’s Specifications.

6.2 TRAFFIC SAFETY MEASURES DURING RECONSTRUCTION OF CROSS DRAINAGE STRUCTURES WHERE TRAFFIC CAN BE PASSED OVER PART WIDTH

Providing Traffic Safety Measures on road during RECONSTRUCTION OF CROSS DRAINAGE STRUCTURES in part width, comprising of traffic signboards and devices as per detailed design, drawing and specification as directed by Engineer.

This includes providing traffic safety arrangements required for traffic control within the vicinity of work site before actual start of the widening of the C.D. Work. The Contractor will have to provide the traffic safety arrangements as per the detailed drawing before starting the dismantling the existing structure. The traffic safety arrangements will have to be got approved from the Engineer by the Contractor before taking any construction activity for the C.D. work.

The Engineer shall get himself satisfied about the traffic safety arrangement provided on the work site before allowing Contractor to dismantle the existing structure and certificate to get effects shall be recorded in the Measurement Book.

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6.2.1	The Sign No. 1 the board display the message “GO SLOW – WORK IN PROGRESS’ shall be placed at a distance of 120 m. away from the point of detour and shall be of size 1.0 m. x 1.0 m. having red background and messages in white colour.	
6.2.2	The Sign No. 2 “SPEED LIMIT (20)” shall be placed at a distance of 100 m. away from the point of detour. The boards will be of size 60 cm. dia. having white background and red border and the numerals shall be in black colour as per IRC:67-1977. Distance between Sign No. 1 and Sign No. 2 shall be minimum 20 m.	
6.2.3	Speed Breakers / Humps shall be provided and marked with black and white colour in checkered pattern and stop line 20 cm. wide with letters “STOP” painted white on the pavement in accordance with IRC:99-1988 and IRC:35. Speed breakers shall be provided at a distance of minimum 20 m. away from the point of detour and line indicating “STOP” shall be exactly on the point of detour.	
6.2.4	The Sign No. 3 – The cautionary signboard indicating “SPEED BREAKER” shall be placed on either side of the speed breaker at a distance of at least 40 m. away from the speed breaker. The cautionary board shall be of an equilateral triangle of size 90 cm. having white colour background, Retro-reflective border in red colour and non-reflective symbol in black colour. The definition plate shall be of size 60 cm. x 20 cm. having retro-reflective white colour background and message with non reflective black colour as per IRC:99-1988. Retro-reflective “CAT – EYE” (Aluminium) shall also be provided on either side of the speed breaker as shown in the drawing.	
6.2.5	The Sign No. 4 – STOP sign with definition plate indicating “ONE WAY TRAFFIC” shall be placed at the point of detour. The STOP sign shall be octagonal in shape of size 90 cm having red background and message in white colour as per IRC:67-1977.	
6.2.6	Road marking for guiding the traffic (centerline / edge marking) approaching the work area shall be provided on the pavement with pavement marking paint in white colour as per IRC:35-1970 as shown in the drawing.	

Retro-reflective Cat – Eye made of aluminium body shall be placed along centerline marking before speed breakers as shown in the drawing. Sand filled plastic cones mounted with Retro-reflective Arrow Hazard Marker sign shall be placed as indicated in the drawing. Plastic cone shall be 73 cm. in height having 39 cm. square / hexagonal base.

6.2.7 Retro-reflective Strong Inviolable Stand Type Barrier painted black and having white Retro-reflective Strips shall be placed at either ends of the widening area in half width of the carriageway edge of the formation. The barricades shall not be removed unless the permission is given by the responsible officer of the rank not less than Resident Engineer. The Barricade shall have two plates of size 1.30 m x 0.20 m. painted black and shall have White Retro-reflective Strips and mounted on Angle Iron Stand of 1.0 m. height.

6.2.8 Retro-reflective Hazard Marker shall be provided on opposite side of work area at both the ends of parapet wall of cross drainage structure. The size of sign plate shall be 30 cm. x 90 cm. painted with black colour and yellow retro-reflective strips as per IRC:79-1981

6.2.9 Yellow light flasher shall be kept lit from sunset to sunrise, 2 Nos. along the white painted line and 3 Nos. at barriers on both sides as indicated in the drawing.

6.2.10 Informatory sign board indicating name of work, Amount of Contract, Completion period, Defect Liability period, Name of Contractor with Telephone No., Name of Executive Engineer with Telephone No. shall be provided between sign board No. 4 and the barricade. The sign board shall be having Blue Stove Enamel Paint background and white messages retro-reflective as per IRC:67-1977.

6.2.11 The sign No. 5 “RESTRICTION ENDS” sign shall be placed at 200 m. beyond the edge of work area. The size of sign plate shall be 60 cm. dia having white background retro-reflective and black band of non reflective.

The Signs, Lights, Barricades and other traffic control devices shall be well maintained, till such time that the traffic is commissioned on the new C.D. Work. The size, shape and colour of all the sign and caution boards shall be as mentioned above

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as per detailed drawings in accordance with the relevant I.R.C. specifications and as per Ministry of Surface Transport's Specifications.		

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VOLUME-VII A1

BID PURPOSE DRAWINGS

(MECHANICAL)

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Following revised drawings shall be considered for TG Building GA				
Vol. No./Page No./Sr. No.	Dwg. No.	Revision	TITLE	
VII A1/7 of 9/6	PE-189-GA-106	P1	GENERAL ARRANGEMENT: TG BUILDING (EL.(+)32.800M, (+)38.000M, (+)50.000M)	

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BID PURPOSE DRAWINGS

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	CORRIGENDUM - I			
Following revised drawings shall be considered for Ash Handling System				
Vol. No./Page No./Sr. No.	Dwg No	Revision	TITLE	
VII A2/8 of 11/23	PE-189-PF-235	P2	PROCESS FLOW DIAGRAM : BOTTOM ASH AND COARSE ASH HANDLING SYSTEM	
VII A2/8 of 11/24	PE-189-PF-236	P2	PROCESS FLOW DIAGRAM : FLY ASH HANDLING SYSTEM	
VII A2/8 of 11/25	PE-189-PI-237	P3	P & I DIAGRAM : BOTTOM ASH HANDLING SYSTEM	
VII A2/9 of 11/26	PE-189-PI-238	P2	P & I DIAGRAM : COARSE ASH HANDLING SYSTEM	
VII A2/9 of 11/27	PE-189-PI-239	P2	P & I DIAGRAM : FLY ASH HANDLING SYSTEM	
VII A2/9 of 11/28	PE-189-PI-240	P2	P & I DIAGRAM : HCSD SILO & REMOTE SILO	
VII A2/9 of 11/29	PE-189-PI-241	P1	P & I DIAGRAM : HIGH CONCENTRATION SLURRY DISPOSAL SYSTEM	
VII A2/9 of 11/30	PE-189-PI-242	P2	P & I DIAGRAM : COMMON ASH SLURRY DISPOSAL SYSTEM	

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VOLUME VIII-A1

DATA / DRAWINGS TO BE FURNISHED BY BIDDER

(MECHANICAL)

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CONSULTANT : PROCON ENGINEERS

Data Sheet –B of Transport Air Compressor in Ash Handling System (Sec-14, Sr no: 3.14) is amended as under:

<u>SR.NO.</u>	<u>ITEM</u>	<u>UNIT</u>	
1.0	Designation		
2.0	Numbers offered		
3.0	Type of compressor		
4.0	Make and model number		
5.0	Testing standard		
6.0	Number of stages		
7.0	Capacity FAD	m ³ /min	
8.0	Type of suction and discharge valve		
9.0	Suction pressure	Kg/cm ² (g)	
10.0	Discharge pressure	Kg/cm ² (g)	
11.0	Suction temperature each stage	°C	
12.0	Discharge temperature each stage	°C	
13.0	Selected compressor speed	rpm	
14.0	BKW		
15.0	Recommended maximum speed		
16.0	BKW at recommended maximum speed		
17.0	Volumetric efficiency		
18.0	Load/unload setting	Kg/cm ² (g)	
19.0	Auto start stop setting	Kg/cm ² (g)	

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<u>SR.NO.</u>	<u>ITEM</u>	<u>UNIT</u>	
20.0	Motor make, rating and speed		
21.0	Lube oil type and consumption for each compressor		
22.0	Lube oil pump driven by compressor motor		
23.0	Type and make of bearings		
24.0	Painting		
25.0	Cooling water requirement		
25.1	Flow rate	m ³ /hr	
25.2	Inlet and minimum outlet pressure	Kg/cm ²	
25.3	Inlet and maximum outlet temperature	°C	
26.0	Intake filter type		
26.1	Filter element		
26.2	Rated capacity		
26.3	Efficiency		
26.4	Type and Number of steps		
26.5	Method Employed in case of constant speed type		
27.0	Weight of Entire unit mounted on common base frame	Kg. apx.	
28.0	Overall dimensions of common base frame L x W x H	mm	
29.0	Single largest component to be lifted during maintenance		
30.0	Discharge flange- final stage size/standard / rating		

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<u>SR.NO.</u>	<u>ITEM</u>	<u>UNIT</u>		
31.0	Coolers (Air Water)			
31.1	Numbers Offered			
31.2	Type			
31.3	Capacity	m ³ /hr		
31.4	Design pressure (Air / Water)	Kg/cm ²		
31.5	Air / Gas Inlet /Outlet Temperature	°C		
31.6	Cooling water inlet/maximum outlet temperature			
31.7	Code of construction			
31.8	Corrosion allowance	mm		
31.9	Number of passes			
31.10	Moisture Traps			
32.0	Oil cooler			
32.1	Type			
32.2	Qty			
33.0	Silencer			
33.1	Qty			
33.2	Type			
34.0	Material of construction		For screw compressor	For centrifugal compressor
34.1	Compressor chamber casing			
34.2	Rotors			
34.3	Bull gear			
34.4	Pinion Gear			

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<u>SR.NO.</u>	<u>ITEM</u>	<u>UNIT</u>		
34.5	Timing Gears			
34.6	Drive shaft			
34.7	Oil cooler (Plate type)			
34.8	Inter cooler and After cooler casing			
34.9	Inter cooler and after cooler Tubes			
35.0	Capacity of Compressor **	m ³ /min		
36.0	Discharge Pressure **	Kg/cm ² (g)		
37.0	Power consumption on Load **	kW		
	For discharge pressure of 8.8kg/cm ² (g)	kW		
38.0	Power consumption Unload	kW		
39.0	Temperature of air at outlet of after cooler	°C		
40.0	Cooling water flow rate	m ³ /hr		
41.0	Cooling water outlet temp	°C		
42.0	Cooling water pressure drop	Kg/cm ² (g)		
43.0	Temperature	°C		
44.0	Relative humidity	%		
45.0	Atm. Pressure	%		
46.0	Elevation above Mean sea Level	M		
47.0	Noise level	dBA		
48.0	Pressure drop across air filter	Bar		
49.0	Motor	kW		

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DATA / DRAWINGS TO BE FURNISHED BY BIDDER

(CIVIL)

(DATASHEET-C)

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DATASHEET- C NATURAL DRAUGHT COOLING TOWER			
<u>SR. NO.</u>	<u>ITEM</u>	<u>UNIT</u>	
1.0	<u>GENERAL INFORMATION</u>		
1.1	Tower manufacturer		
1.2	Tower Model		
1.3	Tower Type		Natural Draught Counter flow Cooling Tower with Film Fill
1.4	Numbers furnished		
1.5	Site Elevation	M	
1.6	Design wind speed	KMPH	
2.0	<u>PERFORMANCE DATA OF COOLING TOWER AT DESIGN CONDITION</u>		
2.1	<u>DESIGN CONDITION</u>		
2.1.1	Rated circulating water flow,	m³/hr.	
2.1.2	Design wet bulb temperature (ambient)	°C	27
2.1.3	Design inlet air wet bulb temperature (considering recirculation)	°C	
2.1.4	Design dry bulb temperature	°C	
2.1.5	Design Relative Humidity	%	40
2.1.6	Design cooling range	°C	
2.1.7	Design approach to ambient wet bulb temperature,	°C	
	Guaranteed Performance Data under above Design Condition		

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<u>SR. NO.</u>	<u>ITEM</u>	<u>UNIT</u>		
2.1.8	Maximum drift loss (at design)	m ³ /hr		
2.1.9	Required pumping head w.r.t NWL	MWC		
2.1.10	Hot water temperature	°C		
2.1.11	Cold water temperature	°C		
3.0	<u>INLET AIR PROPERTIES</u> (BS air properties)			
3.1.1	Dry bulb temperature	°C		
3.1.2	Wet bulb temperature	°C		
3.1.3	Dry air density	kg/m ³		
3.1.4	Wet air density,	kg/m ³		
3.1.5	Relative Humidity	%		
3.1.6	Specific Humidity	Kg/kg of dry air		
3.1.7	Enthalpy	(Kcal/k g)		
4.0	<u>EXIT AIR PROPERTIES</u> (BS air properties)			
4.1.1	Dry bulb temperature	°C		
4.1.2	Wet bulb temperature	°C		
4.1.3	Dry air density	kg/m ³		
4.1.4	Wet air density,	kg/m ³		
4.1.5	Relative Humidity	%		
4.1.6	Specific Humidity	Kg/kg of dry air		
4.1.7	Enthalpy	(Kcal/k g)		

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<u>SR. NO.</u>	<u>ITEM</u>	<u>UNIT</u>		
5.0	Heat Transfer Data			
(a)	Heat transfer co-efficient (K)			
(b)	Tower co-efficient (C = KaV/L)			
(c)	Cooling water flow (L), per Sq.m of fill area	kg/hr		
(d)	Dry air flow (G), per Sq.m of fill area	kg/hr		
(e)	Ratio of water to air weights, (L)/(G)			
(f)	Water Heat load	Kcal/sec		
(g)	Evaporation loss at design condition	m ³ /hr		
(h)	Evaporation heat load	Kcal/sec		
(i)	Total heat load (f + h)	Kcal/sec		
(j)	Heat gain by air	Kcal/kg of air		
(k)	Total heat gained by air	Kcal/sec		
(l)	Sensible heat gained by dry air	Kcal/kg		
(m)	Latent heat gained by dry air	Kcal/kg		
(n)	Difference in air densities (wet)	Kg/m ³		
6.0	<u>DRAUGHT CALCULATION</u>			
6.1	Draught Losses			
(a)	Inlet to fill	mmWC		
(b)	Through fill	mmWC		
(c)	Distribution Pipes/ troughs, etc.	mmWC		
(d)	At throat	mmWC		
(e)	Total	mmWC		
6.2	Necessary Draught Height = Total draught losses in mmWC/Density difference of air(m) + above fill mean			

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	elevation			
6.3	Tower height to be provided	M		
6.4	Draught Factor (f)			
6.5	Performance Co-efficient(C)			
6.6	Duty Co-efficient (D)			
7.0	<u>PUMPING HEAD</u>			
7.1	Static head above normal water level	MWC		
7.2	Frictional losses in pipes and distribution	MWC		
7.3	Margin	MWC		
7.4	Total	MWC		
8.0	Wind load & seismic effect considered in design, as specified?			
9.0	<u>TOWER DIMENSION</u>			
9.1	CL diameter of basin at the center-at the basin invert level	M		
9.2	CL diameter at sill top	M		
9.3	CL diameter of Ring beam bottom	M		
9.4	Diameter of shell at Fill top	M		
9.5	Diameter of shell at the distribution level	M		
9.6	CL diameter of shell at throat	M		
9.7	CL diameter of shell at top			
9.8	OD of paving around the tower			
10.0	<u>HOT WATER INLET</u>			
10.1	Number			
10.2	Nominal diameter, metre			

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10.3	Description, location, etc.			
10.4	Centre line height above basin kerb, metre			
11.0	<u>ELEVATIONS (w.r.t. sill top)</u>			
11.1	Finished ground level (FGL)	M		
11.2	Normal water level	M		
11.3	Minimum water level	M		
11.4	Basin invert level at the centre	M		
11.5	Air inlet Top (Ring Beam bottom) level	M		
11.6	Fill Bottom Level	M		
11.7	Fill Top level	M		
11.8	CL of HW Pipe at entry of primary duct			
11.9	Invert level of distribution pipe	M		
11.10	Top of Deck of water ducts	M		
11.11	Throat level	M		
11.12	Top of Shell	M		
12.0	<u>FLOW CONTROL VALVE</u>			
12.1	Make			
12.2	Type			
12.3	Size			
12.4	Numbers offered			
13.0	<u>COOLING TOWER BASIN</u>			
13.1	Material		RCC	
13.2	Storage Capacity of basin at normal working level	m ³		

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13.3	Height of basin kerb from grade level	M		
13.4	<u>BASIN DIAMENSION</u>			
13.4.1	Basin diameter	M		
13.4.2	Height from bottom to basin kerb,	M		
(a)	At the cold water outlet end			
(b)	Near sludge pit			
13.4.3	Maximum, minimum and normal water levels with respect to basin kerb	M		
14.0	<u>ISOLATING VALVES IN SLUDGE PIT</u>			
14.1	Numbers offered			
14.2	Nominal size	mm		
14.3	Type			
14.4	Name of Manufacturer			
14.5	Conforms to IS 780 (indicate also the applicable class)			
14.6	<u>MATERIAL OF CONSTRUCTION</u>			
14.6.1	Body			
14.6.2	Stem			
14.6.3	Trim			
14.7	Type of connection between valve stem and pedestal type operator spindle			
14.8	<u>PEDESTAL TYPE OPERATOR</u>			
14.8.1	Type			
14.8.2	Make			
14.8.3	Rising spindle?		Yes/No	
14.8.4	Type of valve position indicator			

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15.0	<u>SPRAY NOZZLES</u>			
15.1	Type			
15.2	Material for Construction		Poly Propylene	
15.3	Nozzle orifice size			
15.4	Nozzle flow capacity required			
15.5	Spray area coverage for nozzle(Enclose curve indicating head (vs) Area coverage)			
15.6	Fixing arrangement of spray nozzle to distribution headers(pipes & ducts)			
15.7	Spray nozzle spacing			
16.0	<u>SCREEN</u>			
16.1	Numbers			
16.2	Size & materials of bars			
16.3	Mesh Opening size, wire netting type and wire size			
16.4	Screen guide frame material of construction			
16.5	Screen material of construction			
16.6	Weight of screen			
16.7	Lifting arrangement			
17.0	<u>SLIDE GATES</u>			
17.1	No. of gates provided			
17.2	Gate size			
17.3	Handling arrangement type and details			
17.4	Side seal type and material			
17.5	Bottom seal type and material			

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17.6	Gate guide frame material of construction			
17.7	Gate material of construction			
17.8	Lifting arrangement			
17.9	Weight of gate			
17.10	Gate to be suitable for Bi-directional sealing			
18.0	<u>FILL & FILL SUPPORTS</u>			
18.1	Fill type		Double edge folded /edge thickened –cross fluted-Film type fill	
18.2	Average Sheet spacing(17 mm minimum)			
18.2.1	Material ,colour & protection		PVC, Black, UV stabilised	
18.2.2	Type of joining		Glued	
18.2.3	Fill module size: m(tentative) x m x m height			
18.2.4	Fill Height			
18.2.5	No. of fill pack layers in vertical height (minimum 2)			
18.2.6	Enclosed with proposal full detail of Tenderer's or his foreign collaborator's experience with cooling tower having similar fill as offered ?			
18.2.7	Arrangement of fill			
18.2.8	Wetted surface area per m³ of fill	m²		
18.2.9	Gross fill packing area	m²		
18.2.10	Effective fill volume	m³		
18.2.11	Effective wetted surface area of fill	m²		

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18.2.12	Water loading per m ² of fill	Kg/m ² /hr		
18.2.13	Air loading per m ² of fill	Kg/m ² /hr		
18.2.14	Fill pack PVC sheet thickness after forming (minimum 0.25 mm)			
18.2.15	PVC sheet edge formation		Double edge folded/edge thickened	
18.2.16	Fill packing arrangement details		Stacked	
18.2.17	Method to prevent dislocation of fills			
18.2.18	Material/size of ropes/wires for fixing up fill with supporting grids			
18.3	<u>FILL SUPPORT GRIDS</u>			
18.3.1	Fill supporting arrangement details		RCC CAST-IN-SITU/PRE-CAST BEAMS	
18.3.2	No. of support points per pack length			
18.3.3	Manner of joining these structural members			
18.4	<u>GRID SUPPORT FRAMES</u>			
18.4.1	Type			
18.4.2	Material			
18.4.3	Type of treatment			
18.5	<u>FASTNERS</u>			
18.5.1	Type			
18.5.2	Material			
18.6	Fill			
18.7	Fill support grids			

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18.8	Frames for supporting the grids			
19.0	<u>DRIFT ELIMINATORS</u>			
19.1	Drift Eliminator Provided ?		Yes/No	
19.2	Whether drift rate is limited to 0.01% of water flow rate?		Yes/No	
19.3	Number of passes			
19.4	Gross face area per pass per cell	m ²		
19.5	Type of Drift eliminator			
19.6	Material of Drift Eliminator			
19.7	Support Span			
19.8	<u>ELIMINATOR BLADES</u>			
19.8.1	Material			
19.8.2	Type of treatment			
19.8.3	Maximum length of blade	mm		
19.8.4	Size and shape of blades			
19.9	Type and material of drain boards			
19.10	<u>BLADE SUPPORT SPACERS</u>			
19.10.1	Type			
19.10.2	Material			
19.10.3	Type of treatment			
19.11	Support for Spacers			
19.11.1	Type			
19.11.2	Material			
19.11.3	Type of treatment			
19.12	Fastners			

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19.12.1	Type			
19.12.2	Material			
20.0	<u>COLD WATER CHANNEL AND DUCT ARRANGEMENT</u>			
20.1	Size and shape of channel			
20.2	Flow Capacity	M ³ /hr		
20.3	Bottom Elevation & Top Elevation			
20.4	No. Of Bays provided in the channel			
20.5	Flow velocity through cold water ducts			
21.0	<u>HOT WATER SUPPLY HEADERS OUTSIDE TOWER</u>			
21.1	Size and shape of supply header: OD in mm X mm thk PIPE			
21.2	Velocity of flow	m/sec		
21.3	Material of construction		M.S.	
21.4	Supporting system			
22.0	<u>HOT WATER PRIMARY DUCT</u>			
22.1	Duct size			
22.2	Material of construction			
22.3	Bottom elevation			
22.4	Velocity of flow	m/sec		
22.5	Flushing and inspection provision details			
23.0	<u>HOT WATER SECONDARY DUCT</u>			
23.1	Header size, shape			
23.2	Material of construction			

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23.3	Bottom elevation (invert level)			
23.4	Velocity of flow	m/sec		
24.0	<u>DISTRIBUTION PIPE</u>			
24.1	Material and class of pipe			
24.2	Size of pipes			
24.3	Velocity of flow	m/sec		
24.4	Spacing of AC / PVC pipes			
24.5	Pipe support			
24.6	Flushing provision details			
25.0	<u>ELECTRICAL</u>			
25.1	Whether lighting protection system conforming to IS2309 is provided?		Yes/No	
25.2	Whether Earthing protection system conforming to IS3043 is provided ?		Yes/No	
25.3	Whether aviation warning system provided in toto with ICAO norms (High intensity Type-A lights)?		Yes/No	
26.0	<u>MONORAIL, CHAIN PULLEY HOIST & ACCESSORIES FOR LIFTING SCREEN</u>			
26.1	Individual monorail to serve screen and gate in each cold water tunnel?			
26.2	Number of push type trolleys, for mounting of chain pulley hoist, furnished			
26.3	<u>CHAIN PULLEY / HOISTS</u>			
26.3.1	Number furnished			

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26.3.2	Type			
26.3.3	Hoisting capacity, each	kg		
26.3.4	Conforms to IS-3932 Class 2?			
26.3.5	Make			
26.3.6	Suitable for outdoor installation?			
26.4	Number of chains, hooks, furnished for attaching the screen with chain pulley hoists			
27.0	<u>BUTTERFLY VALVES (BFV)</u>			
27.1	Manufacturer			
27.2	Type		Double flanged ,Manual operating type valve conforming to AWWA-C-504/BS standard	
27.3	Size/Numbers provided			
27.4	Installation (Horizontal/Vertical Shaft)			
27.5	Design flow	m ³ /hr		
27.6	Maximum allowable flow	m ³ /hr		
27.7	Design Pressure			
27.8	Maximum allowable flow velocity thru valve	m/s		
27.9	Pressure drop at design flow	MWC		
27.10	Operating time from open to "Close" condition and vice/versa	Secs		
27.11	Design standard/pressure class			
27.12	Whether material of construction as per specification			

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27.13	Operator & Accessories			
27.13.1	Valve operator			
27.13.2	Gearing			
(a)	Overall reduction ratio			
(b)	Lubrication			
27.14	<u>BALL VALVES</u>			
27.14.1	Type		Threaded ,full bore pattern in single piece as per IS: 9890	
27.14.2	Size (minimum 80 mm)			
27.14.3	Numbers provided			
27.14.4	Design Pressure			
27.14.5	Material of construction			
27.14.6	Type of valve position indicator			
27.15	Approximate weight of each valve assembly, including head stock,	kg		
28.0	<u>STRUCTURAL</u>			
28.1	Basic wind speed	m/s		
28.2	Earthquake Zone			
29.0	<u>WEIGHT OF EQUIPMENT</u>			
29.1	Total weight of cooling tower excepting basin			
29.2	Weight of heaviest part to be handled			
29.3	Size of largest part to be handled			
30.0	Pressure Ratio (i.e. the ratio of system pressure drop from the inlet to the eliminator exit plane to velocity pressure			

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	at the average at the average entrance velocity)			
31.0	To ensure uniform water distribution over fill whether nozzle arrangement and the design of tower structure in the spray chamber have full and even coverage, but not less than 90% of the plan area?			

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**MAHARASHTRA STATE POWER
GENERATION CO. LTD.**

**PROJECTS & PLANNING
DEPARTMENT**

BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1

ADDENDUM -1

**TECHNICAL SPECIFICATION
FOR
ADDITIONAL SOURCING OF RAW WATER**

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10.0	TESTING	
11.0	SPARES, CONSUMABLES AND LUBRICANTS	
12.0	DATA SHEET – A	
13.0	DATA SHEET – B & C	
ANNEXURE-I	GENERAL ARRANGEMENT OF RIVER WATER PUMP HOUSE & SCHEME OF INTAKE WATER TO 1X660 MW PLANT	
ANNEXURE-II	PROPOSED RAW WATER PIPE ROUTE FROM RIVER WATER PUMP HOUSE	
ANNEXURE-III	KEY SINGLE LINE DIAGRAM FOR WATER SUPPLY ARRANGEMENT FROM TAPI RIVER PUMP HOUSE.	

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1.0

INTRODUCTION

1.1

This section presents the system description, scope of work, basic design criteria and performance requirements of the additional sourcing of Raw Water for the 1 x 660 MW Bhusawal expansion project.

2.0

SYSTEM DESCRIPTION

2.1

The main source of Raw Water for plant make up is Ozerkheda reservoir belonging to Irrigation Department, located about 20 km from plant site.

2.2

At present, the Line from Ozerkheda reservoir is being built to cater to the requirement of 2 x500 MW units, together with the projected requirement for the 1 x 660 MW unit.

2.3

MAHAGENCO also have their own pump house on Tapi River which is used to serve through a canal, the existing 2x210MW units as well as the 2x500 MW units currently under execution. For the proposed 1x660MW unit also MAHAGENCO intends to use the Tapi River water as an additional source. It has been decided to go for a dedicated pipeline from the existing pump house on Tapi River to the plant site.

2.4

The distance from the existing river water pump house to the 1 x 660 MW unit (Unit # 6) is approximately 3 km. The proposed pipe line from Tapi river water pump house shall join the line coming from Ozerkheda near one day reservoir for 1 x 660 MW. The scope under this addendum covers the two numbers of intake water pumps and connecting pipework from river water pump house to the one day reservoir for 1 x 660 MW. The isolation arrangement shall be near to one day reservoir within plant boundary of 1x660 MW unit.

2.5

Five (5) pumps are presently installed in River Water Pump House out of which one pump is not operational owing to mechanical faults. This non operational pump is to be replaced by one of the new pumps. Further, space for installing one additional pump is also available in the pump house. Thus, two (2) pumps (1W+1S/B) can be accommodated in the pump house for catering to the requirement of 1x660 MW unit. However, this needs to be independently verified by the bidder.

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2.6

This river water will be transported to the power plant site by cross country M.S. pipe line and stored in the raw water reservoir in the plant

2.7

The layout of River water Pump House and the proposed scheme is as per the enclosed sketch (Drg. PE-189-ME-SK-1043).

3.0

SCOPE OF WORK

3.1

The scope of work shall include design, manufacture / fabrication, inspection, testing, packing & forwarding, transportation, delivery, erection, commissioning & performance test at site of raw water system (including carrying out soil investigation, excavation and backfilling of the soil, providing requisite thrust blocks wherever applicable etc) from the existing river water pump house of MAHAGENCO located on Tapi river to the one day reservoir of 1 x 660 MW unit, including all electrical, control and instrumentation.

3.2

The scope inter-alia shall include the dismantling of one of the existing pumps in order to make way for the new pump.

3.3

The layout of the existing pump house as well as the indicative routing of the cross-country piping is shown in the attached sketches ; However, the bidder shall independently carryout the site survey and determine the detailed scope.

3.4

The major scope of work under this specification are Two (2) vertical pump sets (1W+1S/B), One (1) M.S. cross country piping (partly buried and partly above ground), valves and related electrical and instrumentation. The pumps and piping specification is as per Datasheet-A enclosed. However, any item not specifically mentioned but deemed necessary by the Bidder for making the system completely reliable and efficient shall also be included.

3.5

Providing and laying M.S. pipeline of commercial quality Fe-410 grade conforming to IS 3589, aligning proper line and level as per site requirement.

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3.6

PIPING VALVES AND SPECIALTIES

(a)

Motorized butterfly valves at pump discharge with associated actuator.

(b)

Manually operated butterfly valve and non-return valve at the interconnection point near One Day reservoir for 1x660 MW unit

(c)

Rubber expansion joints at pump discharge.

(d)

Double kinetic air valves and accessories at pump discharge.

(e)

Drain arrangement with isolation gate valve at pump discharge. All drains shall be header routed.

(f)

Pressure gauge and pressure switch with isolation globe valves at pump discharge and pressure gauge at common header.

(g)

Pipe supports and associated civil/structural works as required including all temporary frames for transport.

(h)

Electro -Magnetic Flow meter with integrator on pipe line

(i)

Expansion joints to be provided at an interval of 300m for above ground portion of pipe line.

3.7

The raw water intake channel at existing pump house located in the Tapi River shall be provided with level indicators and level switches with protection interlocks for associated pumps. All pumps drawing suction from the raw water intake channel and shall be protected against operation under low suction condition. Annunciation for abnormal conditions levels (low and high) in the raw water pumps shall be annunciated in the control panel. The MCC for pumps providing power supply to the pumps shall be provided in the adjoining room of the raw water intake pump house.

3.8

The raw water intake pump set shall be supplied with the following accessories, as applicable.

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(a) Heavy duty couplings of approved design to connect the pump shaft directly with the motor shaft.

(b) Sets of base plates, support plates, grounding pads, thrust blocks, lifting lugs, eye bolts, nuts etc for each pump and motor set.

(c) Slip on type drilled steel counter flanges of proper rating to suit the discharge flange of each pump set. All the counter flanges shall be complete with requisite number of bolts, nuts and gaskets etc.

(d) Thrust pads, if required, for pump discharge head complete with all necessary fixing and bolting arrangement, fasteners etc.

(e) One (1) pressure indicator with isolating cocks at the discharge side of each pump, two (2) additional stubs with isolating root valves for pressure tapings and two (2) thermowells for temperature tappings at the discharge side of each pump for performance testing. Thrust bearing shall be furnished with thermometer, temperature switch for high temperature annunciation and oil level gauge. Thrust bearing temperature indicator shall be hooked-up to the PLC.

(f) All internal/integral piping with valves, fittings and instruments for lubrication, cooling and sealing, if applicable, shall preferably be tapped off from respective pump discharge.

(g) Pump using 6.6 kV drive shall be equipped with vibration measuring and temperature measuring probes for pump and motor bearing with adequate annunciation / interlock function. The vibration measurement, Start/Stop and necessary interlocks shall be hooked-up to PLC.

4.0 **TERMINAL POINT :**

4.1 River water pipeline shall be connected to tap off line from supply pipe coming from Ozerkheda reservoir within the plant boundary and near the one day reservoir of 1x660 MW plant.

5.0 SPECIFIC DESIGN CRITERIA

- 5.1 In case the pumps/ motors need external cooling, the bidder shall consider the same and include in the proposal.
- 5.2 The design shall take into account the effect of internal/external pressure, thermal expansion, self weight of piping, support reactions, surge and water hammer, earthquake and wind effects at site, corrosion and erosion etc. and any other effects dictated by good engineering practices.
- 5.3 Pipelines shall be laid underground or in tunnels as far as possible. Wherever it is not possible, pipelines shall be laid over ground on the R.C.C. saddle supports with M.S. clamping.
- 5.4 The raw water pipe line and pumping system sizing shall be based on Sixteen (16) hours operation per day for a quantity equivalent to 110 % of the plant make up water requirement arrived at by considering a cycle of concentration of five (5). The capacity of the each pump shall be equivalent to 110% of quantity requirement for plant makeup considering Cycle of concentration (C.O.C) of five (5). The number of pumps shall be Two (2) (1W+1 S/B).
- 5.5 Bidder shall carry out surge analysis for determining the thickness of the cross country piping with provision of additional 1.5 mm thickness for corrosion allowance.
- 5.6 Sizes of pipe line shall be selected such that the velocity of fluid in pipes does not exceed the range of 1.5 – 1.7 m/s.
- 5.7 The pipe network shall be provided with air release valves at high points and drain valves at the lower points. Air valve should be placed at least every 500 meters.
- 5.8 Pipeline passing under or through equipment foundations or walls of buildings or any other inaccessible structure shall be provided with steel encasing pipes for easy insertion and removal.

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5.9	The over ground piping, wherever required, shall have a minimum vertical clearance of 0.9 metres above finished ground level and 8.5 meters above road level in plant working area.	
5.10	Valves provided on the over-ground pipe network shall be provided with steel structural platforms and access ladders.	
5.11	C/C distance between two supports shall not be more than 6.0 m.	
5.12	All the buried pipelines shall be laid with a nominal slope towards the drain point.	
5.13	In case of the buried pipe lines, the top of the pipeline shall be minimum 1200 mm below the finished ground level.	
5.14	Isolation /control valves, drain valves, air release valve provided on the buried pipe network shall be housed in suitably sized covered valve pit and the valve pits shall be of self draining type. Air release valves shall be provided at the highest points of each sector of the pipeline and drainage valves shall be provided at the lowest points of each sector of the pipeline.	
5.15	Wherever the buried pipelines are crossing the roads and tracks, they shall be suitably encased with mild steel pipes or reinforced concrete casing pipes of NP3 class or as required as per statutory norms, whichever stringent. Permissions for crossing (Road/Railway track etc.) shall be obtained by the bidder from the concerned department.	
5.16	Mechanical cleaning and anticorrosive protection of underground MS pipelines shall conform to IS: 10221 - 1982. The anticorrosive protection of pipelines shall consist of the following activities in sequence: (a) Application of one coat of coal tar primer (b) Application of one coat of coal tar enamel (c) One wrap of fibre glass tissue (d) Application of one coat of coal tar enamel	

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(e) One layer of fibre glass tissue impregnated in coal tar enamel. (f) Application of the final coat of a water-resistant white wash 5.17 Alternatively, Coal tar based anticorrosion tape as per IS :15337 - 2003 shall be provided for protection of underground mild steel pipelines. The thickness of tapes shall be 3 mm up to pipe diameter DN 300 mm and 4 mm above pipe diameter DN 300 mm. 5.18 <u>INTERNAL PAINTING TO PIPELINE</u> Food-grade epoxy coating, minimum 250 micron thick, shall be imparted to the internal surface of M.S. pipeline. Surface preparation of internal surface shall be made as per clause no. 5.21. Resin and hardener shall be mixed in standard proportions and the mix shall be applied as primer to the internal surface within ‘open time’ of the resin hardener mix. When the primer is “touch dry”, two (2) top coats shall be applied to a total thickness of 250 micron. 5.19 <u>LAYING BURIED PIPELINES</u> 5.19.1 All buried pipelines shall be laid with earth cover sufficient to avoid damage from pressure of vibration caused by the surface traffic. Minimum earth covering over the pipe shall be 1200 mm from the finished ground levels. For laying of buried pipelines earth work in excavation, back filling and acceptance of trenches etc. shall be as per IS: 5822-1994, IS: 3114-1994 and IS: 12288-1987. 5.19.2 The trench shall be so dug that the pipe line can be laid to the required alignment and at the required depth, proper levelling of the excavated surfaces is an essential requirement. 5.19.3 The bottom of the trench shall be levelled by sand layer for a minimum thickness of 150 mm. 5.19.4 If the depth of excavation is more, proper protection for side walls shall be provided till the pipe levelling is completed.		

- 5.19.5 The entire pipe trenches bottom shall be covered with local sand bed of 150 mm thick layer.
- 5.19.6 After laying the pipelines, 150 mm thick layer of local sand shall be provided all around the pipe.
- 5.19.7 Precautions shall be taken at all the times to prevent damage to the coating and wrapping in the pipe lines and appurtenances as applicable by workmen or trespassers during laying or at any other time. Pipe handling slung and any blocking used in handling or storing the pipes must be well padded to avoid damage to pipe and its coating.
- 5.19.8 After laying a pipeline on skids it shall be thoroughly cleaned, inspected for any damage to the protective coating. Satisfactory repair work shall be performed while the pipe is suspended above the trench.
- 5.19.9 After the pipes are erected and tested, the back filling of the trenches shall be done with loose soil free from stones, bricks and metallic pieces in layers and shall be well rammed and compacted.
- 5.19.10 The underground pipelines shall be provided with pipe markers at regular interval for proper identification.
- 5.19.11 The coating system for under ground piping based upon the soil resistivity may be selected on the following basis:

	SOIL RESISTIVITY	CORROSIVITY	COAL TAR COATINGS	WRAPPING TAPES
(a)	≤ 1000 ohm-cm	Extremely corrosive	3 coats and 3 wraps	3 layers of tape
(b)	> 1000 ohm-cm	Corrosive & non-corrosive	2 coats and 2 wraps	2 layers of tape

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5.20

PROTECTION FOR ABOVE GROUND PIPING

5.20.1

The coating shall consist of two coats of synthetic enamel painting over a coat of primer, as per relevant standard and manufacturer’s specification.

5.20.2

The two ends of each length of pipe shall be left bare of primer coating for a distance of 150 mm from the end to facilitate field welding and subsequent field coating.

5.20.3

The supply, application, characteristics of materials and testing requirements shall be strictly as per relevant IS.

5.21

SURFACE PREPARATION

5.21.1

Pipe surfaces to be provided with underground protection shall be cleaned by shot blasting. The cleaning shall be so carried out that the piping surface is free from mill scale, rust, oil, welding scale and other foreign materials. Primer shall be applied immediately after shot blasting to prevent rust forming. Superficial rust formed shall be removed by wire brushing or by the use of emery paper. If the rust formation is heavy, re-blasting may be necessary. Around field joints, the pipe surfaces may be cleaned by wire brushing prior to the application of anti-corrosive protection

5.22

PRIMER COAT

5.22.1

The primer shall be compatible with the grade of enamel used. It shall be thoroughly mixed before using by stirring or by rocking the drum to provide uniformity of material. The primer coat shall be applied over a thoroughly clean and dry surface within three (3) hours of the cleaning operation, and shall be applied preferably immediately with a uniform thickness on the entire surface of the piping using appropriate quantity per unit area of surface as recommended by the manufacturer. The primer coating shall be free of bubbles, globules, drips and runs. Pipes having a longitudinal seam shall be carefully examined to determine that all excess primer has been brushed out of each side of the welding seam. The primer shall be thoroughly dry before the enamel is applied. If

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ready-made tapes are used, then primer, as suggested by the manufacturer, shall be used.

5.22.2 Freshly-primed pipe shall be handled carefully to prevent damage. The damaged area shall be re-primed before applying enamel/wrapping tapes.

6.0 PERFORMANCE REQUIREMENTS

6.1 Performance requirements for all the pump(s) shall be as specified in datasheet-A enclosed.

6.2 Pump(s) shall preferably be designed to have the best efficiency at the specified duty point. Further, the pump(s) shall be suitable for continuous operation at any point within its range of operation as specified in datasheet-A enclosed.

6.3 Pump(s) shall have continuously rising head-capacity characteristics, with maximum head at pump discharge shut-off, to enable parallel operation

6.4 Under all circumstances, the `range of operation' of the pump(s) shall exclude any unstable operating zone of the head-capacity curve.

7.0 ELECTRICAL

7.1 The existing 6.6 kV switch gear & Power and control cables in Tapi River Pump house are 40 years old and they shall be replaced. The entire replacement of 6.6 kV switch gear and cables and all associated work shall be done by the EPC contractor. The scope of above work is generally given below. The EPC contractor is expected to visit the site to make the assessment of the quantum of work as the entire activities are included in the scope of EPC contractor.

7.2 **Broad Scope Shall Be As Follows:**

7.2.1 Disconnection of existing power and control cables, bus section wise connected to 12.5 MVA transformers, 6.6 KV switch gears, motors & control panels etc.

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7.2.2	Removal of these cables from Trays, trenches, underground locations & transport & storing them at suggested location.	
7.2.3	Removal of existing switchgear panels bus section wise and transport & storing them at suggested location.	
7.2.4	Civil modification such as modifications of frames, trenches etc. as required for installation of new switch gear, cables & control panel etc.	
7.2.5	Design, engineering, manufacturing, testing at works, Insurance supply to site, unloading, checking, storage, erecting / installation at site testing & commissioning and putting into successful commercial operation of the following electrical equipments. (a) 6.6 kV, 50 Hz, 3 phase, 1250A, 40KA VCB switch gear #1 & #2 as per key single line diagram no PE-189-EL-SK-5007/P0 attached here with. (b) Two (2) new pumps with squirrel cage motors (c) Two (2) control panels for Two (2) new pumps	
7.2.6	11/ 6.35 kV XLPE armoured cables & control cables for :- (a) Connection between 12.5 MVA transformer no. 1 to incomer of 6.6 kV switchgear #1. (b) Connection between 12.5 MVA transformer no. 2 to incomer of 6.6 kV switch gear #2. (c) Connection between 6.6 kV switchgear #1 & 2. (d) Connection to all existing 6.6 kV motors. (e) Connection to two (2) new 6.6 kV motors. (f) Connection to Two (2) 6.6 kV/ 433 V 500 KVA existing transformers. (g) Connection to new control panel.	

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(h) Any other as required 7.2.7 Grounding for the entire system 7.2.8 All electrical system studies such as short circuit levels, voltage drops, grounding, relay setting & relay coordination, all sizing calculations etc & preparation & submission of all necessary document and drawings for approvals & then with approved AS BUILT STATUS. 7.2.9 Any other activity required for completion of the project on EPC Basis. 7.3 <u>LOCAL CONTROL PANEL</u> 7.3.1 Degree of protection - IP 54 or better totally enclosed type 7.3.2 Mounting - Floor mounted, Free standing, dead front assemblies. 7.3.3 Base plates - steel channel / Angle with anti vibration mounting & stainless steel kick plates. 7.3.4 Construction - Sheet steel Minimum 2 mm thickness. 7.3.5 Door - Rear Door with concealed Type hinges & Pad locking arrangement. Door shall be grounded by copper braid. All doors & removable covers shall be provided with neoprene rubber gaskets all around and sufficiently strong. 7.3.6 Height - panel height shall match with existing panels. Working height of panels shall be limited between 750 mm & 1800 mm. 7.3.7 Control transformers / space Heater - two (2) (1*100% stand by) per panel. 7.4 All electrical equipments and systems shall comply with the Volume II, Volume IV A, Volume IV B and relevant drawings of Bid specification.		

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8.0

CONTROL AND INSTRUMENTATION

A programmable logic control (PLC) shall be considered for the monitoring and control of the proposed raw water pumps. For detailed requirement of Control and Instrumentation system, Volume –V shall be referred to.

9.0

CIVIL

9.1

The bidder shall visit the site to acquaint himself regarding all site features and scope & extent of Civil/Structural works to be carried out for this purpose to amalgamate with the new facilities in consultation with Owner/owner’s consultant.

9.2

Scope includes site survey, soil investigation, site development works, complete design engineering and construction of Civil, Structural works and to obtain necessary various approvals from concern Departments/agencies well in advance including necessary charges.

9.3

For crossing of the pipe lines with nallahs, rivers, canals etc, pipe shall be laid over RCC supports and bottom of pipe shall be kept at 0.5 m above H.F.L.

9.4

Providing and Laying pipe line including their supports and foundations, thrust blocks etc wherever required including earth mat/lightening protection.

9.5

Thrust blocks shall be provided to resist the thrust load from pipelines considering the test pressure in the pipelines at bends/tees etc.

9.6

Backfilling, around foundations and bottom of pipes, thrust blocks etc shall be carried out with approved material in layers not exceeding 30 cm thickness and each layer shall be compacted to 90% standard proctor density for cohesive soil and to 75% of relative density for non- cohesive soils.

9.7

For detailed civil specification, refer volume VI-B.

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10.0

TESTING

10.1

THICKNESS

10.1.1

The thickness of the pipe coating shall be measured either by elcometer or by coating thickness gauge.

10.2

BOND

10.2.1

Bond test shall be carried out by cutting 25 mm square at three locations of the coating on a sample test specimen to qualify the procedure. Coating shall be pulled out by lifting one corner of the square. For a good coating, the section shall not peel off easily.

10.2.2

The coating on the pipe shall be carried out only after satisfactory completion of the qualifying test.

10.2.3

In case of doubt regarding the quality of coating, bond test shall be carried out on any location of the pipe to the satisfaction of the Owner.

10.3

FIELD ADHESION TEST FOR WRAPPING TAPES

10.3.1

Adhesion test shall be made to determine the proper bond between the tape and primed pipe. The temperature of the tape and pipe to be tested shall be between 10 and 27 °C. If the temperature is outside this range, hot or cold water shall be poured over the test area until this temperature range is attained. A test area shall be selected by the inspector where the tape is smooth for 15 cm in the longitudinal direction of the tape. Two knife cuts that are 15 cm long and 5 cm apart shall be made through the tape. A flat blade shall be used to pry up 5 cm of the fabric. This 5 cm flap of fabric shall be grasped firmly in one hand and shall be pulled with a quick motion in the direction of the remaining 10 cm of the 15 cm knife cut.

10.3.2

The adhesion is satisfactory if the tape tears at the point of stripping or the fabric strips from the underlying coal tar component, leaving exposed not more than 10% of the primer or metal.

10.4 HOLIDAY TEST

10.4.1 On completion of coating/wrapping, the quality of the coating shall be tested using efficient high voltage holiday detectors, operating at a voltage high enough to jump an air gap, the length of which is equal to the thickness of the coating/wrapping. All holidays found shall be repaired and the repairs shall be retested with the holiday detector to ensure that adequate repairs have been made.

10.4.2 The suggested test voltage shall be as follows:

$$V = 1250 (t)^{1/2} \text{ where}$$

V - voltage in volts,
t - coating thickness in mils (1 mil = 0.001 in.)

10.5 CERTIFICATES

The CONTRACTOR shall furnish certificates of all the materials purchased by him and also complete instructions from the manufacturer regarding the storage, preparation and application of the coating materials.

11.0 SPARES AND CONSUMABLES AND LUBRICANTS

Bidder shall consider identical mandatory spares for all mechanical, electrical and instrumentation items in line with Volume- II, Section-9 and include in the scope.

Similarly, all consumables and lubricants till COD of the unit shall be included in the scope.

Further, bidder shall offer recommended spares for Three (3) year operation as specified under Volume- I .

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SR.NO.	DESCRIPTION		
(d)	Estimated Total dynamic head at rated capacity (MLC)	By Bidder to be determined as follows: Static head: Elevation difference between minimum water level in the raw water sump indicated in the attached sketch (PE-189-ME-SK-1043) plus 3 mWC residual pressure at the destination. Frictional head: 20 % margin on the calculated drop in the line based on Hazen Williams formula with a C factor of 120.	
(e)	Pump shut off head (MLC)	Bidder to indicate	
(f)	Permissible tolerance in rated capacity (%)	± 2.5 percent at the rated head	
(g)	Permissible tolerance in efficiency at rated capacity	No negative tolerance	
15.0	<u>DESIGN AND CONSTRUCTIONAL FEATURES</u>	Please refer to Volume III-E2	
16.0	<u>MATERIAL OF CONSTRUCTION</u>		
17.0	<u>SUPPLY OF ACCESSORIES AND SERVICES</u>		
(a)	Sole plate	Yes	
(b)	Foundation bolts, nuts, sleeves etc	Yes	
(c)	Discharge flanges with nuts, bolts and gaskets	Yes	
(d)	Gland Sealing / cooling and bearing cooling / lubrication	Yes	

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	system complete with pipes, valves, fittings and instruments as required		
(e)	Thrust Block	Yes, if applicable	
(f)	Pump motor Coupling and guard	Yes	
(g)	Eye bolts, lifting tackle etc	Yes	
(h)	Discharge pressure gauges with isolating cocks	Yes	
(i)	Instrument connections	Yes	
(j)	Vent with isolating cock	Yes	
(k)	All other accessories and services	Yes	
18.0	<u>INSPECTION AND TESTING</u>		
(a)	Material testing of casing, impeller and shafts	Yes	
(b)	Hydrostatic testing	Yes	
(c)	Dynamic balancing test	Yes	
(d)	Sump model tests	Yes	
(e)	NDT Tests on casing/ shaft	Yes	
(f)	NDT Test on impeller	Yes	
(g)	Vibration and noise measurement	Yes	
(h)	Performance Tests	Yes	
(i)	Performance test to be done on	Proto type at rated speed	
(j)	Performance test required for determining	H Vs. Q curve P Vs. Q curve N Vs. Q curve NPSH Vs. Q curve	

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SR.NO.	DESCRIPTION		
(k)	Field performance test required	Yes	
(l)	Other tests as per applicable clauses of this specification	Yes	

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DATA SHEET A

1.0 PIPING AND SPECIALITIES

1.1 Please refer volume III - F

DATASHEET A

1.0 BUTTERFLY VALVES

1.1 Please refer volume III - F

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SR. NO.	DESCRIPTION	UNIT	VALUES / REQUIREMENTS	
(f)	Flange		Flat face per ASME B 16.1	
(g)	Seats		IS 318 Gr LTB2 / ASTM B62	
11.0	Flange drilling standard		Flat face per ASME B 16.1	
12.0	Accessories		---	

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HT SWITCHGEAR (6.6 kV)

DATA SHEET - A

<u>SR NO.</u>	<u>ITEM</u>	<u>UNITS</u>	
1.0	<u>SWITCHGEAR</u>		6.6 kV
1.1	<u>GENERAL</u>		
(a)	Type		Metal-clad, draw out
(b)	Service		Indoor
(c)	Enclosure		IP – 4X
1.2	<u>SYSTEM</u>		
(a)	Rated Voltage	kV rms	6.6 ± 10%
(b)	Phase		Three (3)
(c)	Rated Frequency	Hz	50 Hz ± 5%
(d)	System grounding		Non effectively earthed through resistance
1.3	<u>DESIGN AMBIENT TEMPERATURE</u>	°C	50
1.4	Rated Current inside the cubicle and at design ambient temperature of 50°C		
(a)	Bus bar		1250A
(b)	Circuit breaker		1250A

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		ADDENDUM- I		
<u>SR NO.</u>	<u>ITEM</u>	<u>UNITS</u>		
1.5	<u>SHORT CIRCUIT RATING</u>			
(a)	Rated short time withstand current	kA	40 kA	
(b)	Duration		3 Sec	
(c)	Rated peak withstand current	kA	100 kA	
1.6	<u>INSULATION LEVEL</u>			
(a)	Rated lightning impulse withstand voltage	kV	As per IEC	
(b)	Rated one minute power frequency withstand voltage	kV	As per IEC	
1.7	<u>AC/DC POWER SUPPLY</u>			
(a)	Control voltage	V	110 V DC	
(b)	Service voltage	V	240V ± 10%, 1 Ph, 50 Hz ± 5%	
2.0	<u>CIRCUIT BREAKER</u>			
2.1	Duty Cycle		0 - 3' - CO - 3' – CO	
2.2	<u>BREAKING CURRENT</u>			
(a)	A.C. Symmetrical	kA	40 kA	
(b)	A.C. Asymmetrical		As per IEC	
2.3	Making Current	kA	100 kA p	
2.4	<u>OPERATION TIME</u>			
(a)	Opening time (ms)		Not more than 60	

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	ADDENDUM- I		
<u>H.V. POWER CABLE (6.6 kV)</u> <u>DATA SHEET - A</u>			
<u>SR. NO.</u>	<u>ITEM</u>		
1.0	<u>6.6 kV POWER CABLE FOR NON EFFECTIVELY EARTHED SYSTEM</u>		
1.1	11kV /6.35 grade 90° C continuous rating under normal condition and 250° C rating under short circuit condition heavy duty XLPE power cable suitable for use in non-effectively earthed (UE) system conforming to following requirement and in line with IS-7098, IS-8130, IS-5831 & IS-3975, manufactured by Triple Extrusion Dry Cure(CCV) process using pressurized Nitrogen		
1.1.1	Conductor		Stranded and compacted circular aluminium conductor of grade H2 & class 2 for all sizes, generally conforming to IS:8130
1.1.2	Conductor Screen		Extruded semi-conducting compound
1.1.3	Insulation		Extruded cross linked polyethylene (XLPE) conforming to IS7098 (Part-2)
1.1.4	Insulation Screen		Extruded semi-conducting compound in combination with a layer of lapped copper tape of thickness is not less than 0.1mm.
1.1.5	Core Identification		By coloured strips applied on (For three core cables) cores or by numerals.

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SR. NO.	ITEM		
1.1.6	Inner Sheath		Extruded HRPVC/FRLS compound conforming to type ST2 of IS: 5831 for three core cables. Single core cables shall also have inner sheath. Filler material shall also be of type ST2 PVC.
1.1.7	Armour		Galvanised single round steel wire armour for twin and multicore cables
			Non-magnetic hard drawn aluminum single round wire conforming to H4 of IS-8130 latest for single core cables.
1.1.8	Overall Sheath		Extruded FRLSH HRPVC compound conforming to type ST2 of IS: 5831.
1.1.9	Drum		Steel Drum

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	ADDENDUM- I		
<u>CONTROL CABLE</u> <u>DATA SHEET - A</u>			
<u>SR. NO.</u>	<u>ITEM</u>		
1.0	<u>CONTROL CABLES</u>		
1.1	Rating : 1.1 kV grade 85° C continuous rating under normal condition and 160°C under short circuit condition rating HRPVC Control cable (YWY) conforming to following requirement and in line with IS:1554, IS:8130, IS:5831 and IS:3975.		
1.1.1	Conductor		Stranded, non-compacted & circular, high conductivity annealed plain copper, generally conforming to IS: 8130.
1.1.2	Insulation		Extruded HRPVC type-C compound conforming to IS: 5831. The minimum volume resistivity of insulation shall be 3.5 x 10 ¹⁴ ohm-cm at 27°C and 3.5 X 10 ¹¹ OHM-CM at 85°C.
1.1.3	Core Identification		By color coding and numbering at interval of 100mm or less.
1.1.4	Inner Sheath		Extruded HRPVC compound conforming to type ST2 FRLS of IS: 5831 for multicore cables. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST2.

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<u>DATA SHEET-B</u> <u>VERTICAL PUMPS</u>			
<u>SR. NO.</u>	<u>ITEM</u>	<u>UNIT</u>	
1.0	<u>GENERAL</u>		
1.1	Designation of the pumps		Raw water intake pumps
1.2	Manufacturer and Model No.		
1.3	Number of pumps offered		
2.0	<u>GUARANTEED PERFORMANCE PARAMETERS</u>		
2.1	Performance standard		
2.2	Rated capacity with tolerance	m ³ /hr	
2.3	Total dynamic head at discharge elbow at rated capacity	mlc	
2.4	Shut-off head	mlc	
2.5	"Range of operation" within which the pump can operate continuously without any problem		...% to ...% of rated capacity
2.6	Pump rated speed	RPM	
2.7	Pump overall efficiency at rated capacity	%	
2.8	Maximum value of peak to peak amplitude of vibration on any pump/motor bearing	microns	

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<u>SR. NO.</u>	<u>ITEM</u>	<u>UNIT</u>		
2.9	Maximum noise level	dB		
3.0	<u>DESIGN</u> & <u>CONSTRUCTIONAL FEATURES</u>			
3.1	Pump duty		Continuous / Intermittent	
3.2	Pump Type		Centrifugal/Mixed flow/Axial flow	
3.3	Pump design		Pull out/Non-Pull out/Above floor discharge/Below Floor Discharge	
3.4	Impeller type		Closed/Semi-Open/Open	
3.5	Number of stages			
3.6	Running speed			
3.7	NPSHr			
3.8	Pump specific speed			
3.9	Pump suction specific speed			
3.10	Minimum submergence required at rated capacity	mlc		
3.11	<u>REVERSE ROTATION</u>			
3.11.1	Is the pump suitable for reverse flow condition?		Yes/No	
3.11.2	Runaway speed of the pump due to reverse flow	rpm		
3.11.3	Head at Reverse Flow	m		
3.12	Pump Critical Speed	rpm		

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<u>SR. NO.</u>	<u>ITEM</u>	<u>UNIT</u>	
3.13	<u>MODE OF PUMP STARTING</u>		
3.13.1	Whether the pumps offered can be started with discharge valve closed ?		Yes/No
3.13.2	(a) If the answer is "no" whether the discharge valve should be kept partially open and for what % flow?		Yes/No, ...% flow
	(b) If the answer is "yes" allowable duration for such operation	minutes	
3.13.3	What precautionary measure is required to be taken to avoid hammering action on the valve disc if the pump is started with valve fully closed?		
3.14	Provision for impeller adjustment available.		Yes/No
3.15	Type and make of coupling between pump and drive.		
3.16	Number of column pipes and maximum length of single piece.	mm	
3.17	Number of shaft pieces and maximum length of single piece.	mm	
3.18	Type of shaft coupling		

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		ADDENDUM- I		
<u>SR. NO.</u>	<u>ITEM</u>	<u>UNIT</u>		
3.19	<u>SHAFT BEARINGS</u>		Impeller shaft bearings	Line and head shaft bearings
3.19.1	Type of bearings and Manufacturer			
3.19.2	Numbers provided			
3.19.3	Type of lubrication & cooling		Self/External	Self/External
3.19.4	Type of lubricant		Liquid handled / clear water/ oil	Liquid handled /clear water/ oil
3.20	<u>THRUST BEARING (S)</u>			
3.20.1	Location		On Pump / On Motor	
3.20.2	Numbers provided			
3.20.3	Type			
3.20.4	Manufacturer & Catalogue No			
3.20.5	Design life at pump duty point	Hrs.		
3.20.6	Description of lubrication arrangement and lubricant			
3.20.7	Coolant		Handling fluid/external water	
3.21	<u>SHAFT SEALING ARRANGEMENT</u>			
3.21.1	Type			
3.21.2	Sealing fluid		Handling fluid/External water	
4.0	<u>MATERIAL OF CONSTRUCTION</u> (indicate applicable code/ standard)			

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		ADDENDUM- I		
<u>SR. NO.</u>	<u>ITEM</u>	<u>UNIT</u>		
4.1	Discharge head and discharge casing			
4.2	Column pipe			
4.3	Impeller bowl			
4.4	Suction bell			
4.5	Impeller			
4.6	Impeller shaft, head shaft and line shaft			
4.7	Impeller and casing wear rings			
4.8	Shaft sleeve			
4.9	Shaft coupling			
4.10	<u>STUFFING BOX</u>			
(a)	Submerged			
(b)	Above fluid level			
5.0	<u>CONNECTIONS AND OTHER DIMENSIONAL DETAILS</u>			
5.1	<u>DISCHARGE NOZZLE</u>			
(a)	Diameter	mm		
5.2	Column pipe O/D & thickness	mm		
5.3	Suction bell diameter	mm		
5.4	Impeller shaft diameter	mm		
5.5	Line and head shaft diameter	mm		
5.6	Shaft enclosing tube O/D and thickness	mm & mm		

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<u>SR. NO.</u>	<u>ITEM</u>	<u>UNIT</u>		
5.7	Recommended Sump Dimensions (Bidder to furnish for each individual pump)			
5.7.1	Bottom clearance required from the edge of suction bell	mm		
5.7.2	Back wall clearance from pump centre line	mm		
5.7.3	Side wall clearance from pump centre line	mm		
5.7.4	Minimum water level	m		
5.7.5	Maximum water level	m		
5.7.6	Normal water level	m		
5.8	Approx. centre line elevation of discharge nozzle from floor level.	mm		
5.9	Minimum hook lift required from floor level to handle pump and drive.	mm		
6.0	<u>DRIVE DATA</u>			
6.1	Drive element output at ambient condition	kW		
6.2	Whether drive element rating takes care of the stipulations of the specification ?		Yes/No	
6.3	Cooling arrangement for the drive			

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	ADDENDUM- I		
<u>SR. NO.</u>	<u>ITEM</u>	<u>UNIT</u>	
7.0	<u>INSPECTION AND TESTING</u>		
7.1	Material test		Yes/No
7.2	Hydrostatic test pressure and duration	kg/ cm ² (g) and minutes	
7.3	<u>PERFORMANCE TEST</u>		
7.3.1	Testing standard		
7.3.2	Test to be conducted on		Proto- type
7.3.3	Test speed	rpm	
7.4	Cavitation test		Yes/No
7.5	Submergence test		Yes/No
7.6	Dynamic balancing test		Yes/No
8.0	<u>WEIGHT & LOADING DATA</u>		
8.1	Approximate weight of the pump and drive assembly	kg	
8.2	Weight of the largest single piece to be handled for	kg	
(a)	Erection		
(b)	Maintenance		

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DATA SHEET - C**DRAWINGS, DATA, CURVES AND INFORMATION REQUIRED:****1.0 DRAWINGS/DATA****1.1 Drawings/Data**

- (a) Determination of pump head and capacity as per guidelines of this specification.
- (b) General arrangement drawings showing the principal dimensions, weight and location of the suction and discharge connections of the pumps offered. Details of lubrication and sealing arrangement shall be included.
- (c) Outline drawings of the pump showing the various dimensions, suction and discharge locations.

1.2 Anticipated performance curves showing the following characteristics:

- (a) Capacity Vs Head
- (b) Capacity Vs Power & Efficiency
- (c) Capacity Vs Submergence
- (d) Capacity Vs NPSH requirement

1.3 A write-up describing clearly the procedure for installing the pump with its column pipe - piece by piece and also for overhauling the pump in a like manner. A diagram showing the required pump house crane hook lift above the pump operating floor has also to be furnished.

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</			

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		ADDENDUM- I		
<u>SR. NO</u>	<u>ITEM</u>	<u>UNIT</u>		
(d)	Material of construction (indicate code/standard)			
(e)	Type of joints			
	(i) For size 65 NB & above			
	(ii) For size 50 NB & below			
1.1.5	Fittings			
(a)	Manufacturer			
(b)	Material			
(c)	Type of Construction			
(d)	Standard			
(e)	End details			
	(i) For size 65 NB & above			
	(ii) For size 50 NB & below			
1.1.6	Flanges			
(a)	Manufacturer			
(b)	Type			
(c)	Standard			
(d)	Material Standard			
(e)	Gasket			
1.1.7	(a) Welding Process			
	(b) Type and make of welding rods to be used			

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		ADDENDUM- I		
<u>SR. NO</u>	<u>ITEM</u>	<u>UNIT</u>		
1.1.8	Hydrostatic Test Pressure	ata		
1.1.9	All equipment and temporary piping for hydro testing furnished?		Yes/No	
1.1.10	Type of rust inhibitor given before shipment			
1.1.11	Procedure for galvanization of pipes and fittings (mention standard)			
1.1.12	Outside protection for Buried Pipes			
(a)	Type and make of primer			
(b)	Type and make of paint			
(c)	Number of coats of primer			
(d)	Number of coats of paints			
(e)	Total dry thickness of the paint applied			
(f)	Type of wrapping			
(g)	Number of layer of wrapping			
(h)	Surface preparation before painting			
1.1.13	Outside Painting for Overground/ Trench Pipes			
(a)	Type and make of primer			

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		ADDENDUM- I		
<u>SR. NO</u>	<u>ITEM</u>	<u>UNIT</u>		
(b)	Type and make of paint			
(c)	Type of surface preparation before use of paint			
2.0	The following data is to be furnished for each category (different materials, type and size of valves for different services)			
2.1	<u>TYPE AND CLASS OF VALVE</u>			
2.1.1	Manufacturer			
2.1.2	Service/Location			
2.1.3	Design Standard/Code			
2.1.4	Pressure class			
2.1.5	Material of construction for valve components (Indicate also applicable codes/standards and grades)			
(a)	Body and Bonnet			
(b)	Trim/Wedge			
(c)	Seating surfaces/Seat rings			
(d)	Yoke			
(e)	Stem			
(f)	Flanges			
(g)	Bolts			
(h)	Nuts			
2.1.6	Gear operator provided		Yes/No	

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<u>SR. NO</u>	<u>ITEM</u>	<u>UNIT</u>		
(a)	If so, for what size of valve			
(b)	Type			
(c)	Make			
2.1.7	Integral bypass valve provided		Yes/No	
(a)	If so, for what size of valve			
2.1.8	End preparation			
2.1.9	Valves are outside screw and rising spindle type?		Yes/No	
2.1.10	Type of valve position indicator for the valves			
2.1.11	(a) Hand-wheel included with all valves?		Yes/No	
	(b) Are the valves provided with service tag discs at the hand- wheel?		Yes/No	
2.1.12	All the valves under this Group as desired for safe and reliable operation offered?		Yes/No	
2.1.13	Flange standard			
2.1.14	Standard for Bolts and nuts for counter flanges		Yes/No	
2.1.15	Enclosed with proposal, manufacturer's descriptive and illustrative literature/drawings on the valves		Yes/No	

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		ADDENDUM- I		
<u>SR. NO</u>	<u>ITEM</u>	<u>UNIT</u>		
2.1.16	Testing Standard			
3.0	<u>BUTTERFLY VALVE</u>			
3.1	<u>GENERAL</u>			
3.1.1	Manufacturer			
3.1.2	Whether double flanged		Yes / No	
3.1.3	Size of the valve	mm		
3.1.4	Number offered			
3.1.5	Installation		Horizontal / Vertical Shaft	
3.1.6	Type and Make			
3.2	<u>EQUIPMENT PROCEDURE</u>			
3.2.1	Maximum disc differential pressure	Kg/cm ² (g)		
3.2.2	Maximum differential back pressure allowable for valve operation	Kg/cm ² (g)		
3.2.3	Maximum allowable flow	m ³ /hr		
3.2.4	Maximum allowable fluid velocity through valve	m/sec		
3.2.5	Pressure drop across the valve at design flow when valve is fully open	Kg/cm ² (g)		
3.2.6	Angle of travel from wide open to shut-off condition in degrees (applicable for Butterfly Valves only)			

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		ADDENDUM- I		
<u>SR. NO</u>	<u>ITEM</u>	<u>UNIT</u>		
3.2.7	Design pressure	Kg/cm ² (g)		
3.2.8	Design temperature	⁰ C		
3.3	<u>DESIGN AND CONSTRUCTION</u>			
3.3.1	Valve design standard			
3.3.2	Design pressure class			
3.3.3	Maximum torque required at the disc shaft for operation (Including seating and unseating)	Kg. m		
3.4	<u>VALVE BODY & DISC</u>			
3.4.1	Body construction		Cast /Fabricated	
3.4.2	Pressure class			
3.4.3	Thickness of disc.			
3.4.4	Disc. Construction		Cast / Fabricated	
3.4.5	Flange drilling standard for flanged valve			
3.5	<u>VALVE SEAT</u>			
3.5.1	Material			
3.5.2	Location			
3.5.3	Seat thickness (mm) and radial width	mm	On body /on disc	
3.5.4	Whether of replaceable design		Yes/No	

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3.5.5	Whether reinforcement provided (applicable for resilient material)		Yes/No	
3.5.6	Number of retaining ring segments			
3.6	<u>VALVE SHAFT</u>			
3.6.1	Shaft attachment piece		Stubbed/Single	
3.6.2	Shaft diameter	mm		
3.7	<u>SHAFT BEARING</u>			
3.7.1	Type and make			
3.7.2	Location			
3.7.3	Number's provided			
3.7.4	Catalogue No.			
3.7.5	Design life at normal operating conditions	Hrs		
3.7.6	Whether self lubricating		Yes / No	
3.8	<u>THRUST BEARING</u>			
3.8.1	Type and make			
3.8.2	Catalogue No.			
3.8.3	Location			
3.8.4	Numbers provided			
3.8.5	Design axial thrust	Kgf		

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3.8.6	Design life at normal operating conditions	Hrs		
3.9	<u>SHAFT SEAL</u>			
3.9.1	Type			
3.9.2	Location			
3.9.3	Seal replacement possible without dismantling the valve			
3.10	<u>MATERIAL OF CONSTRUCTION</u>			
3.10.1	Valve body			
3.10.2	Valve disc			
3.10.3	Valve seat ring			
3.10.4	Valve shaft			
3.10.5	Shaft bearings			
3.10.6	Thrust bearings			
3.10.7	Shaft seals/stuffing box packing			
3.10.8	Gears			
3.10.9	Extension spindle, if any			
3.10.10	Clamping rings			
3.10.11	Hand wheel/Chain wheel			
3.10.12	Internal fasteners (pins, screws, etc.)			

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		ADDENDUM- I		
<u>SR. NO</u>	<u>ITEM</u>	<u>UNIT</u>		
3.10.13	External fasteners			
3.10.14	Floor stand, if any			
3.10.15	Seal			
3.10.16	Gear casing			
3.11	<u>INSPECTION AND TESTING</u>			
3.11.1	Material test			
3.11.2	Hydrostatic Test			
3.11.2.1	Pressure	kg/cm ² (g)		
3.11.2.2	Duration	minutes		
3.11.3	Disc Strength Tests			
3.11.3.1	Disc strength test pressure	Kg/cm ² (g)		
3.11.3.2	Duration	minutes		
3.11.4	Air Leakage Test			
3.11.4.1	Pressure	kg/cm ² (g)		
3.11.4.2	Duration	minutes		
3.11.5	Seat Test			
3.11.5.1	Pressure	kg/cm ² (g)		
3.11.5.2	Duration	minutes		
3.12	<u>VALVE SEAL</u>			
3.12.1	Whether seal is mounted on disc or body?			

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		ADDENDUM- I		
<u>SR. NO</u>	<u>ITEM</u>	<u>UNIT</u>		
3.12.2	Thickness and radial width of seal	mm		
3.12.3	Type of reinforcement or inserts provided in rubber seal			
3.12.4	Replaceable design			
3.13	Class & Retaining Rings etc., for Rubber Seal			
3.13.1	Type			
3.13.2	Type of construction			
3.13.3	Replaceable design			
3.14	<u>WEIGHT DATA</u>			
3.14.1	Weight of the valve assembly complete with gearing, motor etc.	kg		
3.14.2	Weight of the largest piece to be handled	kg		
4.0	<u>DOUBLE KINETIC AIR VALVE</u>			
4.1	<u>GENERAL</u>			
4.1.1	Manufacturer			
4.1.2	Size of the valve	mm		
4.1.3	Number offered			
4.1.4	Installation		Horizontal / Vertical Shaft	

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<u>SR. NO</u>	<u>ITEM</u>	<u>UNIT</u>		
4.1.5	Type and Make			
4.1.6	Working pressure	Kg/cm ² (g)		
4.1.7	Design pressure	Kg/cm ² (g)		
4.1.8	Maximum allowable flow	m ³ /hr		
4.1.9	Pressure drop across the valve at design flow when valve is fully open	Kg/cm ² (g)		
4.1.10	Design pressure	Kg/cm ² (g)		
4.1.11	Design temperature	°C		
4.2	<u>DESIGN AND CONSTRUCTION</u>			
4.2.1	Valve design standard			
4.2.2	Design pressure class			
4.2.3	Maximum torque required at the disc shaft for operation (Including seating and unseating)	Kg. m		
4.2.4	Body construction			
4.2.5	Top Cover			
4.2.6	Splash cover			
4.2.7	Floats			
4.2.8	Bolts and nuts			
4.2.9	Flange			

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**DATA SHEET – C****DRAWINGS, DATA, INFORMATION & MANUALS REQUIRED:**

- 1.0** Final versions of all the documents, furnished during the bid.
- 2.0** A complete list of all piping systems and corresponding materials included in the scope of work.
- 3.0** A complete list of all valves with their quantities and ratings.
- 4.0** Detailed layout of the cross- country piping from Tapi river water pump house upto the interconnection point.
- 5.0** Manufacturer's catalogue indicating complete range of available size and rating of pipes, fittings, valves and specialties.
- 6.0** General Arrangement and Sectional drawings with data on weight and material of construction for each category of Expansion Joints with control rod assemblies.
- 7.0** Outline drawings and Cross Sectional drawings indicating principal dimensions and weights of equipment, size and location of various nozzles, connections, nozzle sizes and foundation arrangement.
- 8.0** Detail drawings including fabrication drawings of all shop fabricated piping system indicating design parameters and complete bill of material (Relevant Standards and grades to be indicated) and information/data pertaining to the hydrostatic and non-destructive test requirements to be submitted progressively.
- 9.0** Detail dimensioned drawing of each valve, specialties, indicating tag no., pressure rating, manufacturing standard, the bill of materials and hydrostatic test pressures. The drawing shall include the end preparation details and shall indicate the position of the hand wheel/operator. Technical particulars of motor operators wherever applicable shall also be indicated.

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	ADDENDUM- I	
10.0	General arrangement drawing for each hanger/support/anchor etc. indicating identification number, auxiliary supporting structural details, other details & information as required in the specification.	
11.0	Wiring diagram for all limit switches of motor operated valves.	



**MAHARASHTRA STATE POWER
GENERATION CO. LTD.**

**PROJECTS & PLANNING
DEPARTMENT**

BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1

CORRIGENDUM - III



MAHARASHTRA STATE POWER GENERATION CO. LTD.

BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1

CORRIGENDUM - III

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CORRIGENDUM TO BID SPECIFICATION

VOLUME-I

COMMERCIAL AND GENERAL CONDITIONS OF

CONTRACT

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		BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		
		CORRIGENDUM - III		
Sr. No.	Section/Page No./ Cl. No.	Existing Particulars	To be read as	
1.	Section 1,Page 38/ Cl. No.18.2	The date of ----- in number of days from the date of award of contract----- period offered by him.	The date of ----- in number of days from the zero date ----- period offered by him.	
2.	Section 1, Page 40/ Cl No. 19.1, Table item Sr No. 2.	Loading for evaluation of shortfall in performance	Loading for evaluation of shortfall in performance	
		Heat Rate: Increase in turbine cycle heat rate (considering lowest quoted Heat Rate as base) in kCal/kWh under rated steam conditions at 76mm of Hg(back pressure) with zero make up at 100% unit load at generator terminals.	Heat Rate: Increase in weighted average turbine cycle Heat rate in KCal/Kwh (refer clause No. 1.2.3, Section 8, Vol-II) as compared to the lowest quoted in weighted average Heat rate received against this bid.	
		INR 40,000,000/- (INR Forty Million only) per kCal/kWh	INR 40,000,000/- (INR Forty Million only) per kCal/kW	
3.	Section 1, Page 50/ Cl No. 29.1,	After opening of Part-I i.e. Techno-commercial bid in both electronic as well as physical form -----	After opening of Part-I i.e. Techno-commercial bid in physical form -----	
4.	Section 1, Page 51/ Cl No. 29.4,	By obtaining clarifications/ confirmations in respect of each of the techno-commercial bids, all the bids will be brought at par as far as technical requirements and commercial terms & conditions are concerned.	By obtaining clarifications/ confirmations in respect of each of the techno-commercial bids, all the bids will be brought at par as far as functional technical requirements and commercial terms & conditions are concerned.	
			The deviations indicated in the deviation schedules may be acceptable to the owner provided- i) The deviation indicated is due to superiority of offered system/equipment compared to the specified requirements and/or ii) The deviation is due to	

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		CORRIGENDUM - III		
Sr. No.	Section/Page No./ Cl. No.	Existing Particulars	To be read as	
			intrinsic design features pertaining to the Steam Turbine Generator set & Steam Generator set and its associated control system, without compromising the specified functional & performance requirements. In deciding the superiority of the offered system/ equipment or intrinsic design feature, the decision of the owner will be final and binding on the bidder. In such circumstances, the cost of withdrawal indicated in Schedule-10 & Schedule-11 shall not be considered for evaluation	
5.	Section 1, Page 58/ Cl No. 35.7,	The contract shall be signed in One Original and One Copy.The Original shall be retained by the owner and the copy shall be handed over to the contractor.- - - - -	The contract shall be signed in One Original and Two Copies. The Original and One Copy shall be retained by the owner and the copy shall be handed over to the contractor.- - - - -	
6.	Section 1, Page 59/ Cl No. 37.2	Three Years O&M Spares (Recommended Spares):the Bidder shall - - - - -. The price of these spare parts shall be firm on price basis and shall have extended validity not less than 18 (eighteen) months after the placement of order for Main Plant Package. The Prices - - - - -.	Three Years O&M Spares (Recommended Spares):the Bidder shall - - - - -. The price of these spare parts shall be firm on price basis and shall have extended validity not less than 12(twelve) months after the placement of order. The Prices - - - - -	
7.	Section 1, Page 118/	Cross-fall-Breach clause: Breach of any of the terms and	Cross-fall Breach Clause : Breach of any of the terms and	

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		CORRIGENDUM - III		
Sr. No.	Section/Page No./ Cl. No.	Existing Particulars	To be read as	
	Annexure-XII, Cl No. 4.0,	conditions of this contract shall be deem breach of	conditions of this contract shall be deem breach of other contracts which will automatically be construed as breach of other contracts which confer right on the owner to terminate the other contract(s) also at the risk & cost of the contractor.	
8.	Section 1, Page 128/ Schedule-3, Cl No. 1.4.2	Wpo= Value of "Wholesale Price Index" as declared by Office of the Economic Advisor, GoI, New Delhi as on base date. Wp1=Value of Index "Wholesale Price Index" "as declared by Office of the Economic Advisor, GoI, New Delhi as on applicable as on the 1st day of the month in which the shipment is effected.	Wpo= Value of Index "All commodities" as declared by Office of the Economic Advisor, GoI, New Delhi as on base date. Wp1= Value of Index "All commodities" as declared by Office of the Economic Advisor, GoI, New Delhi as on the 1st day of the month in which the shipment is effected.	
9.	Section 1, Page 128/ Schedule-3, Cl No. 1.5	In the event of the shipment beyond Scheduled date of supply completion of the respective equipment/spare/material as the case may be, the price adjustment shall be worked out based on i) the scheduled date of supply completion of respective equipment/spare/material and ii) the actual date of completion of the same and whichever is beneficial to the owner shall be payable	In the event of the shipment beyond Scheduled date of supply completion of the respective equipment/spare/material as the case may be for the reasons not attributable to the contractor, the price adjustment shall be worked out based on i) the scheduled date of supply completion of respective equipment/spare/material and ii) the actual date of completion of the same and whichever is beneficial to the owner shall be payable	
10.	Section 1, Page 129/ Schedule-3,	E0 = Basic Price less advance paid for Erection, Testing & Commissioning charges	E0 = Basic Price (Without Taxes and duties payable against the contract, transport, Insurance	

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		BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		
		CORRIGENDUM - III		
Sr. No.	Section/Page No./ Cl. No.	Existing Particulars	To be read as	
	Cl No. 2.1	completed during the month. E1 = Adjusted Price less advance paid for Erection, Testing & Commissioning charges completed during the month.	etc.) less advance paid for Erection, Testing & Commissioning charges completed during the month. E1 = Adjusted Price (Without Taxes and duties, transport, Insurance etc.) less advance paid for Erection, Testing & Commissioning charges completed during the month.	
11.	Section 1, Page 129/ Schedule-3, Cl No. 3.1	C0 = Basic Price less advance paid for Civil, Structural & Architectural Works completed during the month. C1 = Adjusted Price less advance paid for Civil, Structural & Architectural Works completed during the month.	C0 = Basic Price (Without Taxes and duties, transport, Insurance etc.) less advance paid for Civil, Structural & Architectural Works completed during the month. C1 = Adjusted Price (Without Taxes and duties, transport, Insurance etc.) less advance paid for Civil, Structural & Architectural Works completed during the month.	
12.	Section 1, Cl No.3.2 page 130	In the event of the work performed beyond Scheduled date of completion of the respective activity, the price adjustment shall be worked out based on i) the scheduled date of completion of respective activity and ii) the actual date of completion of the activity and whichever is beneficial to the owner shall be payable	In the event of the work performed beyond Scheduled date of completion of the respective activity for the reasons not attributable to the contractor, the price adjustment shall be worked out based on i) the scheduled date of completion of respective activity and ii) the actual date of completion of the activity and whichever is beneficial to the owner shall be payable	

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		CORRIGENDUM - III		
Sr. No.	Section/Page No./ Cl. No.	Existing Particulars	To be read as	
13.	Section 2, Page 170/ Cl No. 3.1 xxxvi	“Zero Date” shall mean the date of commencement of work which shall be either the date of issuance of the Letter of Award OR the date of issuance of Notice to proceed if the LOA issued does not stipulate the Zero date.	“Zero Date” shall mean the date of commencement of work which shall be either the date of issuance of the Letter of Award OR the date of issuance of Notice to proceed if the LOA issued does not stipulate the Zero date. In case of delay in first advance payment beyond the contractual period, the zero date shall be extended by the period equal to the delay in making the payment of first instalment of the advance to the contractor.	
14.	Section 2, Page 189/ Cl No. 28.5	The charges levied by the Directorate of Insurance or Lead Insurer proposed by them together with taxes and duties applicable thereon, if any, shall be reimbursed to the contractor at actual.	The charges levied by the Directorate of Insurance or Lead Insurer proposed by them together with taxes and duties applicable thereon, if any, shall be reimbursed to the contractor at actual within 30 days from the date of submission of invoice alongwith all the relevant documents including money receipt.	
15.	Section 2, Page 194/ Cl No. 36.3	In the event, the Owner for any reason does not consider it necessary to avail of the training facilities; he shall be entitled for rebate on this account.	In the event, the Owner for any reason does not consider it necessary to avail of the training facilities; he shall be entitled for rebate on this account at the rate mutually agreed upon.	
16.	Section 2, Page 203/ Cl No. 44.1.3	All spares shall be properly protected and packed for long storage at site under prevailing conditions.	All spares shall be properly protected and packed for long storage at site under prevailing conditions, upto expiry of guarantee period of the spares as per the provisions of clause	

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		BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		
		CORRIGENDUM - III		
Sr. No.	Section/Page No./ Cl. No.	Existing Particulars	To be read as	
			No. 44.1.4, Section 2.	
17.	Section 2, Page 203/ Cl No. 44.2.1	It shall be the responsibility of the contractor to maintain adequate items in sufficient number, as erection & commissioning spares to ensure that erection commissioning works and operation up to end of guarantee period do not hamper -----.	It shall be the responsibility of the contractor to maintain adequate items in sufficient number, as erection & commissioning spares to ensure that erection commissioning works and operation up to end of Performance Guarantee Test do not hamper -----.	
18.	Section 2, Page 203/ Cl No. 45.1	The Contractor shall ensure the long term availability of spares to the owner for the full life of the equipment covered under the contract. The contractor shall also ensure that before going out of production of spare part of the equipment covered under the contract,-----	The Contractor shall ensure the long term availability of spares to the owner for the full life of the equipment (i.e. 25 Years from the date of commencement of guarantee period) covered under the contract. The contractor shall also ensure that before going out of production of spare part of the equipment covered under the contract,-----	
19.	Section 2, Page 212/ Cl No. 61.1.6	If the sum payable to the contractor as per Clause 61.1.5 and the costs incurred by the owner are execution of the balance works by pursuant to this clause exceed the contract price, the contractor shall be liable for such excess.	If the sum payable to the contractor as per Clause 61.1.5 and the costs incurred by the owner in execution of the balance works by pursuant to this clause exceed the contract price, the contractor shall be liable for such excess.	
20.	Section 2A, Page 225/ Cl No. 2.1	Critical/Vital Equipment / Materials :	Critical/Vital/Major Equipment or Materials :	
21.	Section 2A, Page 225/ Cl No. 2.1.1	----- before the Pre-despatch inspection of such equipment.	----- before the Pre-despatch inspection of such equipment or material.	

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		BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		
		CORRIGENDUM - III		
Sr. No.	Section/Page No./ Cl. No.	Existing Particulars	To be read as	
22.	Section 2A, Page 226/ Cl No. 2.2.1	All the equipment not enlisted as Critical/Vital Equipment/ Material shall deem to be classified as Non-Critical/Non-Vital Equipment/Materials.	All the equipment/ materials not classified as Critical/Vital/Major as mentioned in Clause no. 2.1 above, shall deem to be classified as Non-Critical/Non-Vital Equipment/Materials.	
23.	Section 2A, Page 229/ Cl No. 4.1	On completion of tests of equipment at manufacturer’s works, the Contractor shall furnish 4 copies of test certificate(s) as required as per the approved quality plan -----	On completion of tests of equipment/material enlisted in the list as mentioned under Clause No. 2.1 above, at manufacturer’s works, the Contractor shall furnish 4 copies of test certificate(s) as required as per the approved quality plan-----	
24.	Section 2A, Page 229/ Cl No. 4.3	Only on approval of these test results by the controller of Quality and the despatch clearance thereafter by the Project Manager, -----	Only on approval of these test results by the controller of Quality and the despatch clearance thereafter by the Controller of Quality, -----	
25.	Section 2A, Page 229/ Cl No. 4.4	New Clause	For non-critical/non- vital/ minor items, the despatch clearance shall not be required. However, the test certificates/inspection report of the pre-despatch inspection/ tests carried out by the contractor/sub-vendor shall invariably accompany the consignment.	
26.	Section 2A, Page 233/ Cl No. 8.8	No tax other than stipulated under this clause shall be payable/reimbursable to the contractor against the supply of goods against this contract. Further, no CST/MAVT, as the case be, shall be payable on the transactions which can be	No tax other than stipulated under this clause shall be payable/reimbursable to the contractor against the supply of goods against this contract. Further, the contractor shall cover all the imports under the provision of Section 5 (2) sale in	

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		BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		
		CORRIGENDUM - III		
Sr. No.	Section/Page No./ Cl. No.	Existing Particulars	To be read as	
		covered under the provisions of Section 5(2), Sale in Course of Import and Section 6 (2), Sale in Transit of Central Sales Tax Act 1956. The contractor shall be responsible for all the documentation, procedures to be adopted for the purpose of claiming the admissible exemptions of CST/MAVT.	course of import (Sale occasioning the import) of Central Sales Tax Act 1956 and no CST/MVAT shall be payable on these transactions. In case of sale in course of Transit as per Section 6(2) of Central Sales Tax Act 1956, except for the reimbursement of CST as mentioned under Clause No. 8.3.2, no CST/MVAT shall be payable to the contractor. The contractor shall be responsible for all the documentation, procedures to be adopted for the purpose of claiming the admissible exemptions of CST/MAVT as the case may be, as above.	
27.	Section 2A, Page 237/ Cl No. 12.1.4	The payments shall be released by the Project Manager or the financing institute(s) with whom the owner has tied up the funding for this project.	The payments shall be released by the Project Manager or the financing institute(s) with whom the owner has tied up the funding for this project through Crossed Cheque/NEFT/RTGS.	
28.	Section 2A, Page 237/ Cl No. 12.1.5	New Clause	The owner, as per guidelines and conditions specified herein, shall arrange the payment to the contractor only for the performance of the works under the contract. All payments during the currency of the contract shall be “on account” payments only. The payments shall be made in Indian Rupees and or in foreign currency as per the contract.	

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		BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		
		CORRIGENDUM - III		
Sr. No.	Section/Page No./ Cl. No.	Existing Particulars	To be read as	
29.	Section 2B, Page 255/ Cl No. 4.5.1	The owner will allow the contractor to use the railway siding facilities and shunting locomotive, (when construction in the vicinity of the owner’s existing Power Station) for unloading of material and equipment despatched against the contract as and when available without any charge.----- -----	The owner will allow the contractor to use the railway siding facilities and shunting locomotive, which shall be operated by the owner's operator (when construction in the vicinity of the owner’s existing Power Station) for unloading of material and equipment despatched against the contract as and when available without any charge.--- ---	
30.	Section 2B, Page 283/ Cl No. 37.4	Unless all material are removed and clear space is handed over back to the owner, the final bill payment as well as release of contract performance security shall not be considered by the owner.	Unless all material are removed and clear space is handed over back to the owner, release of contract performance security shall not be considered by the owner.	
31.	Section 2C, Page 300/ Cl No. 20.6	The contractor shall submit reconciliation statement of steel/cement/ other materials used by him and incorporated in the work once in every three (3) months (quarter)	Deleted	
32.	Section 3, Page 309/ Cl No. 2.1.1	Steam Generator shall ----- ----- water wall tubing for which he is qualified.	Steam Generator shall ----- ----- water wall tubing for which he is qualified. Steam Generator shall be in successful operation for at least one year from date of commissioning till the date of bid opening.	
33.	Section 3, Page 318/ Cl No. 2.6.2.1, ii)	In case the vendor is - - - - - - - - - - AND Collaborate(s)/ Associate(s) with party (ies) who meet(s) the requirement under clause 5.2.1	In case the vendor is - - - - - - - - - - AND Collaborate(s)/ Associate(s) with party (ies) who meet(s) the requirement under clause	

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		BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1				
		CORRIGENDUM - III				
Sr. No.	Section/Page No./ Cl. No.	Existing Particulars		To be read as		
		above which the contractor/subcontractor himself is not able to meet.		2.6.2.1 above which the contractor/subcontractor himself is not able to meet.		
34.	Section 3, Page 323/ Cl No. 4.5	Any change in the ----- --- during contractual work completion period and extended contractual work completion period for the reasons attributable to the owner, if any, shall be to the owners' account. However,-----shall only be payable.		Any change in the ----- ---- during contractual work completion period and extended contractual work completion period for the reasons not attributable to the contractor, if any, shall be to the owners' account. However,-----shall only be payable.		
35.	Section 3, Page 326/ Cl No. 6.3, Table Sr No. 1	Auxiliary	Multiplication Factor	Auxiliary	Multiplication Factor	
		Boiler Feed Pumps	1.00	Deleted	Deleted	
36.	Section 3, Page 324/ Cl No. 6.3, Table Sr No. 1	Variation factor	Rate of Liquidated Damages	Variation factor	Rate of Liquidated Damages	
		Heat Rate: Increase in gross turbine cycle heat rate----- ----.	INR 60,000,000/- (INR Sixty Millions only) per Kcal/Kwh	Heat Rate: Increase in weighted average turbine cycle heat rate (refer clause no. 1.2.3 of Sec.8, Vol-II) -----.	INR 60,000,000/- (INR Sixty Millions only) per Kcal/Kwh	
37.	Section 3, Page 325/ Cl No. 6.3, Table Sr No. 5	Shortfall in Capacity of Steam Generator(Main Steam): Drop of -----Steam Generator as compared to 2000 TPH	INR 60,000,000/- (INR Sixty Millions only)	Shortfall in Capacity of Steam Generator(Main Steam): Drop of --- ----- Steam Generator as compared to bidders guaranteed value.	INR 60,000,000/- (INR Sixty Millions only)	
38.	Section 1, Annexure VII A Page 108	Proforma for Commercial Deviations without Price Implication: We confirm that all the Commercial Deviations.....with price implication shown.....		Proforma for Commercial Deviations without Price Implication: We confirm that all the Commercial Deviations.....without price implication shown.....		

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		BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		
		CORRIGENDUM - III		
Sr. No.	Section/Page No./ Cl. No.	Existing Particulars	To be read as	
39.	Section 2B, Page 273 Clause 27.5.1	70% payment towards the Price Adjustment on supply of equipment/mandatory spares along with taxes	70% payment towards the Price Adjustment on services rendered along with taxes	
40.	Section 2A Page 240 Clause no.12.3.3	30% payment shall be retained and out of which 20% payment shall be released on achievement of important milestones in the project completion as stipulated below.	30% payment of invoice value shall be retained and out of which 20% payment of invoice value shall be released on achievement of important milestones in the project completion as stipulated below.	
41.	Section 2B Page 272 Clause no.27.3.2	30% payment shall be retained and out of which 20% payment shall be released on achievement of important milestones in the project completion as stipulated below.	30% payment of invoice value shall be retained and out of which 20% payment of invoice value shall be released on achievement of important milestones in the project completion as stipulated below.	
42.	Section 2A Page 244 Clause no.15.1	ii) all consumables like, grease, lubricating oils, chemicals, ink & graphs for recorders etc. up to satisfactory completion of trial operation. The Contractor shall also arrange any additional quantities required specifically for the Performance Guarantee Test.	ii) all consumables like, grease, lubricating oils, chemicals, ink & graphs for recorders etc. up to taking over the unit by owner as stipulated in Cl. 41.0, Section 2. The Contractor shall also arrange any additional quantities required specifically for the Performance Guarantee Test.	

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	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		
	CORRIGENDUM - III		
Corrigendum for Words "Contract Value" and "Contract Price" in Clauses Volume -1 of Bid Specification.			
Sr. No.	Section/Page No./ Cl. No.	Existing Particulars	To be read as
1.	Section IFB,Page 13/ Cl. No.4.3	The bidder/consortium ----- -----or 0.05% of the contract value whichever is higher, valid beyond 90 days from the scheduled date of completion of guarantee period.	The bidder/consortium ----- -----or 0.05% of the contract price whichever is higher, valid beyond 90 days from the scheduled date of completion of guarantee period.
2.	Section 1, Page 27/ Cl No. 4.3,	The bidder/consortium ----- -----or 0.05% of the contract value whichever is higher, valid beyond 90 days from the scheduled date of completion of guarantee period.	The bidder/consortium ----- -----or 0.05% of the contract price whichever is higher, valid beyond 90 days from the scheduled date of completion of guarantee period.
3.	Section 1, Page 30/ Cl No. 8.2,	Agent's commission, if any, ----- ----- with the payments towards base contract price .	Agent's commission, if any, ----- ----- with the payments towards base contract value .
4.	Section 1, Page 50/ Cl No. 28.4, Sr No. 5)	Billing Break-up of Contract Value (Clause 26.0, Scetion-2B)	Billing Break-up of Contract Price (Clause 26.0, Scetion-2B)
5.	Section 1, Schedule-3, Page 125/ Cl No. 1.1.2	EC0=Ex-works / FOB supply price-component (without taxes and duties, transport, Insurance etc.) less advance paid of the contract price for equipment, shipment-wise.	EC0=Ex-works / FOB supply price-component (without taxes and duties, transport, Insurance etc.) less advance paid of the contract value for equipment, shipment-wise.
6.	Section 1, Schedule-3, Page 126/ Cl No. 1.2.1	The Ex-Works price of Steel for Civil, Structural and Architectural Works shall be subject to price adjustment limited to ± 20% of the contract price of steel.	The Ex-Works price of Steel for Civil, Structural and Architectural Works shall be subject to price adjustment limited to ± 20% of the contract value of steel.
7.	Section 1, Schedule-3, Page 127/ Cl	S0 =Ex-works price-component (without taxes and duties, transport, Insurance etc.) less	S0 =Ex-works price-component (without taxes and duties, transport, Insurance etc.) less

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		CORRIGENDUM - III		
Sr. No.	Section/Page No./ Cl. No.	Existing Particulars	To be read as	
	No. 1.2.2	advance paid of the contract price for steel, shipment-wise.	advance paid of the contract value for steel, shipment-wise.	
8.	Section 1, Schedule-3, Page 127/ Cl No. 1.3.1	The Ex-Works price of Cement for Civil, Structural and Architectural Works shall be subject to price adjustment limited to $\pm 20\%$ of the contract price of Cement.	The Ex-Works price of Cement for Civil, Structural and Architectural Works shall be subject to price adjustment limited to $\pm 20\%$ of the contract value of Cement.	
9.	Section 1, Schedule-3, Page 128/ Cl No. 1.3.3	In any case, the price adjustment shall not exceed $\pm 20\%$ of the contract price of Cement.	In any case, the price adjustment shall not exceed $\pm 20\%$ of the contract value of Cement.	
10.	Section 1, Schedule-3, Page 128/ Cl No. 1.4.1	The basic price of Aggregates (other than Steel & Cement) for Civil, Structural & Architectural Works shall be subject to price adjustment limited to $\pm 20\%$ of the contract price for the same.	The basic price of Aggregates (other than Steel & Cement) for Civil, Structural & Architectural Works shall be subject to price adjustment limited to $\pm 20\%$ of the contract value for the same.	
11.	Section 1, Schedule-3, Page 128/ Cl No. 1.4.2	A0 =Ex-works price-component (without taxes and duties, transport, Insurance etc.) less advance paid of the contract price for Supply of other Aggregates for Civil, structural & Architectural Works.	A0 =Ex-works price-component (without taxes and duties, transport, Insurance etc.) less advance paid of the contract value for Supply of other Aggregates for Civil, structural & Architectural Works.	
12.	Section 1, Schedule-3, Page 128/ Cl No. 1.4.3	The price adjustment shall be limited to $\pm 20\%$ of the contract price of other aggregates.	The price adjustment shall be limited to $\pm 20\%$ of the contract value of other aggregates.	
13.	Schedule - 8(B)/Page 148/Foot Note No.3	Insert amount equivalent to 0.5% of the contract value in words and figures in all currencies of the contract.	Insert amount equivalent to 0.5% of the contract price in words and figures in all currencies of the contract.	
14.	Schedule - 8(C)/Page 151/Foot	Insert amount equivalent to 0.5% of the contract value in words and figures in all currencies of	Insert amount equivalent to 0.5% of the contract price in words and figures in all	

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		CORRIGENDUM - III		
Sr. No.	Section/Page No./ Cl. No.	Existing Particulars	To be read as	
	Note No.1	the contract.	currencies of the contract.	
15.	Section 2, Page 192/ Cl No. 30.2.2	Notwithstanding anything contained hereinabove; the total liability of the contractor against this clause No. 30.2 shall not exceed 10% of the contract value .	Notwithstanding anything contained hereinabove; the total liability of the contractor against this clause No. 30.2 shall not exceed 10% of the contract price .	
16.	Section 2, Page 192/ Cl No. 30.4	Notwithstanding anything ----- ----- exceed 25% of the contract value . -----	Notwithstanding anything ----- ----- exceed 25% of the contract price . -----	
17.	Section 2B, Page 250, Table of Contents, Sr No. 26.0	Billing Break-up of Contract Value	Billing Break-up of Contract Price	
18.	Section 2B, Page 270, Clause No. 26.0	Billing Break-up of Contract Value	Billing Break-up of Contract Price	

Table under Clause No.24.2 , Page No. 45, Section-I, Volume-I, is revised as under:

Section of the Bid	Contents
Bid Proposal Part – 1	Bid Proposal in format as per Annexure – 1 (A). Key Particulars of the bid in format as per annexure - III Documents of incorporation of bidder/ consortium members. Power of Attorney in favour of person(s) signing the bid, Deed of Joint Undertaking (DJU) and consortium agreement (if applicable). Consent of Proposed Assignee¹, if any, as per the format given in Annexure – XI
Enclosure – 1	Bid Security as per Clause No. 6.0, Section – 1, Volume – I of the Bid Specification.
Enclosure – 2	Summary of Qualification of the bidder/ consortium members (Annexure – IV) Documents establishing the qualification of the bidder as stipulated in Annexure – IV Deed(s) of Joint undertaking in the formats as per Annexure – V (A) or V (B) as may be applicable.
Enclosure – 3	Copy of the bid specification (Volume – I to Volume - VIII) including all clarifications, corrigenda, addenda, errata, amendments thereto issued by the owner duly sealed and signed (without filling in any data).
Enclosure – 4	<u>Deleted</u>
Enclosure – 5	Schedule of Deviations against Volume – I (commercial part) of the bid specification in the format as per Annexure – VII (A) and VII (B). Any other information called in Volume – I



Section of the Bid	Contents
Enclosure – 6	Bid Data Sheets and drawings as required under Volumes – II to VIII duly filled in and enclosures thereto if called for/required.
Enclosure – 7	Schedules of Deviations against Volume – II to VIII (Technical part) of the bid specification in the format as per Annexure – VIII (A) and VIII (B)
Enclosure – 8	List of proposed vendors/subcontractors as per format in Schedule - 9 List of the Mandatory Spares proposed by the bidder in the format as per Annexure - IX. List of 3 Years O&M spares proposed by the bidder in the format as per Annexure - X.

The Tables under Clause No. 24.3.1, Page 47 and Clause No. 2.0 of Annexure-I(B), Page No. 71, Section 1, Volume I shall be replaced by following table :

Section of the bid	Contents
Price Bid Form	Covering Letter as per Annexure – I (B).
Enclosure – 1	Break-up of Quoted Price in the format as per Schedule - 1.
Enclosure - 2	Break-up of prices of Mandatory Spares as per Schedule - 2
Enclosure - 3	Details of Price Adjustment Schedule - 3
Enclosure – 4	Details of Imports proposed (Schedule – 4)
Enclosure – 5	Schedule of Unit Prices of items for the Purpose of Addition/ Deletion (Schedule – 5)
Enclosure – 6	Guaranteed Completion Period and details of the inputs required from owner as per schedule-6 of the specification and Guaranteed Technical Particulars as per Schedule-7
Enclosure – 7	Schedule of Commercial Deviations indicating costs of withdrawal (Schedule – 10)
Enclosure – 8	Schedule of Technical Deviations indicating cost of withdrawal (Schedule - 11)
Enclosure – 9	Schedule of 3 Year's O&M (Recommended) Spares (Schedule – 12)



Following Table shall be added at Sr No. 7) under Clause No. 1.0 of Annexure-XII, Page 117

7) Various sections of Volume-I shall be attached to the contracts as under :

i) In case the bidder is an Indian Entity

Section	Description	To be incorporated in		
		First Contract	Second Contract	Third Contract
2	General Conditions of the Contract	Yes	Yes	Yes
2A	Terms & Conditions of the Contract - Supply	Yes	No	No
2B	Terms & Conditions of the Contract - Site Services	No	Yes	Yes
2C	Additional Conditions of the Contract - Civil	No	No	Yes
3	Special Terms & Conditions of the Contract	Yes	Yes	Yes

ii) In case the bidder is a Foreign Entity

Section	Description	To be incorporated in		
		First Contract	Second Contract	Third Contract
2	General Conditions of the Contract	Yes	Yes	Yes
2A	Terms & Conditions of the Contract - Supply	Yes	Yes	Yes
2B	Terms & Conditions of the Contract - Site Services	No	No	Yes
2C	Additional Conditions of the Contract - Civil	No	No	Yes
3	Special Terms & Conditions of the Contract	Yes	Yes	Yes



Schedule-1, Volume-I, Section 1 at Page No. 121 is revised as under :

Schedule – 1

Proforma for Break-up of Prices

(to be in electronic form on line)

Sr. No.	Particulars	Price			Applicable Taxes	
		INR	FC1	FC2	Tax	Rate
1.	Supply of Equipment, Mandatory Spares and Materials					
1.1	Supply of Indigenous Equipment & Materials				Excise Duty	
					CST	
					M VAT	
1.2	Supply of Indigenous Mandatory Spares				Excise Duty	
					CST	
					M VAT	
1.3	Supply of Imported Equipment, and materials to be directly delivered to the site on CFR basis				Total Customs Duty	
1.4	Supply of Imported Mandatory Spares to be directly delivered to the site on CFR basis				Total Customs Duty	
1.5	Supply of Steel, Cement and other aggregates for Civil, Structural and Architectural Works		NA	NA	Excise Duty	
					CST	
					M VAT	

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		BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1					
		CORRIGENDUM - III					
Sr. No.	Particulars		Price			Applicable Taxes	
			INR	FC1	FC2	Tax	Rate
	1.6	Inland Freight for FOR Site Delivery of 1.1 to 1.5 above including taxes thereon, if any		NA	NA	---	---
	Total					---	---
2.	Erection, Testing & Commissioning						
	2.1	Equipment Related Design & Engineering (except for Civil Design & Engineering				Service Tax	
	2.2	Erection, Testing & Commissioning		NA	NA	Service Tax	
	Total					---	---
3.	Civil Construction, Structural and Architectural Works						
	3.1	Civil Works related Design Engineering		NA	NA	Service Tax	
	3.2	Civil Construction, Structural and Architectural Works		NA	NA	Service Tax	
	Total			NA	NA	----	----
Grand Total (1+2+3)							

NA = Not Applicable i.e. Foreign Currency bid price and payment not acceptable for the respective element of the bid price. FC1, FC2 = Foreign Currencies of bidders option.

1. We confirm that the taxes at the rates mentioned above are applicable as on record date considering the prevailing Project Import Regulations. However, the above mentioned Taxes and Duties shall be payable at the rates prevailing considering 1) Deemed Export

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Page 23 of 42
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	
	CORRIGENDUM - III	
Benefits and 2) Mega Power Project benefits (including benefits for Expansion Unit of Mega Power Project benefits) shall only be payable to us. 2. We confirm that subject to grant of the Mega Power Project/Expansion Unit of Mega Power Project status by the Ministry of Power for the Project (Bhusawal TPS 1x660 MW Unit- 6), we shall avail all the benefits of taxes and duties so available to the project as per the prevailing rules and pass on all such benefits on this account to the owner. 3. We confirm that in view of International Competitive Bidding, Deemed Export Benefits as per the current Foreign Trade Policy (FTP) 2009-2014 are available to the project. Note : Total Foreign currency component indicated in schedule-1, shall not exceed the foreign currency component indicated in Schedule-4 of the bid specification		



MAHARASHTRA STATE POWER GENERATION CO. LTD.

BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1

CORRIGENDUM - III

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Schedule-4, Volume-I, Section 1 at Page No. 131 is revised as under :

Schedule - 4

DETAILS OF IMPORT CONTENT OF BID

(to be submitted in electronic form on line by uploading the *.pdf file)

Sr. No.	Item Description	Unit of Measure	Quantity		Rate/Unit		
					INR	FC 1	FC 2
1.	Goods imported and Directly Despatched to the site quoted on CFR Basis						
				FOB			
				CFR			
				FOB			
				CFR			
Total				FOB			
				CFR			
2.	Input Material included in Supply Price						
				FOB			
				CFR			
				FOB			
				CFR			
Total				FOB			
				CFR			
Total Foreign currency component of import content of bid (CFR)					INR	FC 1	FC 2



Schedule-5, Volume-I, Section 1 at Page No. 132 is revised as under :

Schedule - 5

Price Schedule for Unit Price for Addition/Deletion

(to be submitted in electronic form by uploading a *.pdf file. Giving unit prices of every item is mandatory)

PRICE SCHEDULE FOR UNIT PRICE FOR ADDITION/DELETION (Refer Clause No ____, Section - __)

The item wise unit price including insurance, port handling, loading/unloading, receiving, storage etc. and all the taxes and duties but taxes and duties as stipulated under Clause No. 8, Section - 2A, Volume - I are as under. We confirm that in the event of the any addition or deletion of any item(s), the Inland Transportation Charges shall be revised in proportion with the contract price for supply. The taxes and duties shall be payable as per the provisions of Clause No. 8, Section - 2A, Volume - I.

Sr. No.	Description	Unit of Measure (UoM)	Currency	Price Per Unit
(1)	(2)	(3)	(4)	(5)
	Item Sr. No. A 1 to 8, B 1 to 15, C 1 to 22, D 1 to 9 and E 1 to 19 stand deleted			
C 23	Complete Breaker Cubicle with			
	i) Incomer			
	ii) Tie Feeder			
	iii) Motor Feeder			
	iv) Transformer Feeder			
	v) Bus Coupler			
	vi) PT Cubicle			
	vii) Feeder Protection Relay			
	viii) Motor protection Relay			
	ix) Dummy Panel			

Note: The bidder may add other items as per his experience.

Schedule-6, Volume-I, Section 1 at Page No. 141 is revised as under :

Schedule – 6

Details of Work Completion Schedule and Inputs Required from the Owner

(to be submitted on the letterhead of the bidder/lead member of consortium)

WORK COMPLETION SCHEDULE

We are herewith submitting our Work Completion Schedule comprising of major milestones as under:

Sr. No.	Milestone	Duration from the date of LOA/Notice to Proceed
1	Commencement of excavation for Boiler foundation	
2	Site development and grading	
3	Completion of Boiler foundation	
4	Commencement of Boiler Erection	
5	Hydraulic Test	
6.	Commissioning of DM Plant	
7	Boiler Light up	
8	Commencement of excavation for TG building	
9	Casting of TG raft	
10	Casting of TG Deck	
11	Commencement of Condenser Erection	
12	Commencement of TG Erection	

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	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		
	CORRIGENDUM - III		
13	Stator lifting		
14	Boxing up of Turbine and Generator		
15	Rolling of Turbine		
16	Commissioning of Cooling Tower and CW System		
17	Commissioning of WTP and STP		
18	Synchronisation of the Unit		
19	Commissioning of CHP and AHP		
20	Coal Firing of unit on achieving commissioning of CHP and AHP		
21	Completion of successful Trial Operation		
22	Completion of Performance Guarantee Test and Handover of the unit to the owner		

In order to complete the project as per above mentioned schedule, following inputs shall be required from the owner on or before the days from the date of Letter of Award as mentioned against those inputs:

Sr. No.	Input Required	Due date in terms of No. of days from the zero date of the contract



MAHARASHTRA STATE POWER GENERATION CO. LTD.

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CORRIGENDUM - III

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1. We confirm that the probable date of the availability of above mentioned inputs shall be discussed during pre award stage and the due dates shall be modified accordingly.

Signature: _____

Name: _____

Designation: _____

Seal of the Company: _____



Schedule-7, Volume-I, Section 1 at Page No. 143 is revised as under :

Schedule - 7**GUARANTEED TECHNICAL PARAMETERS**

(to be submitted on letter head of the bidder/lead member of the consortium)

GUARANTEED TECHNICAL PARAMETERS

For the purpose of evaluation of price bid in terms of Clause No. 19 read with Clause No. 31, Section - 1, Volume - 1 and for the purpose of Clause No. 6.3, Section - 3, Volume - 1, we are herewith submitting guaranteed technical particulars which shall be demonstrated by us during Performance Guarantee Test:

Sr. No.	Guaranteed Particulars	Unit of Measure	Value Guaranteed
1.	Maximum Weighted Average Turbine Heat Rate (Clause no. 1.2.3 of Sec.8, Vol-II)	kCal/kWh	
2.	Minimum Efficiency of Steam Generator	%	
3.	Maximum Auxiliary Power Consumption	kW	
4.	Suspended Particulate Matter (SPM) Level (maximum acceptable 50 mg/Nm ³)	mg/Nm ³	

Signature: _____

Name: _____

Designation: _____

Seal of the Company: _____



Annexure -I(A), Section-1, Volume-I, page No. 63 is revised as under :

Annexure - I(A)

Bid Proposal

(to be submitted on the official letterhead of the bidder/consortium leader)

Bid Proposal No. _____

Date: _____

To

The Chief Engineer (P&P)

Maharashtra State Power Generation Co. Ltd.

3rd Floor, 'Prakashgad', Prof. Anant Kanekar Marg,

Bandra (East), Mumbai - 400 051

Subject: Bid Proposal for Design, engineering, manufacture, inspection, testing at Manufacturer's work, supply, forwarding to site, Civil, Structural & Architectural Works, Marine-cum-Erection insurance, transportation, delivery, unloading, receipt at site, storage at site, erection, testing and commissioning of Bhusawal Thermal Power Station 1x660 MW Unit - 6 project complete with all auxiliaries, accessories including supply of mandatory spares, specified tools & tackles and 3 years O&M spares as prescribed in the bid specification No. DG/BSL U-6/2011/T-1 as a fully integrated package.

Reference: Invitation For Bids (IFB) No. DG/BSL U-6/2011/T-1/_____ issued on _____.

Dear Sir,

We the undersigned bidder, having read and examined in detail all the contents of the bid specification No. DG/BSL U-6/2011/T-1 pertaining to the works as stated above for your Bhusawal T.P.S. Unit - 6: 1X660 MW Project and addenda/corrigenda/amendments/errata to the same bearing Nos. _____, do hereby propose to perform the works as a fully coordinated package as set forth in your specification and documents and do hereby submit our bid for the same.

1.0 Bid validity: We confirm that all the terms, conditions and price of this proposal are valid for acceptance up to and inclusive of the last date of the calendar

month in which 180 days from the date of opening of Bid Cover No. One expires i.e. up to _____¹.

2.0 Status of the Bidder:

²We are submitting this bid in our sole capacity as Qualified Manufacturer of Supercritical Steam Generator (SG), Supercritical Steam Turbine (ST) and Generating Set (GS) as stipulated in the bid Specification

OR

We are qualified Manufacturer as stipulated in bid specification of super Critical Stem Generator (SG) and or Super Critical Turbine and Generating set/EPC contractor and are submitting this bid in consortium with:

- i) M/s. _____ a qualified Manufacturer as stipulated in bid specification of Super Critical Steam Generator (SG) and /or Super Critical Steam Turbine (ST) and Generating Set (GS) /Qualified EPC contractor as stipulated in bid specification.
- ii) M/s. _____ a Qualified Manufacturer as stipulated in bid specification of Super Critical Turbine (ST) and Generating Set (GS).
- iii) M/s. _____ a Qualified Manufacturer as stipulated in bid specification of Generating Set (GS)

3.0 Contents of the Bid:

3.1 Techno-commercial Bid (Part - 1 Bid):

3.1.1 As required in the bid specification, we have attached herewith below mentioned documents:

Section of the Bid	Contents	Page No. of the Bid

31313142_____

¹ Insert the date of validity of the bid.

² Strikeout whichever is not applicable.

	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Page 32 of 42
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		
	CORRIGENDUM - III		
	Section of the Bid	Contents	Page No. of the Bid
	Bid Proposal Part – 1	Bid Proposal in format as per Annexure –I (A). Key Particulars of the bid in format as per Annexure - III Documents of incorporation of bidder/ consortium members. Power of Attorney in favour of person(s) signing the bid and consortium agreement (if applicable). Consent of Proposed Assignee ³ if any as per the format given in Annexure – XI	
	Enclosure – 1	Bid Security as per Clause No.6.0, Section – 1, Volume – I of the Bid Specification.	
	Enclosure – 2	Summary of Qualification of the bidder/ consortium members (Annexure – IV) Documents establishing the qualification of the bidder as enlisted in Annexure - IV Deed(s) of Joint undertaking in the formats as per Annexure – V (A) or V (B) as may be applicable.	
	Enclosure – 3	Copy of the bid specification (Volume – I to Volume - VIII) duly sealed and signed.	Yes
	Enclosure – 4	Deleted	
	Enclosure – 5	Schedule of Deviations against Volume – I (Commercial part) of the bid specification in the format as per Annexure – VII(A) and VII (B) and any other information called in Volume – I	

32323242_____

³.insert only if applicable

Section of the Bid	Contents	Page No. of the Bid
Enclosure - 6	Bid Data Sheets and drawings as required under Volumes - II to VIII duly filled in and enclosures thereto if called for/required.	
Enclosure- 7	Schedules of Deviations against Volume - II to VIII (Technical part) of the bid specification in the format as per Annexure - VIII (A) and VIII (B)	
Enclosure - 8	List of proposed vendors/subcontractors as per format in Schedule - 9 List of the mandatory spares proposed by the bidder in the format as per Annexure - IX. List of O&M spares proposed by the bidder in the format as per Annexure - X.	

- 3.2 Price Bid (Part - 2 Bid):** As required under the bid specification the price bid and the enclosures thereto as under have been submitted on line on micro website <https://mbspcl.abcpurchase.com>.

Section of the bid	Contents
Price Bid Form	Covering Letter as per Annexure -I (B).
Enclosure - 1	Break of Quoted Price in the format as per Schedule - 1.
Enclosure - 2	Breakup of prices of Mandatory Spares as per Schedule - 2
Enclosure - 3	Details of Price Adjustment as per Schedule - 3
Enclosure - 4	Details of Imports proposed (Schedule - 4)

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	Section of the bid	Contents
	Enclosure – 5	Schedule of Unit Prices of items for the Purpose of Addition/ Deletion (Schedule – 5)
	Enclosure – 6	Guaranteed Completion Period and details of the inputs required from owner as per schedule-6 of the specification and Guaranteed Technical Particulars as per Schedule-7
	Enclosure – 7	Schedule of Commercial deviations indicating costs of withdrawal (Schedule – 10)
	Enclosure – 8	Schedule of Technical deviations indicating cost of withdrawal (Schedule - 11)
	Enclosure – 9	Schedule of 3 Year's O&M (Recommended) Spares (Schedule – 12)

4.0 Construction of the Contract:

4.1 ⁴We are a foreign national firm having been incorporated by virtue and under the Laws of _____⁵ and do hereby confirm that:

- We have studied all the extent laws in India in connection with execution of Engineering and Construction contracts, employment of labour, taxation including the Income Tax Act etc. and shall abide with the same and other laws which may come into force during the performance of the contract.
- We have studied the Clause 35.3, Section – 1, Volume – I and have noted that in the event of acceptance of our bid, you shall award three contracts as stipulated therein. We also accept that all these three contracts shall have cross-fall-breach clause to the effect that breach of any contract shall be considered as breach of remaining contracts.
- ⁶We propose M/s. _____ as our assignee for execution of Second and/or Third Contract (strike out whichever is

34343442_____

⁴ Applicable for Offshore bidders only, Indian Bidders to strike out this portion till marked @@.

⁵ Insert the name of the country where the bidder is registered.

⁶ Insert only if applicable



not applicable) and enclose their unequivocal consent to work as your independent contractor on the terms and conditions offered/accepted by us. We also confirm that the proposed assignee has capacity and experience to perform the contract to your entire satisfaction. However, if the proposed assignee is not acceptable to you, we shall propose alternate assignee or perform the contract(s) proposed to be assigned by ourselves. We also confirm that the assigned contracts shall also contain cross-fall-breach clause to the effect that any breach of the contract(s) by assignee may be considered as the breach of the remaining contracts including the first contract and vice-a-versa.@@

⁷ We are Indian Bidder and do hereby confirm that:

- i) We have studied all the extent laws in connection with execution of Engineering and Construction contracts, employment of labour, taxation including the Income Tax Act etc. and shall abide with the same and other laws which may come into force during the performance of the contract.
- ii) We have studied the Clause 35.2, Section – 1, Volume – I and have noted that in the event of acceptance of our bid, you shall award three contracts as stipulated therein. We also accept that all these three contracts shall have cross-fall-breach clause to the effect that breach of any contract shall be considered as breach of remaining contracts.§§

5.0 We have understood that deviation in essential terms and conditions as mentioned under Clause 28.4, Section -1, Volume – I of the bid specification shall render our bid to be non-responsive. We confirm that we have not taken any deviation, directly or indirectly, explicitly or implicitly to these terms and conditions. If any such deviation is observed in the bid, the same shall deem to be unconditionally withdrawn by us without any financial implication to the owner.

6.0 We confirm and accept that you are not bound to accept the Lowest evaluated Bid or the Lowest Price Bid or any other bid you may receive.

7.0 The work completion period offered by us and the inputs required from the owner for the same are submitted as Schedule – 6 and Guaranteed Technical Particulars as Schedule – 7. We also accept your right to the bid offering lowest completion period on time preference basis. We also confirm that if our bid is

35353542_____

⁷ Applicable for Indian bidders. Offshore bidders to strike out this provision till §§

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	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	
	CORRIGENDUM - III	

accepted on such criterion and if we fail to achieve the completion of the project, the difference in our evaluated price and lowest evaluated price shall be recovered by you from amounts payable to us.

8.0 If our bid is accepted, we undertake to provide an Advance Payment Security, Contract Performance Securities, performance Security for Phased Manufacturing Programme and Securities for Deed(s) of Joint Undertaking (as applicable) in the form and amounts and within the times specified in the Bid Specification.

9.0 We confirm that upon notification of the contract (issuance of LOA) as stipulated in the bid specification, the contract shall get concluded and our acceptance of the notification of award shall not be required for this purpose. Our contractual obligations shall commence from the notification of award of the contract.

10.0 We undertake, if our bid is accepted, to commence work on the facilities immediately upon your Notification of Award/Notice to Proceed whichever stipulates the date of commencement of contract to us and to achieve Completion of project and Conduct Guarantee Tests within the time offered by us in the Bid.

11.0 Any clarification required about any part of our bid shall be complied promptly.

Thanking you, we remain,

Yours' truly,

For M/s. _____

Signature: _____

Name: _____

Designation: _____

Seal of the Company: _____



Annexure-II, Section 1, Volume -I, Page No. 73 is revised as under :

Annexure - II

Proforma for bank Guarantee against Bid Security

(to be submitted on the stamp paper of requisite money value purchased in the name of the guarantor bank)

BANK GUARANTEE

In accordance with Invitation for Bids (IFB) issued by Maharashtra State Power Generation Co. Ltd. (MAHAGENCO) against Bid Specification No. DG/BSL U-6/2011/T-1 for Design, engineering, manufacture, In accordance with Invitation for Bids (IFB) issued by Maharashtra State Power Generation Co. Ltd. (MAHAGENCO) inspection, testing at Manufacturer's work, supply, forwarding to site, Civil, Structural & Architectural Works, Marine-cum-Erection insurance, transportation, delivery, unloading, receipt at site, storage at site, erection, testing and commissioning of Bhusawal Thermal Power Station 1x660 MW Unit - 6 project complete with all auxiliaries, accessories including supply of mandatory spares, specified tools & tackles and 3 years O&M spares as prescribed in the bid specification as a fully integrated package.

And Whereas M/s. _____ having its registered office at _____ wish/wishes to participate in the said bid.

As per the aforementioned Bid Specification, the bidder is required to furnish Bid Security (EMD) Rs. _____ (In words Rs. _____) and the same is acceptable in the form of Bank Guarantee valid for a minimum period of 30 days (in words _____ days) days from the date of expiry of the validity of the bid which, in terms of the bid specification should be last day of calendar month in which 180 days from the date of opening of the bid expire is required to be submitted by the Bidder. We, (name of the bank) , hereby unconditionally and irrevocably guarantee and undertake that during the period commencing from the date of issuance of this guarantee till the last date of validity of this guarantee, to immediately pay on written demand (in the form of post/fax/telegram) served by Maharashtra State Power Generation Co. Ltd. (Mahagenco), Prakashgad, Bandra (East) Mumbai, India the amount of _____ (In words _____ only) to the said Company without any reservation or protest. This guarantee would remain valid up to _____ 816.00 hrs. IST and if any further extension to this is required, the same will be extended on receiving instructions from M/s. _____ on whose behalf this guarantee has been issued.

37373742_____

⁸ Insert the date 30 days beyond the validity of the bid.

**MAHARASHTRA STATE POWER GENERATION CO. LTD.**

BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1

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We confirm that appropriate stamp duty against issuance of this bank guarantee has been paid in terms of the statute in force in the state of _____⁹.

In witness whereof, we _____ Bank Limited have executed this on this the _____ day of _____.

Signed and delivered by (name of the bank) by the hand of Shri./Smt. _____ its (designation) and authorized official.

Notwithstanding anything contained hereinabove:

1. Our liability under this Guarantee is restricted to _____
2. It shall remain in force upto and including _____ with further claim period of six months thereafter.
3. The guarantor is liable to pay the guaranteed amount or any part thereof under this bank guarantee only and only if the owner serves upon us a written claim or demand on or before _____.

For -----(Name of the Bank) ---

[Authorised Signatory(ies)]

38383842_____

⁹ Insert the name of the state where the issuing branch of the bank resides.



Annexure – IV

Summary of Qualification

(to be submitted on the letter head of the bidder)

SUMMARY OF QUALIFICATION

(Refer Clause No. 4.0, Section – 1, Volume – I)

Clause No.	Particulars	Details				
4.1	Details of the EPC orders executed by the Engineering, Procurement & Construction(EPC) Company. (Certificate issued by the owner should indicate details of order, value, date commissioning of the project/contract and date of completion of defect liability period etc.)	Indicate page nos. where the evidencing documents along with summery as per table below are attached:				
		Sr. No.	Owner	Order details	Value	Certificate encl. (page no. of bid)
4.2.1/4.2.2/4.2.3	Name of the Parent manufacturer					
	Equipment	Supercritical Steam Generator (SG)/Supercritical Steam Turbine (ST)/Generating Set (GS)				
	Name of the Project with unit capacity					
	Name of the Owner					
	Date of commissioning of the unit					
	Certificate issued by the owner	(indicate page nos. of the bid)				
	Name of the Indian Subsidiary/JV Company for the Equipment					
	Name(s) of other promoters holding 25% or more equity in the Subsidiary/JV					
	Certificate of Registration/Incorporation/ Commencement of business etc,	(indicate page nos. of the bid)				
	Paid up share capital of the company					

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	CORRIGENDUM - III			

Clause No.	Particulars	Details				
	Pattern of Equity holding	Entity	Amount of Equity (INR)	% of paid-up capital		
		Parent Mfr.				
		Total		100%		
	Technology Transfer agreement	(Indicate page nos. of bid)				
	Details of land held by Subsidiary/JV Company for setting up manufacturing facility of Supercritical equipment [refer Clause 4.2.1 (vii)]	(Give details of the place with detail address, telephone nos. etc. and attach documents statutory showing ownership. Indicate page nos. of bids where this information is enclosed.)				
	Deed of Joint Undertaking	(Indicate page nos. of bid)				
4.2.3	Details of the EPC orders executed by the Indian Promoter holding 51% or more equity in the JV company incorporated for manufacturing of the supercritical equipment. (Certificate issued by the owner should indicate details of order, value, date commissioning of the project/contract and date of completion of defect liability period etc.)	Indicate page nos. where the evidencing documents along with summery as per table below are attached:				
		Sr. No.	Owner	Order details	Value	Certificate encl. (page no. of bid)
4.2.4	Name of the Indian Sub-critical equipment manufacturer					
	Details of the Equipment	Supercritical Steam Generator (SG)/Supercritical Steam Turbine (ST)/Generating Set (GS)				
	Name of the Project with Unit capacity					
	Name of the Owner					
	Date of commissioning of the unit					
	Certificate issued by the owner	(indicate page nos. of the bid)				
	Name of the Collaborator					

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Clause No.	Particulars	Details																				
	Details of the Equipment	Supercritical Steam Generator (SG)/Supercritical Steam Turbine (ST)/Generating Set (GS)																				
	Name of the Project with Unit capacity																					
	Name of the Owner																					
	Date of commissioning of the Unit																					
	Certificate issued by the owner	(indicate page nos. of the bid)																				
	Technology Transfer Agreement	(Indicate page Nos. of the bid)																				
	Deed of Joint Undertaking in Original	(Indicate page Nos. of the bid)																				
4.3	Name of the entity responsible for engineering																					
	Name of the Project(s) with Unit capacity																					
	Name(s) of the Owner																					
	Date(s) of commissioning of the project(s)																					
	Certificate issued by the owner(s)	(indicate page nos. of the bid)																				
4.4	Average Annual Turnover of the bidder/Leader of Consortium	<table border="1"> <thead> <tr> <th>Sr. No.</th> <th>Year</th> <th>Turnover INR Millions)</th> <th>P/L attached at (page No.)</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>	Sr. No.	Year	Turnover INR Millions)	P/L attached at (page No.)																
Sr. No.	Year	Turnover INR Millions)	P/L attached at (page No.)																			
4.5	Net worth as on end of preceding financial year	INR _____ Million as on _____ Audited Balance Sheet attached at (indicate page Nos. of the bid)																				

Signature: _____
 Name: _____
 Designation: _____
 Seal of the Company: _____



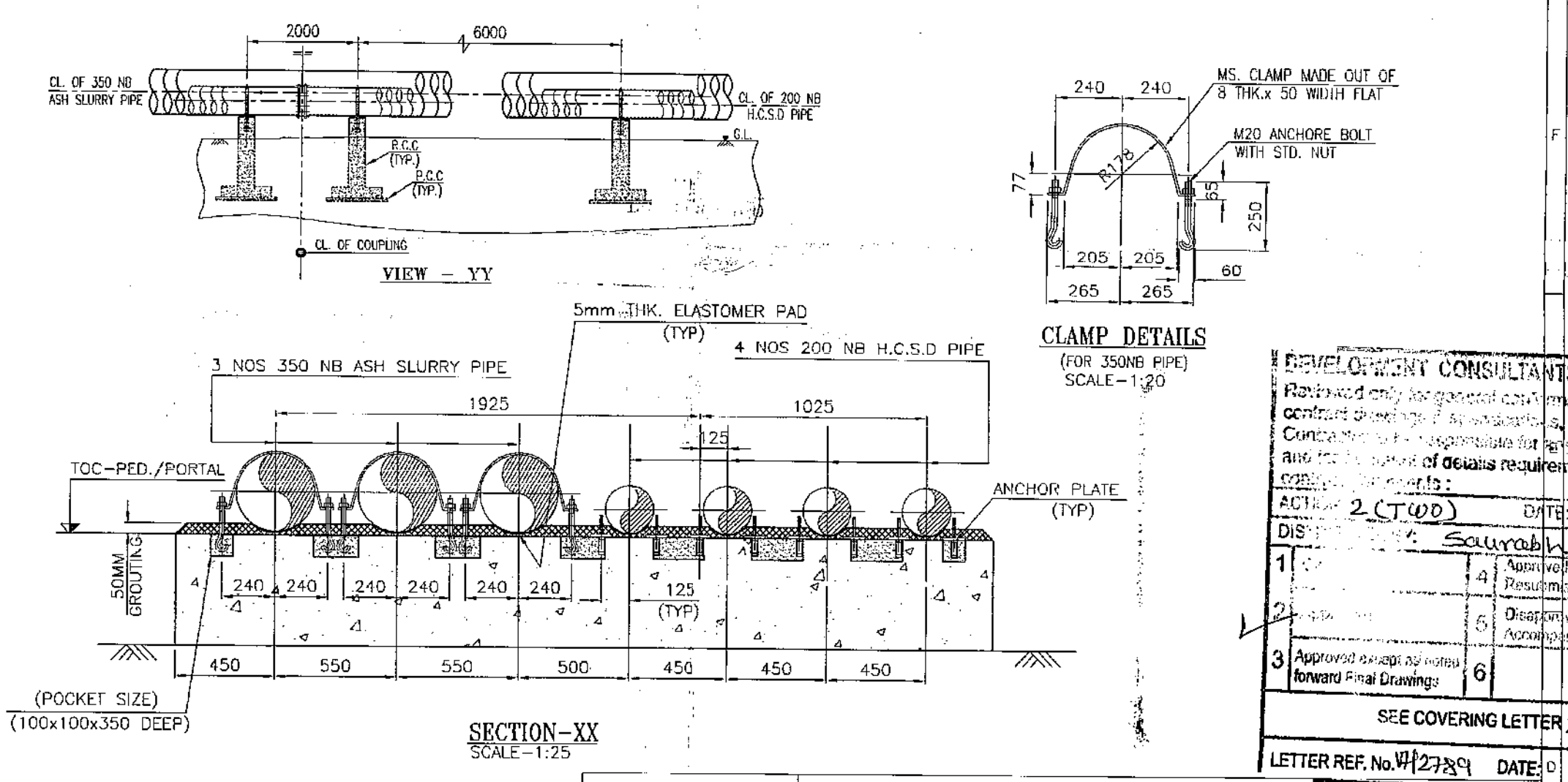
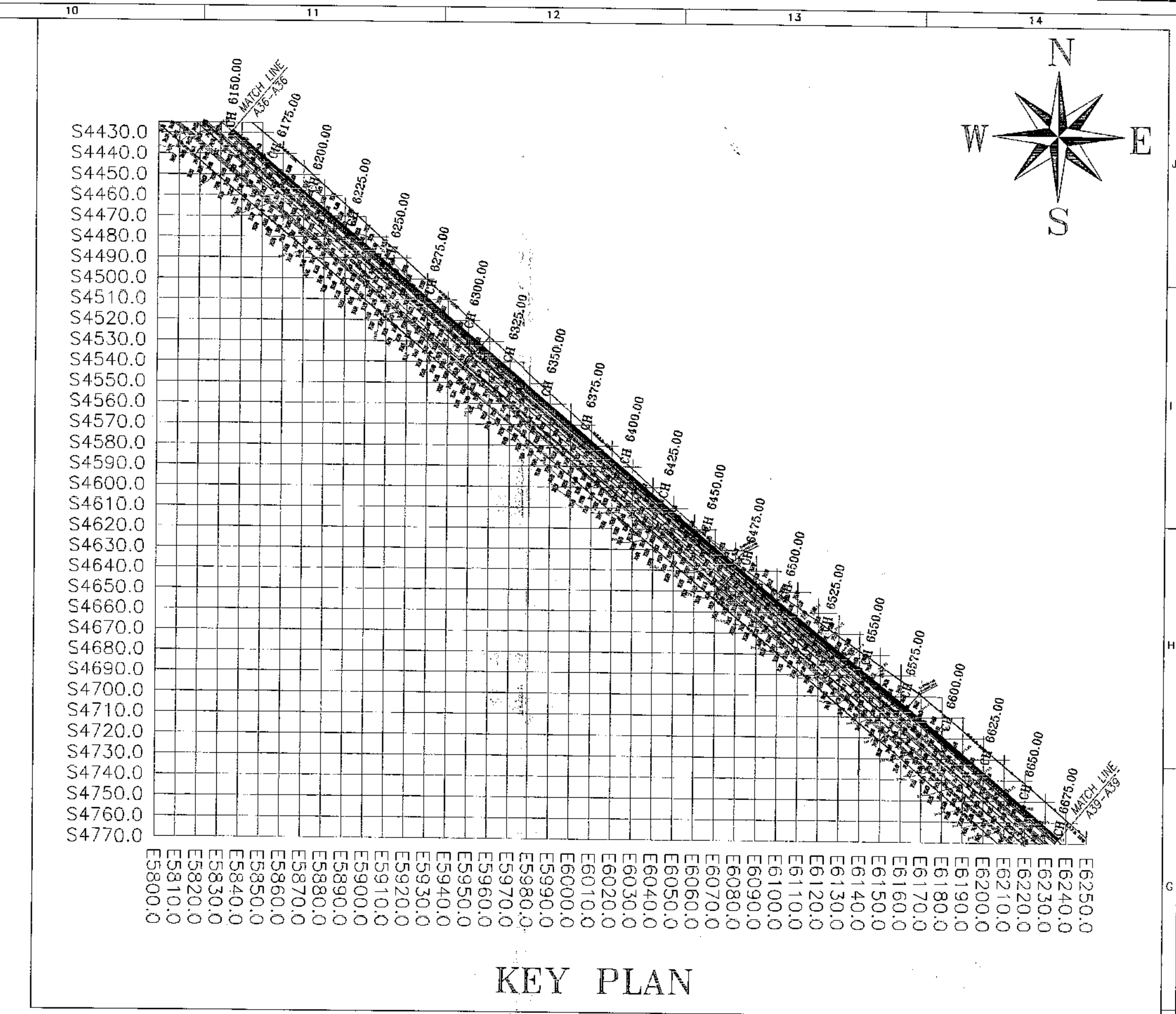
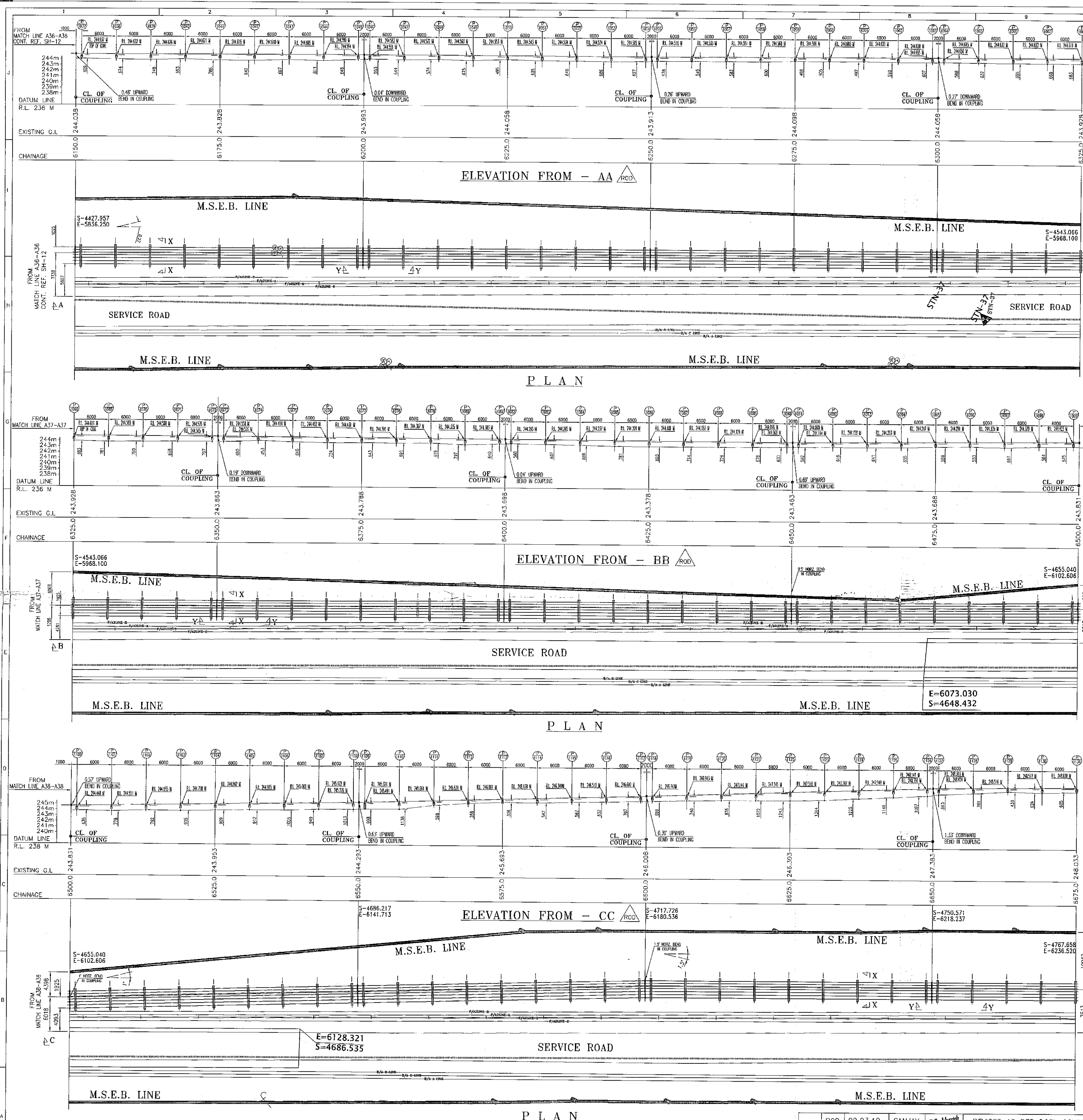
MAHARASHTRA STATE POWER GENERATION CO. LTD.

BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1

CORRIGENDUM - I

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CONSULTANT : PROCON ENGINEERS



NOTES:-

- THE EXISTING CULVERTS SHOWN IN THE DRAWING HAVE TO BE EITHER SUITABLY MODIFIED TO ACCOMMODATE THE PIPELINES OR NEW CULVERTS HAVE TO BE CONSTRUCTED IN THOSE LOCATIONS.
- ALL DIMENSIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
- ALL COORDINATES ARE IN METERS.
- SHEDDED / TRIMMED THE GROUND.
- FIXING CLAMPS ALONG WITH ANCHOR BOLTS AND NUTS SHALL BE SUPPLIED AS LOOSE ITEMS.
- FOR CULVERT (PATH WAY)- EXISTING PATH WAY CULVERT TO BE EXTENDED.
- FOR PIPE AT CULVERT AREA - LOCATION DETAIL OF PIPE SUPPORT PILE SHALL TO BE CHECKED AS PER CULVERT CONSTRUCTION.
- 30 MM GROUTING OVER TOP OF CONCRETE IN THE PIPE SUPPORT FOR ENTIRE DISPOSAL PIPE ROUTE (OUTSIDE & INSIDE PLANT) IS UNDER TCEP'S SCOPE.
- 700 NB RECOVERY LINE IS NOT IN TPL/TECPRO'S SCOPE OF SUPPLY.
- REF. DRG. NO. -
- (GA & RC DETAILS CULVERT AT OUTSIDE PLANT BOUNDARY.) TPL-06T-CV-256-RC-6708
- TYPICAL DETAILS FOR THRUST BLOCK FOR 350NB DISPOSAL ROUTE PIPES (DWG. NO. 547-08-05)

PROJECT		BHUSAWAL T.P.S. EXPANSION PROJECT (2 x 500 MW)	
OWNER		MAHARASHTRA STATE POWER GENERATION COMPANY LTD.	
OWNER'S CONSULTANT		DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS MUMBAI - INDIA	
MAIN BOP CONTRACTOR		TATA PROJECTS LIMITED Hydrabad	
CONSULTANT TO TPL		TCE CONSULTING ENGINEERS LIMITED Kolkata	
TECPRO ASHTECH LTD.		KOLKATA PUNE	
TITLE: SLURRY DISPOSAL PIPING LAYOUT			
DRAWN	SANJAY	CHKD.	S.D.
PROJ. ENGR.	S.D.	DEPT. HEAD	D.D.
DRG. NO.	547-08-02 (SH-13)	PLT. SCALE	1:1
SCALE - 1:350		DATE - 08.04.2009	
JOB NO. 547		COMP. FILE: 547-08-02(SH-13)	
REV. NO.		ROD	

REV. NO.	DATE	DRN.	CHKD.	DESCRIPTION
09.03.10	SANJAY	Subhash		REVISED AS PER DCPL COMMENTS DATED 30.12.09.
23.09.09	P.D.	Subhash		REVISED AS PER DCPL COMMENTS
04.05.09	Asish	Subhash		REVISED AS PER DCPL COMMENTS VIDE TR.NO.-1299, DATED 22.04.09.



**MAHARASHTRA STATE POWER
GENERATION CO. LTD.**

**PROJECTS & PLANNING
DEPARTMENT**

BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1

CORRIGENDUM - X

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CORRIGENDUM TO BID SPECIFICATION

VOLUME-I

COMMERCIAL AND GENERAL CONDITIONS OF

CONTRACT

Following Clauses of the Bid Specification are amended as under:

Sr No	Section /Page No/Cl No.	Existing Particulars of Bid Stipulation including amendment/corrigendum thereof			To be read as		
1	Section 1,Page 35/ Cl. No.15.1 .1	The ~~bidder at his option can offer the bid price in three currencies out of which one shall be in Indian Rupee (INR) only, and remaining two can be out of US Dollar (USD), Sterling Pound (GBP), Euro (EUR), and Japanese Yen (JPY).~~			The bidder, at his option, can offer the bid price in three currencies out of which one shall be Indian Rupee (INR) and remaining two can be out of US Dollar (USD), Sterling Pound (GBP), Euro (EUR) and Japanese Yen (JPY).		
2	Section 1,Page 36/ Cl. No.15.2 .1	i) Price for Supply Equipment/ materials manufactured in India (shall also include the ~~foreign~~ currency portion towards imported raw material, if any) ii) Price for Supply of Mandatory Spares manufactured in India (shall also include the ~~foreign~~ currency portion towards imported raw material, if any)			i) Price for Supply Equipment/ materials manufactured in India (shall also include the foreign currency portion towards imported raw material, if any) ii) Price for Supply of Mandatory Spares manufactured in India (shall also include the foreign currency portion towards imported raw material, if any)		
3	Section 1,Page 40/ Cl. No. 19.1	Sr No	Variation Factor	Loading for evaluation of shortfall in performance	Sr No	Variation Factor	Loading for evaluation of shortfall in performance
		1.	Duration offered (considering the lowest as base) for completion of the Project as envisaged under Clause No. 30.1, Section-2 of the Bid Specification	INR 3,600,000/- (INR Three Million Sixty Thousand Only)	1.	Duration offered (considering the lowest as base) for completion of the Project as envisaged under Clause No. 30.1, Section-2 of the Bid Specification	INR 3,600,000/- (INR Three Million Six Hundred Thousand Only)
4	Section 1, Page 53/Cl. 31.5	For the purpose of evaluation of the bids the prices shall be converted to INR. The exchange rate applicable for this purpose shall be the Bills Selling Rate declared by State Bank of India (SBI) as on the record date (or next working day if the record date is a holiday for SBI			For the purpose of evaluation of the bids the prices shall be converted to Indian Rupees. The foreign currency component quoted by the bidder in the cash flow statement as per Schedule-1A shall be converted in Indian Rupee as per the rate of Indian Rupee in Future contract rates quoted by SBI on Record Date for the 1 st day of the particular month of		

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			Cash FLOW. For the purpose of this clause, the next day of scheduled expiry of validity of the bids shall be considered as the 'Zero Date'.	
5	Section 1,Page 60/Cl. No. 37.3	Commissioning Spares: To cater for any exigency arising during initial trial and initial operation stages upto the satisfactory completion of Trial Operation due to infant mortality of items / components / consumable hardware, the bidder at his own cost shall arrange and maintain an inventory of such items so as not to have any major interruptions during the period from initial trial to Trial Operation.	Commissioning Spares: To cater for any exigency arising during initial trial and initial operation stages upto the satisfactory completion of ~~Trial-Operation~~ <u>Performance Guarantee Test</u> due to infant mortality of items / components / consumable hardware, the bidder at his own cost shall arrange and maintain an inventory of such items so as not to have any major interruptions during the period from initial trial to ~~Trial-Operation~~ <u>end of Performance Guarantee Test</u> .	
6	Section 1,Page 70/Ann exure I(B)/ Cl. No.1.0	Bid Price: In continuation with our Bid Proposal No. _____ dated _____, we hereby offer to perform the subject work as offered by us vide our bid proposal which for the sum (bid Price) of: INR _____ (in words INR) And ~~_____ ¹Foreign Currency 1 (in _____ words)~~ And ~~_____ ¹Foreign Currency 2 (in _____ words)~~ or such sums which may be determined in terms of the contract, if awarded. The detailed breakup of our	Bid Price: In continuation with our Bid Proposal No. _____ dated _____, we hereby offer to perform the subject work as offered by us vide our bid proposal which for the sum (bid Price) of: INR _____ (in words INR) And ~~_____ ²Foreign Currency 1 (in words _____)~~ And ~~_____ ¹Foreign Currency 2 (in words _____)~~ or such sums which may be determined in terms of the contract, if awarded. The detailed breakup of our bid price is enclosed as Schedule - 1 attached hereto- - - - -	
55560_____				
¹ Please name the foreign currencies				
² Please name the foreign currencies				

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Sr No	Section /Page No/CI No.	Existing Particulars of Bid Stipulation including amendment/corrigendum thereof	To be read as	
		bid price is enclosed as Schedule - 1 attached hereto- - -		
7	Section-I, Page 88-89, Annexure-V(A),	10. Any dispute that may arise between the Owner and the Indian executants in connection with this Deed of Joint Undertaking shall be finally settled as per the arbitration procedure / rules mentioned in the Contract documents. Any dispute that may arise between the Owner and the Parent Manufacturer, *the parent manufacturer - GS in connection with this Deed of Joint Undertaking shall be finally settled by reference to arbitration in accordance with the United Nations Commission Trade Law (UNCITRAL) Arbitration Rules of 1976. The Arbitral Tribunal shall consist of three members and shall be appointed in accordance with the said Rules. The appointing authority for the Third Arbitrator shall be the President, International Chamber of Commerce, Paris. The language to be used in arbitral proceedings shall be English. The place of arbitration shall be Singapore. The award made in such arbitration shall be final and binding and shall be enforceable in any court of competent jurisdictions.	10. Any dispute that may arise between the Owner and the Indian executants in connection with this Deed of Joint Undertaking shall be finally settled as per the arbitration procedure / rules mentioned in the Contract documents. Any dispute that may arise between the Owner and the Parent Manufacturer, *the parent manufacturer - GS in connection with this Deed of Joint Undertaking shall be finally settled by reference to arbitration in accordance with the United Nations Commission Trade Law (UNCITRAL) Arbitration Rules of 1976. The Arbitral Tribunal shall consist of three members and shall be appointed in accordance with the said Rules. The appointing authority for the Third Arbitrator shall be the President, International Chamber of Commerce, Paris. The language to be used in arbitral proceedings shall be English. The ~~place~~ <u>venue</u> of arbitration shall be Singapore. The award made in such arbitration shall be final and binding and shall be enforceable in any court of competent jurisdictions.	
8	Section 1, Schedule-8(B) Page 148	~~_____We the Guarantor_____~~ . The Bank undertakes not to revoke this Guarantee during its currency without previous consent of the Owner and further agrees that the Guarantee herein contained shall be enforceable till ninety six months after expiry of its validity. _____	~~_____We the Guarantor_____~~ . The Bank undertakes not to revoke this Guarantee during its currency without previous consent of the Owner and further agrees that the Guarantee herein contained shall be enforceable till ~~ninety~~ six months after expiry of its validity. _____	

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Sr No	Section /Page No/Cl No.	Existing Particulars of Bid Stipulation including amendment/corrigendum thereof	To be read as	
9	Section-1, Schedule-8(B), Page 149	__ _ The bank also agrees that the validity of the Bank Guarantee shall be extended by further period of six months one month before its prevailing date of its validity upon receipt of the demand from the owner to do so without referring the matter to the Parent Manufacturer/the Indian Promoter of Indian Subsidiary Company/JV Company/Collaborator/Indian Subcritical Equipment Manufacturer. The bank further agrees that bank's inability to extend the validity of the bank guarantee as above shall be sufficient ground for encashment of the same by the owner.	__ _The bank also agrees that the validity of the Bank Guarantee shall be extended by further period of six months one month before its prevailing date of its validity upon receipt of the demand from the owner to do so ~~without referring the matter to the Parent Manufacturer/the Indian Promoter of Indian Subsidiary Company/JV Company/Collaborator/Indian Subcritical Equipment Manufacturer.~~ The bank further agrees that bank's inability to extend the validity of the bank guarantee as above shall be sufficient ground for encashment of the same by the Owner.	
10	Section 2,Page 181/ Cl. No. 18.2	All costs, damages or expenses that the owner may have incurred, for which under the contract the contractor is liable, shall be recovered by the owner as and when they are incurred from the contractor's bills becoming due under this contract or any other contract. Such recoveries shall be supported by appropriate documents or explanations, to enable the contractor to properly identify such claims. These amounts may be recovered by actions of law or otherwise, if the contractor fails to satisfy the owner of such claims.	All costs, damages or expenses that the owner may have incurred, for which under the contract the contractor is liable, shall be recovered by the owner as and when they are incurred from the contractor's bills becoming due under this contract or any other contract <u>awarded by the Owner to the Contractor</u> . Such recoveries shall be supported by appropriate documents or explanations, to enable the contractor to properly identify such claims. These amounts may be recovered by actions of law or otherwise, if the contractor fails to satisfy the owner of such claims.	
11	Section 2,Page 192/ Cl. No. 30.4	Notwithstanding anything contained hereinabove, the aggregate liability of the contractor towards payment of Liquidated Damages stipulated under Clause Nos. 30.1 and 30.2 above shall not exceed 25% of the contract price. For the purpose of this clause No. 30.0, the contract price shall mean the total	Notwithstanding anything contained hereinabove, the aggregate liability of the contractor towards payment of Liquidated Damages stipulated under Clause Nos. 30.1 and 30.2 above shall not exceed 15% and 10% of the contract price respectively. For the purpose of this clause No. 30.0, the contract price shall mean the total contract price as per	

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Sr No	Section /Page No/CI No.	Existing Particulars of Bid Stipulation including amendment/corrigendum thereof	To be read as	
		contract price as per Price Schedule (Schedule - 1) of this contract (excluding price of mandatory spares) along with applicable price variation excluding the amount of taxes & duties.	Price Schedule (Schedule - 1) of this contract (excluding price of mandatory spares) along with applicable price variation excluding the amount of taxes & duties.	
12	Section 2,Page 196/ Cl. No. 37.4	The fuel (Coal & Fuel Oil i.e. HFO, LDO), for test/commissioning and PG Test shall be provided by the Owner. Moreover, for the Purpose of commissioning and Guarantee Tests, the Owner shall provide operating personnel for operation of the equipment. Such personnel provided by the Owner shall work under the supervision of the Contractor till the Plant is taken over by the Owner as per Clause No. 41.0 hereunder.	The fuel (Coal & Fuel Oil i.e. HFO, LDO), Electricity and Auxiliary Steam for initial & trial operation, test/commissioning and PG Test shall be provided by the Owner. Moreover, for the Purpose of commissioning and Guarantee Tests, the Owner shall provide operating personnel for operation of the equipment. Such personnel provided by the Owner shall work under the supervision of the Contractor till the Plant is taken over by the Owner as per Clause No. 41.0 hereunder.	
13	Section 2,Page 203/ Cl. No.44.1 .4	Provisions of Clause No. 42.0, Defect Liability Period shall be applicable for all the spares covered under this contract except for the Three Years O&M (Recommended) Spares and Commissioning Spares. Three Years O&M (Recommended) Spares, if covered under this contract shall have guarantee of 12 months from the date of putting in use or 18 months from the date of receipt at site whichever is earlier.	Provisions of Clause No. 42.0, Defect Liability Period shall be applicable for all the spares covered under this contract except for the Three Years O&M (Recommended) Spares and Commissioning Spares. Three Years O&M (Recommended) Spares, if covered under this contract shall have guarantee of 12 months from the date of putting in use or 18 months from the date of receipt at site whichever is earlier. <u>However, If any spares (except for 3years O&M Spares) are delivered at site beyond the date of completion of PG Test/Taking over of the unit, the Defect Liability Period for such spares shall be 12 months from the date of putting in use or 18 months from the date of receipt at site, whichever is earlier.</u>	
14	Section 2A,Page 227/ Cl.	In the event the inspection is not be carried out on the date confirmed as per Clause No. 3.2.3 above and inspection call is required to be	In the event the inspection is not be carried out on the date confirmed as per Clause No. 3.2.3 above and inspection call is required to be cancelled <u>for the reasons attributable to the</u>	

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	No. 3.2.5	cancelled, all the costs of deputing owner's representative /IIA shall be recovered from the contractor's invoices.	<u>Contractor/his Sub-contractor/Vendor</u> , all the costs of deputing owner's representative /IIA shall be recovered from the contractor's invoices.	
15	Section 2A,Page 229/Cl. No. 4.3	Only on approval of these test results by the Controller of Quality and the despatch clearance thereafter by the Project Manager, the material shall be despatched to site. The despatch clearance shall be notified by way of e-mail/fax/letters as may be mutually agreed during execution of the contract.	<u>The approval of Test Reports shall be generally granted within 10 working days from the date of receipt of documents complete in all respects by Controller of the Quality.</u> Only on approval of these test results by the Controller of Quality and the despatch clearance thereafter by the Project Manager, the material shall be despatched to site. The despatch clearance shall be notified by way of e-mail/fax/letters as may be mutually agreed during execution of the contract.	
16	Section 2A,Page 232/Cl. No. 8.3.3	The owner shall issue 'C' form in accordance with the statutory provisions in this regard.	The owner shall issue 'C' form for all the interstate supplies (including cement & steel) made against the contract in accordance with the statutory provisions in this regard.	
17	Section 2A,Page 232/Cl. No. 8.4.2	The owner shall issue form/certificate for concessional rate of tax, as may be applicable as per the prevailing rules in this regard and contractor shall charge the tax accordingly	The owner shall issue form/certificate for concessional rate of tax, as may be applicable as per the prevailing rules in this regard and contractor shall charge the tax accordingly. <u>Currently, MVAT applicable on supplies to the Owner is @5%. The Contractor shall charge the MVAT accordingly.</u>	
18	Section 2A,Page 234/Cl. No. 9.1	If the rates of taxes & duties as stipulated under Clause No. 8.1 to 8.5 above are increased by the respective statutory authorities OR If any tax(es) or duty(ies) are introduced by the Indian Central or State Govt. or Local body with effect from the next day of record date, such changes shall amount to statutory variation. If the contractor/Sub-Contractor, as the case may be, is required to pay any amount	If the rates of taxes & duties as stipulated under Clause No. 8.1 to 8.5 above are increased by the respective statutory authorities <u>OR the concession available as on Record Date are withdrawn by the respective statutory authority</u> OR If any tax(es) or duty(ies) are introduced by the Indian Central or State Govt. or Local body with effect from the next day of record date, such changes shall amount to statutory variation. If the contractor/Sub-Contractor, as the case may	

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Sr No	Section /Page No/Cl No.	Existing Particulars of Bid Stipulation including amendment/corrigendum thereof	To be read as	
		towards such statutory variation against the supplies made against this contract and if CENVAT Credit/set off, as the case may be towards the payment of the same is not available to the contractor, the owner shall reimburse the contractor payments of such statutory variation against documentary evidence. However, statutory variation as above shall be paid/reimbursed against the supplies made during the contractual completion period only. The contractor shall have to bear payments against such statutory variation on supplies beyond contractual completion period.	be, is required to pay any amount towards such statutory variation against the supplies made against this contract and if CENVAT Credit/set off, as the case may be towards the payment of the same is not available to the contractor, the owner shall reimburse the contractor payments of such statutory variation against documentary evidence. However, statutory variation as above shall be paid/reimbursed against the supplies made during the contractual completion period only. The contractor shall have to bear payments against such statutory variation on supplies beyond contractual completion period.	
19	Section 2A,Page 239/Cl. No. 12.2.5	The advance paid as above shall be interest free up to the scheduled date of completion of trial operation of the unit as per the approved project schedule. The advance shall be adjusted against the supplies made by the contractor on prorata basis and shall be determined by the value goods delivered by the contractor in against the contract irrespective of the fact whether payment against such supplies are made by the owner or otherwise. However, the contractor may seek accelerated/ one time adjustment of the advance before the scheduled date of completion of trial operation of the unit as per the approved project schedule.	The advance paid as above shall be interest free up to the <u>Scheduled date of Taking over of the Unit</u> ~~scheduled date of completion of trial operation of the unit~~ as per the approved project schedule. The advance shall be adjusted against the supplies made by the contractor on prorata basis and shall be determined by the value goods delivered by the contractor in against the contract irrespective of the fact whether payment against such supplies are made by the Owner or otherwise. However, the contractor may seek accelerated/ one time adjustment of the advance on or before the <u>Scheduled date of Taking over of the Unit</u> ~~scheduled date of completion of trial operation of the unit~~ as per the approved project schedule.	
20	Section 2A,Page 239/Cl. No. 12.2.6	For the unrecovered advance, if any, beyond the scheduled date of completion of trial operation of the unit as per the approved project schedule, interest at the rate of whichever is higher of i) one percent higher than the rate of borrowing by	For the unrecovered advance, if any, beyond <u>Scheduled date of Taking over of the Unit</u> ~~the scheduled date of completion of trial operation of the unit~~ as per the approved project schedule, interest at the rate of whichever is higher of i) one percent higher than the rate of borrowing by the owner for	

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		the owner for this project or ii) the prevailing Retail Prime Lending Rate (RPLR) of State Bank of India shall be levied.	this project or ii) the prevailing Retail Prime Lending Rate (RPLR) of State Bank of India shall be levied.	
21	Section 2A, Page 242, Cl. No. 12.10	In case of payments in foreign currency, if the supply of the goods is delayed with respect to the scheduled date of work completion as per the project schedule, then the currency amount claimed by the contractor for the delayed supplies shall be restricted to the equivalent Indian Rupees prevailing as on the scheduled date of work completion as per the project schedule or actual date of supply of the equipments whichever is less and shall be paid in currency equivalent to the Indian Rupees worked out as above. For this purpose the Bill Selling Exchange rate by State Bank of India prevailing as on Supply cut off date and actual date of supply of the equipment shall be considered.	In case of payments in foreign currency, if the supply of the goods is delayed with respect to the scheduled date of work completion as per the project schedule, then the foreign currency amount claimed by the contractor for the delayed supplies shall be restricted to the equivalent Indian Rupees prevailing as on the scheduled date of work completion as per the project schedule or actual date of supply of the equipment whichever is less and shall be paid in foreign currency equivalent to the Indian Rupees worked out as above. For this purpose the Bill Selling Exchange rate by State Bank of India prevailing as on scheduled date of Supply and actual date of supply of the equipment shall be considered.	
22	Section 2A, Page 242, Cl. No. 12.11.3	New Clause	As per the provisions of Building & Other Construction Workers Act-1996, BOCW cess @1% of contract price shall be deducted from the invoices of the contractor and deposited to the concerned authorities. Any increase or decrease in the rate from the next day to the Record Date shall accrue to the Owner.	
23	Section 2A, /Cl. No. 12.12	New Clause	In case the Contract is awarded to the Consortium, the payments shall be made as provided in the Consortium Agreement appended to the contract.	
24	Section 2B,Page 268/Cl.	The filed activities of the contractors working at site will be coordinated by the Engineer and the Engineer's	The filed field activities of the contractors working at site will be coordinated by the Engineer and the Engineer's decision shall be	

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Sr No	Section /Page No/Cl No.	Existing Particulars of Bid Stipulation including amendment/corrigendum thereof	To be read as	
	No. 22.1	decision shall be final in resolving any disputes or conflicts between the Contractor and other contractors and tradesmen of the Owner regarding scheduling and co-ordination of work. Such decision by the Engineer shall not be a cause for extra compensation or extension of time for the Contractor.	final in resolving any disputes or conflicts between the Contractor and other contractors and tradesmen of the Owner regarding scheduling and co-ordination of work. Such decision by the Engineer shall not be a cause for extra compensation ~~or extension of time~~ for the Contractor.	
25	Section 2B,Page 271/Cl. No. 27.2.3	The advance paid as above shall be interest free up to the scheduled date of completion of trial operation of the unit as per the approved project schedule. The advance shall be adjusted against the supplies made by the contractor on prorata basis and shall be determined by the value goods delivered by the contractor in against the contract irrespective of the fact whether payment against such supplies are made by the owner or otherwise. However, the contractor may seek accelerated/onetime adjustment of the advance before the scheduled date of completion of trial operation of the unit as per the approved project schedule.	The advance paid as above shall be interest free up to the <u>Scheduled date of Taking over of the Unit</u> ~~scheduled date of completion of trial operation of the unit~~ as per the approved project schedule. The advance shall be adjusted against the supplies made by the contractor on prorata basis and shall be determined by the value goods delivered by the contractor in against the contract irrespective of the fact whether payment against such supplies are made by the owner or otherwise. However, the contractor may seek accelerated/onetime adjustment of the advance <u>on or before Scheduled date of Taking over of the Unit</u> ~~the scheduled date of completion of trial operation of the unit~~ as per the approved project schedule.	
26	Section 2B, Page 273, Cl. No. 27.7	In case of payments in foreign currency, if any, if the activity is delayed with respect to the scheduled date of work completion as per the project schedule, then the currency amount claimed by the contractor for the delayed supplies shall be restricted to the equivalent Indian Rupees prevailing as on the scheduled date of work completion as per the project schedule or actual date of activity completion whichever is less and shall be paid in currency equivalent to the Indian Rupees worked out as above.	In case of payments in foreign currency, if any, if the activity is delayed with respect to the scheduled date of work completion as per the project schedule, then the ~~foreign~~ currency amount claimed by the contractor for the delayed ~~works~~ shall be restricted to the equivalent Indian Rupees prevailing as on the scheduled date of work completion as per the project schedule or actual date of activity completion whichever is less and shall be paid in ~~foreign~~ currency equivalent to the Indian Rupees worked out as above. For this purpose the Bill Selling Exchange rate by State Bank of India prevailing as on <u>scheduled completion</u>	

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Sr No	Section /Page No/Cl No.	Existing Particulars of Bid Stipulation including amendment/corrigendum thereof	To be read as	
		For this purpose the Bill Selling Exchange rate by State Bank of India prevailing as on Supply cut off date and actual date of supply of the equipment shall be considered.	~~date of activity~~ ~~Supply cut off date~~ and actual date of ~~supply~~ <u>work completion of</u> the equipment shall be considered.	
27	Section 2B, Page 274, Cl. No. 27.8.3	New Clause	As per the provisions of Building & Other Construction Workers Act-1996, BOCW cess @1% of contract price shall be deducted from the invoices of the contractor and deposited to the concerned authorities. Any increase or decrease in the rate from the next day to the Record Date shall accrue to the Owner.	
28	Section 2B, Cl. No.27.9	New Clause	In case the Contract is awarded to the Consortium, the payments shall be made as provided in the Consortium Agreement appended to the contract.	
29	Section 2C,Page 296, 297/Cl. No. 17.0	Power to Order Variation: 17.1 The Owner's Engineer shall make any variation of the form, quality and/or quantity of the works or any part thereof that may in his opinion be necessary and for that purpose or if for any other reason it shall in his opinion be desirable shall have power to order the contractor to do and the contractor shall do any of such variations/alteration/ modification and no such variation shall in any way vitiate or invalidate the contract but the value (if any) of all such variations shall be taken into account in ascertaining the amount of the contract price at the time of completion.	<u>Deleted</u>	

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Sr No	Section /Page No/Cl No.	Existing Particulars of Bid Stipulation including amendment/corrigendum thereof	To be read as
30	Section 2C,Page 297, 297/Cl. No. 18.0	Variation to be Carried Out on Written Order: 18.1 No variation shall be made by the contractor without an order in writing by the Officer not below the rank of Executive Engineer (Civil) as per approved execution drawings.	<u>Deleted</u>
31	Section 2C,Page 298/Cl. No. 19.0 (F)	Suspension of Works: a. The Owner reserves the right to suspend and reinstate execution of the whole or any part of the works without invalidating the provisions of the contract. Orders for suspension or reinstatement of the works shall be issued by the Engineer to the Contractor in writing. The time for completion of the works shall be extended for a period equal to duration of the suspension. b. Any necessary and demonstrable costs incurred by the Contractor as a result of such suspension of the works shall be paid by the Owner, provided such costs are substantiated to the satisfaction of the Engineer. c. The Owner, however, shall not be responsible for any liabilities if suspension or delay is due to some default on the part of the contractor or his subcontractor or any agencies outside the control of the Owner.	<u>Deleted</u>

Sr No	Section /Page No/Cl No.	Existing Particulars of Bid Stipulation including amendment/corrigendum thereof	To be read as
32	Section 2C,Page 304/Cl. No. 33.0	Rates of Extra Item: 33.1 Rates for Extra Item of Works: i) The rates for any items of works required to be executed under this contract and considered essential for completion of the work but not included in the contract shall be derived from prevailing Schedule of Rates of PWD. For the items, which are not available in the PWD Schedule of Rates, the rates for such items shall be derived as under and shall include. a) Cost of materials procured by contractor to the extent actually incorporated in the works including permissible wastage if any, subject however to maximum of 5% of the quantities actually incorporated in the works and including all actual expenses towards handling , transport, taxes and Octroi up to site of work. b) Actual cost of labour excluding any type of supervision. c) 15% of (a) and 25% of (b) above to cover tools and plants, supervision, overheads contingencies and profit. ii) If any equipment is specifically required to be hired for	<u>Deleted</u>

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		CORRIGENDUM - X					
Sr No	Section /Page No/Cl No.	Existing Particulars of Bid Stipulation including amendment/corrigendum thereof			To be read as		
		execution of work under extra item, the hire charges (inclusive of fuel cost or exclusive as the case may be) would be considered for the purpose of assessment of extra item. Similarly the transport charges as involved in the extra item of work would also be considered. iii) <u>The contractor shall be bound to execute all extra items of work which are interpreted by the Dy. Chief Engineer / Superintending Engineer</u> - in charge of work as contingent to the works included under the scope of the contract. In case of any dispute regarding interpretation, rates etc., the decision of the Chief Engineer would be final and binding on the contractor. However, the total cost of extra items may not exceed 20% of the contract value.					
33	Section 3,Page 324/Cl. No. 6.3	1.	Heat Rate: increase in gross turbine cycle heat rate in kCal/kWh under rated steam condition at 76 mm of Hg (back pressure) with zero makeup at 100% unit load at generator terminals with respect to guaranteed heat rate at per Schedule 7.	INR 60,000,000/- (INR Sixty Millions only) per kCal/kWh	1	Heat rate : Increase in weighted average turbine Heat rate in kCal/kWh (refer clause no. 1.2.3 , section 8 , Volume 2) as compared to the guaranteed weighted average Heat Rate	INR 60,000,000/- (INR Sixty Millions only) per kCal/kWh

Sr No	Section /Page No/Cl No.	Existing Particulars of Bid Stipulation including amendment/corrigendum thereof			To be read as		
34	Section 3,Page 325/Cl. No. 6.3	3.	Auxiliary Power Consumption: Total auxiliary power consumption of all auxiliaries (as listed below) at 660 MW load with Zero make up, 76mm of Hg back pressure and 100% unit load with respect to the guaranteed Auxiliary Consumption as per Schedule - 7.	INR 450,000/- (INR Four Hundred Fifty Thousand Only) per kWh	3.	Auxiliary Power Consumption: Total auxiliary power consumption of all auxiliaries (as listed below) at 660 MW load with Zero make up, 76mm of Hg(a) or lower guaranteed/design condenser back pressure and 100% unit load with respect to the guaranteed Auxiliary Consumption as per Schedule - 7.	INR 450,000/- (INR Four Hundred Fifty Thousand Only) per kWh

Following Annexure shall be added to the Bid Specification, which shall be applicable to the Collaborator – SG and Indian Manufacturer - SG

Annexure – V (B) 1

Form for Deed of Joint Undertaking

[To be executed by the collaborator of the Equipment and the Indian Manufacturer of the equipment on Non-Judicial Stamp Paper of INR 200/- [(refer Clause No. 4.2.4, Section – I, Volume – I of the bid specification)]

DEED OF JOINT UNDERTAKING

The DEED OF JOINT UNDERTAKING executed this _____day of _____Two thousand _____ by:

M/s. _____, a company incorporated under the provisions of _____ act of _____ (country) _____ having its Registered Office at _____ (hereinafter referred to and called as the “the Collaborator SG”, which expression shall include its successors, administrators, executors and permitted assigns).

And

M/s. _____, a company incorporated under the provisions of Indian Company’s Act 1956 having its registered office at _____ (hereinafter referred to and called as “the Indian Manufacturer SG”, which expression shall include its successors, administrators, executors and permitted assigns) or “the Contractor”.

in favour of Maharashtra State Power Generation Company Ltd., a Government of Maharashtra Enterprise incorporated under the Provisions of Indian Companies Act, 1956, having its Registered Office at 2nd Floor, Prakashgad, Prof. Anant Kanekar Marg, Bandra (East), Mumbai - 400 051, INDIA (hereinafter referred to as either “MAHAGENCO” or “ the Owner” which expression include its successors, administrators, executors and assigns).

WHEREAS, the owner has invited Bids for design, engineering, manufacture, supply, transportation to site, installation, testing, commissioning and conductance of guarantee tests for the Power Plant comprising of Supercritical Steam Generator including its all Auxiliaries (SG), Supercritical Steam Turbine including its all Auxiliaries (ST) & Generator Set including its all Auxiliaries (GS), Balance of the Plant Equipment and Civil Works for its Bhusawal Thermal Power Station 1x660 MW Unit - 6 Project (hereinafter referred to as “Plant”) against its Bid Specification No. : DG/BSL U-6/2011/T-1 vide its Invitation of Bids No. _____ dated _____.

AND WHEREAS Clause 4.2.4, Section – 1, Volume – I of the bid specification stipulates that the Indian manufacturer of sub-critical equipment who meets the experience criteria stipulated therein can be considered as the Qualified Manufacturer of Supercritical Steam Generator including its all Auxiliaries (SG) provided he has a valid ongoing collaboration and technology transfer agreement including license to manufacture and supply of Supercritical Steam Generator including its all Auxiliaries (SG) covering the type, size and rating specified with a manufacturer of the respective equipment (the collaborator SG) who satisfies the experience criterion stipulated under Clause No. 4.2.1 and furnishes a Deed of Joint Undertaking executed by the Indian Manufacturer SG and the collaborator SG.

AND WHEREAS against Owner's aforesaid Invitation for Bids (IFB), M/s. _____ (the bidder) has submitted the bid proposal in consortium with M/s. _____ and M/s. _____ which includes supply of Supercritical Steam Generator including its all Auxiliaries (SG) covering the type, size and rating specified manufactured at the works of the Collaborator SG, the Indian Manufacturer SG and their sub-vendors as per the drawings, specifications, Quality plans etc. approved by the collaborator SG.

AND WHEREAS the Indian Manufacturer SG satisfies the experience criterion stipulated under Clause No. 4.2.4 Section – I, volume – I of the bid specification for Steam Generator and has a valid ongoing collaboration and technology transfer agreement including license to manufacture and supply supercritical Steam Generator covering the type, size and rating specified with the Collaborator SG who satisfies the experience criterion stipulated under Clause 4.2.1, Section – I, volume – I of the bid specification

AND WHEREAS the Indian Manufacturer SG and the Collaborator SG are required to jointly execute and furnish along with the bid an irrevocable Deed of Joint Undertaking and be jointly and severally responsible and bound unto the Owner for the successful performance of the equipment fully meeting the stipulated technical requirements, and Guaranteed parameters and characteristics as per bid specification, in the event, the Bid is accepted by the Owner resulting into a Contract/Contracts.

AND FURTHER WHEREAS the Indian Manufacturer SG and the Collaborator SG are required to jointly execute and furnish along with the bid an irrevocable Deed of Joint Undertaking and be jointly and severally responsible and bound unto the Owner for the successful performance of the Contract with regard to implementation of the Phased Manufacturing Program and transfer of technology in accordance with the bid specification, in the event, the Bid is accepted by the Owner resulting into a Contract/Contracts.

NOW THEREFORE, THIS DEED WITNESSETH AS UNDER:

1. That in consideration of the award of the Contract(s) by the Owner to the Contractor, we the Collaborator SG and the Indian Manufacturer SG do hereby declare and undertake that we shall be jointly and severally responsible to the Owner for the execution and successful performance of the equipment and achievements of all guaranteed parameters as specified under the said Contract(s) to the satisfaction for the Owner.
2. In case of any breach of the Contract(s) committed by the Contractor, we the ~~Indian Manufacturer SG and~~ Collaborator SG do hereby undertake, declare and confirm that we shall be fully responsible for the successful performance of complete equipment, including its satisfactory performance and achievement of all guaranteed parameters as specified in the Contract and undertake to carry out all obligations and responsibilities under this Deed of Joint Undertaking including the technical guarantees for the complete equipment in order to discharge the Contractor's obligations and responsibilities stipulated in the Contract. Further, if the Owner sustains any loss or damage on account of any breach of the Contract(s) related to the equipment, we the Indian Manufacturer SG and the Collaborator SG jointly and severally undertake to promptly indemnify and pay such losses/ damages caused to the Owner on its written demand without any demur, reservation, contest or protest in any manner whatsoever. Determination of losses/ damages shall be in line with provisions on Limitation of Liability of the said Contract(s).

The liability of the Collaborator SG hereunder shall, however, be limited to an amount calculated at the rate of 221 Million for each number of equipment to be supplied by the Contractor. This is without prejudice to any right of Owner against the Contractor under the Contract and all guarantees.

Without prejudice to the joint and several obligations of the Contractor and the Collaborator SG hereunder, the analysis/ investigations of the non-performance of the equipment manufactured by the Contractor may initially be carried out by the Contractor within a period of 15 days from the date of reference of the problem by the Owner, before the Owner approaches the Collaborator SG for any such analysis/ investigation. It shall not be necessary or obligatory for the Owner to first proceed against the Contractor before proceeding against the Collaborator SG (with respect to obligations and responsibilities of the collaborator covered under this Deed of Joint Undertaking). Nor any extension of time or any relaxation given by the Owner to the contractor shall prejudice any

right of Owner under this Deed of Joint Undertaking to proceed against Indian Manufacturer SG and the Collaborator SG and the Contractor.

- 3 Without prejudice to the generality of the undertaking in para '1' above. The manner of achieving the objectives set forth in para '1' above shall be as follows:
 - a) We, the Collaborator SG shall be specifically responsible for complete engineering, preparation of all designs, design calculations, design documents / drawings and manufacturing drawings for all the equipment; selection of their auxiliaries and interfacing / integration of all equipment with their auxiliaries so as to ensure satisfactory, reliable, safe and trouble free performance of all equipment as well as the performance meeting all stipulated technical requirements as well as all guaranteed parameters specified in the Contract (s).
 - b) We, the Collaborator SG shall extend our quality surveillance / supervision / quality control to the Contractor during manufacture, erection, commissioning and performance testing, both at Contractor's works and / or at Owner's project site. Without prejudice to the overall responsibilities of the Collaborator SG for successful commissioning and performance of the equipment, the Collaborator SG shall depute their technical experts from time to time to the works of the Indian Manufacturer SG / Owner's project site, as mutually agreed upon between the owner and the Contractor in accordance with the stipulations of the Contract(s).
 - c) We, the Collaborator SG will supply equipment / components manufactured at our works or at our vendor's works as per requirements / schedule specified in the Contracts.
 - d) We, the Collaborator SG will be fully responsible for the quality of manufacture of all equipment / main assemblies / components for incorporation in the equipment. For the items to be manufactured by the Indian Manufacturer SG at his / or his vendor's works as per design of the Collaborator SG, the Collaborator SG shall ensure completeness and correctness of the design, data, document and information in every detail provided to the Indian Manufacturer SG which would result in the same quality of equipment as if manufactured at the works of the Collaborator SG and shall meet approval / acceptance of the Collaborator SG.
 - e) The Indian Manufacturer SG shall be responsible to manufacture portion of the equipment which are to be manufactured at its works or its vendor's works as per the design of the Collaborator SG and to the quality acceptance

level of the Collaborator SG (to be finalized before Notification of Award). Further, the Indian Manufacturer SG shall erect, commission and carry out the guarantee tests of all the equipment in accordance with the advice, procedure and guidance of the Collaborator SG. In case, there is any need to modify the design / drawings / procedure in certain areas, the Indian Manufacturer SG shall seek specific approval of the Collaborator SG before proceeding further.

- f) In the event any problem is encountered during design, manufacture, erection, testing and commissioning or if the Indian Manufacturer SG fails to demonstrate during the guarantee tests that the equipment meet the guaranteed parameters and demonstration parameters as specified in the contract, the Collaborator SG shall promptly provide all technical assistance / services / support to analyze and suggest corrective measures / modifications to the equipments / systems of all the equipment under the Contract(s) directly to the Owner and the Contractor/ Indian Manufacturer SG and the Collaborator SG shall promptly carry out all corrective measures and modifications (as suggested by the Collaborator SG and agreed by the Owner) for each of their respective equipment / systems supplied by them at their own expense. Thereafter, the Contractor/ Indian Manufacturer SG and the Collaborator SG shall demonstrate the successful performance of the equipment meeting the guaranteed parameters as stipulated under the contract.
4. We the Indian Manufacturer SG and the Collaborator SG do hereby declare and undertake that we shall be jointly and severally responsible to the Owner for the successful implementation of the Phased Manufacturing Program as specified in the said Contract(s).
5. We, the Indian Manufacturer SG and the Collaborator SG do jointly hereby undertake, declare and confirm that we shall be fully responsible for indigenizing the manufacturing of supercritical Steam Generator sets in India in a phased manner in accordance with the Phased Manufacturing Program specified in the said Contract(s).
6. We, the Indian Manufacturer SG and the Collaborator SG do jointly hereby undertake, declare and confirm that we shall be fully responsible for ensuring that transfer of the technological know - how for equipment (of the type, size and rating specified in the Contract (s) in the form of complete transfer of design dossier, design software's, drawings and documentation and quality system manuals is transferred to the Indian Manufacturer as per the Contract(s).

7. We, the Indian Manufacturer SG and the Collaborator SG do further undertake, declare and confirm that we shall be fully responsible for imparting relevant training to the personnel of the Indian Manufacturer SG as part of the technology transfer agreement between the Indian Manufacturer and the Collaborator SG.
8. We, the Indian Manufacturer SG and the Collaborator SG do hereby undertake and confirm that this Deed of Joint Undertaking shall be initially valid till ninety (90) days beyond the schedule date of completion of the defect liability period of the all the equipment or completion of the Phased Manufacturing Program under the Contract (s), whichever occurs later. In case of delay in completion of the defect liability period under the contract(s) or delay in the completion of the Phased Manufacturing Program beyond the aforesaid period, the validity of this Deed of Joint Undertaking shall be extended by such period of delay. However, this Deed of Joint Undertaking shall terminate at the latest 27 months from the scheduled end of defect liability period of the unit of 660MW under the contract. We, the Indian Manufacturer SG and the Collaborator SG do further undertake and confirm that this Deed of Joint Undertaking shall be irrevocable and shall not be revoked till its validity. We further agree that this Deed of Joint Undertaking shall be without any prejudice to the various liabilities of the Contractor including contract performance security as well as other obligations of the Contractor in terms of the Contract(s).
9. In case of award, in addition to the Contract Performance Securities to be furnished by the Contractor, the Indian Manufacturer and the Collaborator SG shall furnish as security on demand Performance Bank Guarantee(s) in favour of the Owner as per provision of the bid specification for each of the contract(s) awarded to the Bidder/Contractor. The value of each such Bank Guarantee shall be equal to one-half percent (0.5%) of the total Contract Price of the Contract(s) (an equivalent absolute amount to be specified at the time of award of Contract) and it shall be guarantee towards the faithful performance/compliance of this Deed of Joint Undertaking in accordance with the terms and conditions specified herein. The bank guarantee shall be unconditional, irrevocable and initially valid till ninety (90) days beyond the scheduled date of completion of the defect liability period of the equipment / component covered under the Contract(s) or completion of the Phased Manufacturing Program under the Contract(s) whichever occurs later. In case of completion of the defect liability period under the Contract(s) or delay in the completion of the Phased Manufacturing Program beyond the aforesaid period, the validity of this Deed of Joint Undertaking shall be extended by such period of delay. However, this bank guarantee shall terminate at the latest 27 months from the scheduled end of defect liability

period of the equipment. The guarantee amount shall be promptly paid to the Owner on demand without any demur, reservation, protest or contest.

10. Any dispute that may arise between the Owner and the Contractor in connection with this Deed of Joint Undertaking shall be finally settled as per the arbitration procedure/rules mentioned in the Contract Documents. Any dispute that may arise between the Owner and the Collaborator SG in connection with this Deed of Joint Undertaking shall be finally settled by reference to Arbitration in accordance with the United Nations Commission on International Trade Law (UNCITRAL) Arbitration Rules of 1976. The Arbitral Tribunal shall consist of three members and shall be appointed in accordance with the said Rules. The appointing authority for the Third Arbitrator shall be the President, International Chamber of Commerce, Paris. The language to be used in arbitral proceedings shall be English. The venue of arbitration shall be Singapore. The award made in such arbitration shall be final and binding and shall be enforceable in any court of competent jurisdiction.

11. This deed of undertaking shall be construed and interpreted in accordance with the Laws of India.

12. That this Deed of joint undertaking shall be operative from the effective date of the Contract.

IN WITNESS WHEREOF, the Collaborator SG and the Indian Manufacturer through their authorized representatives have executed these presents and affixed common seal of their respective companies on the day, month and year first mentioned above.

Witness:

Signature: _____

Name: _____

Office Address: _____

For M/s. (the collaborator)

(Authorised Signatory)

Name: _____

Designation: _____

Witness:

Signature: _____

Name: _____

Office address: _____

For M/s. (Indian Subcritical Equipment mfr.)

(Authorised Signatory)

Name: _____

Designation: _____

‡ Insert only if the Indian Manufacturer -SG

Note : Power of Attorney issued in favour of the persons signing this deed by their respective employers shall be attached along with this deed.

Following Annexure is added to the Bid Specification, which shall be applicable to the Collaborator - ST & GS and Indian Manufacturer - ST & GS

Annexure - V (B) 2

Form for Deed of Joint Undertaking

[To be executed by the collaborator and the Indian Manufacturer for Steam Turbine & Generator on **Non-Judicial Stamp Paper of INR 200/-** [(refer Clause No. 4.2.4, Section - I, Volume - I of the bid specification)]

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DEED OF JOINT UNDERTAKING

The DEED OF JOINT UNDERTAKING executed this _____ day of _____ Two Thousand _____ by:

M/s. _____, a company incorporated under the provisions of _____ act of (country) having its Registered Office at _____ (hereinafter referred to and called as the "the Collaborator ST & GS" which expression shall include its successors, administrators, executors and permitted assigns).

And

M/s. _____, a company incorporated under the provisions of Indian Company's Act 1956 having its registered office at _____ (hereinafter referred to and called as "the Indian Manufacturer ST & GS" or "Contractor", which expression shall include its successors, administrators, executors and permitted assigns).

in favour of Maharashtra State Power Generation Company Ltd., a Government of Maharashtra Enterprise incorporated under the Provisions of Indian Companies Act, 1956, having its Registered Office at 2nd Floor, Prakashgad, Prof. Anant Kanekar Marg, Bandra (East), Mumbai - 400 051, INDIA (hereinafter referred to as either "MAHAGENCO" or " the Owner" which expression include its successors, administrators, executors and assigns).

WHEREAS, the Owner has invited Bids for design, engineering, manufacture, supply, transportation to site, installation, testing, commissioning and conductance of guarantee tests for the Power Plant comprising of Supercritical Steam Generator including its all Auxiliaries (SG), Supercritical Steam Turbine including its all

Auxiliaries (ST) & Generator Set including its all Auxiliaries (GS), Balance of the Plant Equipment and Civil Works for its Bhusawal Thermal Power Station 1x660 MW Unit - 6 Project (hereinafter referred to as "Plant") against its Bid Specification No. : DG/BSL U-6/2011/T-1 vide its Invitation of Bids No. _____ dated_____.

AND WHEREAS Clause 4.2.4, Section - 1, Volume - I of the bid specification stipulates that the Indian manufacturer of sub-critical equipment who meets the experience criteria stipulated therein can be considered as the Qualified Manufacturer of Supercritical Steam Turbine including its all Auxiliaries (ST) & Generating Set including its Auxiliaries (GS) provided he has a valid ongoing collaboration and technology transfer agreement including license to manufacture and supply of Supercritical Steam Turbine including its all Auxiliaries (ST) & Generating Set including its Auxiliaries (GS) covering the type, size and rating specified with a manufacturer of the respective equipment (the collaborator ST & GS) who satisfies the experience criterion stipulated under Clause No. 4.2.1 and furnishes a Deed of Joint Undertaking executed by the Indian Manufacturer ST & GS and the Collaborator ST & GS.

AND WHEREAS against owner's aforesaid Invitation for Bids (IFB), M/s. _____ (the bidder) has submitted the bid proposal which includes supply of Supercritical Steam Turbine including its all Auxiliaries (ST) covering the type, size and rating specified manufactured at the works of the Collaborator ST, the Indian Manufacturer ST & GS and their sub-vendors as per the drawings, specifications, Quality plans etc. approved by the collaborator ST & GS.

AND WHEREAS the Indian Manufacturer ST & GS satisfies the experience criterion stipulated under Clause No. 4.2.4 Section - I, volume - I of the bid specification for Steam Turbine & Generating Set and has a valid ongoing collaboration and technology transfer agreement including license to manufacture and supply supercritical Steam Turbine & Generator Set covering the type, size and rating specified with the Collaborator ST & GS who satisfies the experience criterion stipulated under Clause 4.2.1, Section - I, volume - I of the bid specification

AND WHEREAS the Collaborator ST & GS shall indemnify the Indian Manufacturer ST & GS with respect to patent infringement claims pertaining to the Steam Turbine and Generator Set of Type, size and rating specified and offered, as per the provisions of the said collaboration and technology transfer agreement.

AND WHEREAS the Indian Manufacturer ST & GS and the Collaborator ST & GS are required to jointly execute and furnish along with the bid an irrevocable Deed of Joint Undertaking and be jointly and severally responsible and bound unto the Owner for the successful performance of the Steam Turbine Generator Set including the auxiliaries specified in Annexure-I (hereinafter referred to as "Equipment") fully meeting the stipulated technical requirements, and Guaranteed parameters and characteristics as per Contract documents, in the event, the Bid is accepted by the Owner resulting into Contracts.

AND FURTHER WHEREAS the Indian Manufacturer ST & GS and the Collaborator ST & GS are required to jointly execute and furnish along with the bid an irrevocable Deed of Joint Undertaking and bound unto the Owner for the successful performance of the Contract with regard to transfer of technology in accordance with the Clause No. 6 hereunder and the Indian Manufacturer ST & GS is responsible for implementation of Phased Manufacturing Program in accordance with the bid specification , in the event, the Bid is accepted by the Owner resulting into a Contract/Contracts.

NOW THEREFORE, THIS DEED WITNESSETH AS UNDER:

1. That in consideration of the award of the Contract(s) by the Owner to the Contractor, we the Indian Manufacturer ST & GS and Collaborator ST & GS do hereby declare and undertake that we shall be jointly and severally responsible to the Owner for the execution and successful performance of the Equipment and achievements of all guaranteed parameters as specified under the said Contract(s).
2. In case of any breach of the Contract(s) committed by the Contractor, we the ~~Indian Manufacturer ST & GS and~~ Collaborator ST & GS do hereby undertake, declare and confirm that we shall be fully responsible for the successful performance of complete Equipment, including its satisfactory performance and achievement of all technical guaranteed parameters of the Equipment as specified in the Contract and undertake to carry out all obligations and responsibilities under this Deed of Joint Undertaking including the technical guarantees for the complete Equipment in order to discharge the Contractor's obligations and responsibilities stipulated in the Contract. Further, if the Owner sustains any loss or damage on account of any breach of the Contract(s) related to the Equipment we the Indian Manufacturer ST & GS and the Collaborator ST & GS jointly and severally undertake to promptly indemnify and pay such losses/ damages caused to the Owner on its written demand without any demur,

reservation, contest or protest in any manner whatsoever, subject to failure on the part of the Indian Manufacturer ST & GS and the Collaborator ST & GS to rectify such breach.

Except in case of criminal negligence or willful misconduct, the Collaborator ST & GS shall not be liable to the Owner, whether in contract, tort, or otherwise, for any indirect or consequential loss or damage, loss of profit, cost of capital, cost of replacement power or increased cost of operation, provided that this exclusion shall not apply to any obligation of the Contractor to pay Liquidated Damages to the Owner.

The aggregate liability of the Collaborator to the Owner hereunder shall not exceed the US\$ 50 Million or the value of services and components supplied by the Collaborator ST & GS to the Indian Manufacturer ST & GS for Bhusawal TPS 1x660MW Unit-6 Project whichever is higher.

This is without prejudice to any right of the Owner against the Contractor under the Contract and all guarantees.

Without prejudice to the joint and several obligations of the Contractor and the Collaborator ST & GS hereunder, the analysis/ investigations of the non-performance of the Equipment manufactured by the Contractor may initially be carried out by the Contractor within a period of 15 days from the date of reference of the problem by the Owner, before the Owner approaches the Collaborator ST & GS for any such analysis/ investigation. It shall not be necessary or obligatory for the Owner to first proceed against the Contractor before proceeding against the Collaborator ST & GS (with respect to obligations and responsibilities of the Collaborator covered under this Deed of Joint Undertaking). Nor any extension of time or any relaxation given by the Owner to the Contractor shall prejudice any right of Owner under this Deed of Joint Undertaking to proceed against Indian Manufacturer ST & GS and the Collaborator ST & GS and the Contractor.

3. Without prejudice to the generality of the undertaking in para '1' above. The manner of achieving the objectives set forth in para '1' above shall be as follows:
 - a) We, the Collaborator ST & GS shall be specifically responsible for complete engineering, preparation of all designs, design calculations,

design documents / drawings and manufacturing drawings for the Equipment; selection of their auxiliaries and interfacing / integration of Equipment with their auxiliaries so as to ensure satisfactory, reliable, safe and trouble free performance of Equipment as well as meeting all stipulated technical requirements and guaranteed parameters specified in the Contract(s).

- b) We, the Collaborator ST & GS shall extend our quality surveillance / supervision / quality control to the Contractor during manufacture, erection, commissioning and performance testing, both at Contractor's works and / or at Owner's project site. Without prejudice to the overall responsibilities of the Collaborator ST & GS for successful commissioning and performance of the Equipment, the Collaborator ST & GS shall depute their technical experts from time to time to the works of the Indian Manufacturer ST & GS / Owner's project site, as mutually agreed upon between the Owner and the Contractor in accordance with the stipulations of the Contract(s).
- c) We, the Collaborator ST & GS will supply equipment / components manufactured at our works or at our vendor's works as per requirements / schedule specified in the Contracts.
- d) We, the Collaborator ST & GS will be fully responsible for the quality of manufacture of all equipments / main assemblies / components for incorporation in the Equipment. For the items to be manufactured by the Indian Manufacturer ST & GS at his / or his vendor's works as per design of the Collaborator ST & GS, the Collaborator ST & GS shall ensure completeness and correctness of the design, data, document and information in every detail provided to the Indian Manufacturer ST & GS which would result in the same quality of equipment as if manufactured at the works of the Collaborator ST & GS and shall meet approval / acceptance of the Collaborator ST & GS.
- e) The Indian Manufacturer ST & GS shall be responsible to manufacture portion of the Equipment which are to be manufactured at its works or its vendor's works as per the design of the Collaborator ST & GS and to the quality acceptance level of the Collaborator ST & GS (to be finalized before Notification of Award). Further, the Indian Manufacturer ST & GS shall erect, commission and carry out the guarantee tests of all the Equipment

in accordance with the advice, procedure and guidance of the Collaborator ST & GS. In case, there is any need to modify the design / drawings / procedure in certain areas, the Indian Manufacturer ST & GS shall seek specific approval of the Collaborator ST & GS before proceeding further.

- f) In the event any problem is encountered during design, manufacture, erection, testing and commissioning or if the Indian Manufacturer ST & GS fails to demonstrate during the guarantee tests that the Equipment meet the guaranteed parameters and demonstration parameters as specified in the contract, the Collaborator ST & GS shall promptly provide all technical assistance / services / support to analyze and suggest corrective measures / modifications to the equipment / systems of all the Equipment under the Contract(s) directly to the Owner and the Contractor/ Indian Manufacturer ST & GS and the Collaborator ST & GS shall promptly carry out all corrective measures and modifications (as suggested by the Collaborator ST & GS and agreed by the Owner) for each of their respective equipment / systems supplied by them at their own expense. Thereafter, the Contractor/ Indian Manufacturer ST & GS and the Collaborator ST & GS shall demonstrate the successful performance of the Equipment meeting the guaranteed parameters as stipulated under the contract.
4. We the Indian Manufacturer ST & GS do hereby declare and undertake that we shall be responsible to the Owner for the successful implementation of the Phased Manufacturing Program as specified in the said Contract(s).
5. We, the Indian Manufacturer ST & GS do hereby-undertake, declare and confirm that we shall be fully responsible for indigenizing the manufacturing of supercritical Steam Turbine Generator sets in India in a phased manner in accordance with the Phased Manufacturing Program specified in the said Contract(s).
6. We, the Indian Manufacturer ST & GS and the Collaborator ST & GS do jointly hereby undertake, declare and confirm that we shall be fully responsible for ensuring a valid technology transfer agreement including license to manufacture and supply in India between the Manufacturer ST & GS and the Collaborator ST & GS covering the type, size and rating of the Equipment specified, valid minimum up to the end of the defect liability period of the

Contract. The technology transfer agreement necessarily covers transfer of the technological know-how for Equipment in the form of complete transfer of design dossier, design software's, drawings and documentation and quality system manuals.

7. We, the Indian Manufacturer ST & GS and the Collaborator ST & GS do further undertake, declare and confirm that we shall be fully responsible for imparting relevant training to the personnel of the Indian Manufacturer ST & GS as part of the technology transfer agreement between the Indian Manufacturer and the Collaborator ST & GS.

8. We, the Indian Manufacturer ST & GS and the Collaborator ST & GS do hereby undertake and confirm that this Deed of Joint Undertaking shall be initially valid till ninety (90) days beyond the scheduled date of completion of the defect liability period of the Equipment under the Contract (s). In case of delay in completion of the defect liability period under the contract(s) beyond the aforesaid period, the validity of this Deed of Joint Undertaking shall stand extended by such period of delay. However, this Deed of Joint Undertaking shall terminate at the latest 24 months from the scheduled end of defect liability period of the unit of 660MW under the contract. We, the Indian Manufacturer ST & GS and the Collaborator ST & GS do further undertake and confirm that this Deed of Joint Undertaking shall be irrevocable and shall not be revoked till expiry of its validity. We further agree that this Deed of Joint Undertaking shall be without any prejudice to the various liabilities of the Contractor including contract performance security as well as other obligations of the Contractor in terms of the Contract(s).

9. In case of award, in addition to the Contract Performance Securities to be furnished by the Contractor/the Indian Manufacturer, the Collaborator ST & GS shall furnish as security on demand Performance Bank Guarantee(s) in favour of the Owner as per provision of the bid specification. The value of such Bank Guarantee shall be equal to one-half percent (0.5%) of the total Contract Price of all the Contract(s) (an equivalent absolute amount to be specified at the time of award of Contract) awarded against this bid specification and it shall be guarantee towards the faithful performance/compliance of this Deed of Joint Undertaking in accordance with the terms and conditions specified herein. The bank guarantee shall be unconditional, irrevocable and initially valid till ninety (90) days beyond the scheduled date of completion of the defect liability period of the Equipment covered under the Contract(s). In case of completion of the

defect liability period under the Contract(s) beyond the aforesaid period, the validity of this Deed of Joint Undertaking shall be extended by such period of delay. However, this bank guarantee shall terminate at the latest 24 months from the scheduled end of defect liability period of the Equipment. The guarantee amount shall be promptly paid to the Owner on demand without any demur, reservation, protest or contest.

10. Any dispute that may arise between the Owner and the Contractor in connection with this Deed of Joint Undertaking shall be finally settled as per the arbitration procedure/rules mentioned in the Contract Documents. Any dispute that may arise between the Owner and the Collaborator ST & GS in connection with this Deed of Joint Undertaking shall be finally settled by reference to Arbitration in accordance with the United Nations Commission on International Trade Law (UNCITRAL) Arbitration Rules of 1976. The Arbitral Tribunal shall consist of three members and shall be appointed in accordance with the said Rules. The appointing authority for the Third Arbitrator shall be the President of the International Chamber of Commerce, Paris. The language to be used in arbitral proceedings shall be English. The venue of arbitration shall be Singapore. The award made in such arbitration shall be final and binding and shall be enforceable in any court of competent jurisdiction.
11. This Deed of Joint Undertaking shall be construed and interpreted in accordance with the Laws of India.
12. This Deed of Joint Undertaking shall be operative from the effective date of the Contract.
13. This Deed of Joint Undertaking shall form an integral part of the Contracts.

IN WITNESS WHEREOF, the Collaborator ST & GS and the Indian Manufacturer through their authorized representatives have executed these presents and affixed common seal of their respective companies on the day, month and year first mentioned above.

Witness:

Name: _____

Office Address: _____

For M/s. (the collaborator) Signature:
(Authorised Signatory)

Name: _____

Designation: _____

Witness: mfr.)	For M/s. (Indian Subcritical Equipment
Signature: _____	(Authorised Signatory)
Name: _____	Name: _____
Office address: _____	Designation: _____

‡ Insert only if the Indian Manufacturer - ST & GS

Note: Power of Attorney issued in favour of the persons signing this deed by their respective employers shall be attached along with this deed.

Annexure-I

A) List of Integral Auxiliaries of Steam Turbine Generator Set

1. Control Fluid System
2. Gland steam sealing system
3. Lube oil system
4. Exhaust hood spray system
5. Stop/Control valves
6. Turbine drain system
7. Turbine protection system
8. Turbine control system (Analog and sequence)
9. Turbine supervisory instruments

B) List of Auxiliaries of Generator

1. Generator Seal oil system
2. Generator water cooling system
3. Hydrogen, Carbon Dioxide & Nitrogen system
4. Generator Excitation system.

The Proforma for Consortium Agreement, at page No. 99, Section I, Volume-I of the bid specification is modified as under:

Annexure - VI

Proforma for Consortium Agreement

(Refer Clause No. 4.1 (b), Section - 1, Volume - I. To be submitted on non-judicial stamp paper of INR. 200/-)

CONSORTIUM AGREEMENT

The CONSORTIUM AGREEMENT executed this ____ day of ____ Two thousand ____ by:

M/s. _____, a company incorporated under the provisions of _____ act of (country) having its Registered Office at _____ (hereinafter referred to and called the "the qualified manufacturer ~~†SG/-TG ST~~ /GS/**The EPC Contractor**", which expression shall include its successors, administrators, executors and permitted assigns) who shall be acting as "the leader of consortium" for the purpose of this agreement and bidding for which this consortium is formed.

And

M/s. _____, a company incorporated under the provisions of _____ act of (country) having its Registered Office at _____ (hereinafter referred to and called the "the qualified manufacturer ~~†SG/-TG ST~~ /GS/**The EPC Contractor**", which expression shall include its successors, administrators, executors and permitted assigns).

And

M/s. _____, a company incorporated under the provisions of _____ act of (country) having its Registered Office at _____ (hereinafter referred to and called the "the qualified manufacturer ~~†SG/-TG ST~~ /GS/**The EPC Contractor**", which expression shall include its successors, administrators, executors and permitted assigns).

And

M/s. _____, a company incorporated under the provisions of _____ act of (country) having its Registered Office at _____ (hereinafter referred to and called the "the qualified manufacturer ~~†SG/-TG ST~~ /GS/**The EPC Contractor**", which expression shall include its successors, administrators, executors and permitted assigns).

And hereinafter, above parties are collectively referred to and called as the parties.

WHEREAS, Maharashtra State Power Generation Co. Ltd. (MAHAGENCO), a 100% owned enterprise of Govt. of Maharashtra, India registered under and by virtue of Indian Companies Act 1956 and having its registered office at 2nd Floor, 'Prakashgad', Prof. Anant Kanekar Marg, Bandra (East), Mumbai (hereinafter referred to and call as the "Owner"), has invited Bids for design, engineering, manufacture, supply, transportation to site, installation, testing, commissioning and conductance of guarantee tests and all Civil Construction and Architectural Works required for its Bhusawal Thermal Power Station 1x660 MW Unit - 6 Project which comprises apart from other equipment, the Supercritical Steam Generator including its all Auxiliaries (SG), Supercritical Steam Turbine including its all Auxiliaries (ST) and Generator Set including its all Auxiliaries (GS) (hereinafter referred to as "Plant") against its Bid Specification No. : DG/1x660MW BSL U-6/~~MP~~/T-1 vide its Invitation of Bids No. _____ dated _____.

AND WHEREAS in terms of the Qualifying Requirements of the Bid Specification Stipulated under Clause No. 4.1 (b), a bid from consortium of Qualified Manufacturer of SG or ~~TG as defined thereunder (as a leader of consortium) in consortium with Qualified Manufacturer(s) of TG and GS or SG & GS respectively~~ Qualified Manufacturer of ST, Qualified Manufacturer of GS *and An Engineering, Procurement & Construction (EPC) Contractor as defined thereunder is acceptable

AND WHEREAS the parties believe that they individually meet the qualifying requirements stipulated in the bid specification for their respective equipment which and hence they can bid as the consortium.

AND WHEREAS the parties have indicated / expressed their willingness to co-operate with each other in respect of preparing and submitting jointly to owner bid for the Project and in the event of contract (hereinafter referred to as the "CONTRACT") being awarded to the parties by owner, the Parties agree to carry out the execution of the Contract and jointly & severally share the responsibility in accordance with the said Contract if awarded.

NOW THIS INDENTURE WITNESSTH AS UNDER:

1.0 Purpose of the Agreement:

All above "Parties" hereby agree to form a consortium to jointly bid for the project under a single bid and in the event of the said single bid submitted by the parties being accepted by the owner, to enter into the Contract and to execute the same to the satisfaction of Tender Specifications. The Parties shall co-operate with each other in order to secure the successful bidding for the Project and thereafter upon its acceptance by owner to execute it successfully.

FURTHER the Parties are desirous of entering into a Consortium for the execution of the Project and to determine, fix and define between them the respective interests, scope of responsibilities and liabilities in connection with the whole execution of their part for the **said Project.**

2.0 Consortium:

The Parties agree to form a consortium for the purposes of undertaking the Bidding Process and if the Bid is successful, for implementing the Project.

Each Party shall Co-operate with the other Party to the fullest extent possible to ensure that all filings made with, and communications to the owner are complete, accurate in all respect and made within the prescribed time limits.

3.0 Lead Member:

The lead member of the consortium i.e. M/s. _____ is authorised to take all actions on behalf of the all the members of the consortium that may be necessary or required in connection with or incidental to the Consortium's Pre-Qualification and Bid, including but not limited to:

- i. Signing and submission of all applications and other documents and written communications;
- ii. Participating in 'Bidders' and other conferences and providing information or responses to the owner;
- iii. Representing the Consortium in all matters before the owner;
- iv. Submission of the Bid;
- v. Signing and execution of all contracts and undertakings consequent to acceptance of the Bid by the owner;
- vi. To incur liabilities and receive instruction for and on behalf of the Consortium;
- vii. To take all the action for entire execution of the Contract and

† accept payments on behalf of the Consortium from the Owner. All the Members further agree and irrevocably accept that the Leader Member shall be authorized to accept payments from the Owner and upon making the payments to the Lead Member after due recoveries, if any, the owner shall have discharged himself in full from all its liabilities to the consortium.

OR

† submit invoices of the Individual Members of the Consortium duly certified, to enable the Owner to make payments to the Individual member after due recoveries, if any. All the Members further agree and irrevocably accept that upon making payments to the members of Consortium as above, the Owner shall have discharged himself in full from all his liabilities to the consortium.

viii. To do any other act or deed in relation to or incidental to submission of the Bid, execution and implementation of the Contract on behalf of the Consortium.

Communication to and from the Lead Partner shall be binding on all the members of the consortium.

4.0 Securities Towards Contract:

In the event of award of the contract by the owner to the consortium, the lead member shall submit the contract performance security amounting to 10% of the contract price and other members of the consortium shall submit on Demand Bank guarantee amounting to 1.5% of the contract price to the owner.

5.0 Division of Responsibilities towards the Contract:

In the event of award of the contract by the owner, the Division of responsibilities of among the parties shall be as under:³

M/s. _____ :

M/s. _____ :

M/s. _____ :

M/s. _____ :

Notwithstanding anything contained above, all the members of the consortium shall be jointly and severally responsible to the owner for the performance of the contract in full.

6.0 Assignment:

Neither party to this agreement is entitled to sell or sub-let or assign or otherwise transfer any of its rights and/or obligations from or in relation to this agreement to any third party, without the prior consent of the other party and further mandatory written consent from the owner

7.0 Liability:

The Parties shall be responsible for completion of their respective scope of work and for the costs and expenses incurred in connection with the execution of the said scope of work. The project schedule for the respective scope of work shall be in tune with the master project schedule. However, each party will co-operate /give its fullest support to other party, if either party make written request for the same.

Each Party shall bear the Pre-approved costs and expenses incurred by any of the party for the bid preparation and follow up on contract until the contract is awarded to the CONSORTIUM by MAHAGENCO.

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³ The division of responsibility shall be such that entire scope of work as stipulated in bid specification is invariably covered. Any missing scope shall deemed to be included in the scope of the lead member of the consortium.

The parties shall be jointly & severally responsible for the execution of the contract. It is clarified that the Members of the Consortium shall remain jointly and severally liable to the Owner, irrespective of whether the entire payment is made to the leader of the Consortium, or whether payment is made directly to individual Members of the Consortium.

8.0 Project Organisation:

All parties should jointly formalize a project organization chart for the execution of the entire project specifying the personnel to be employed for the project with their respective roles & responsibilities and with the respective schedule.

9.0 Authorities of the Parties and their Representatives:

The contractual responsibilities of the parties to each other, on any particular project opportunity, shall be defined by separate written agreement applicable to each such project. By executing this agreement, the Parties shall be deemed independent entities, and neither party authorizes the other to act as its agent or representative, except to the extent set forth herein. Under no circumstances shall the employees of one party be deemed to be the employees of the other party.

Each party shall indemnify and hold harmless the other from and against any and all damages, costs or expenses (including attorney's fees) arising from any representation, action, or undertaking by the indemnifying party which exceeds or is outside of the scope of this agreement.

Each party has appointed / nominated the following individual as its principal representative and will advise the other party, in writing, of any limitations on the authority of the said principal representative. The representative of the parties shall be :

For M/s. (Name of the Company) : (Name of the representative)

For M/s. (Name of the Company) : (Name of the representative)

For M/s. (Name of the Company) : (Name of the representative)

For M/s. (Name of the Company) : (Name of the representative)

Each party may change its representatives so appointed/nominated above at any point of time however a written communication in this regard will be made to other parties and the owner within a period of thirty days from the date of such changes.

10.0 Duration of the Agreement:

This agreement shall cease to exist at an earlier of the following:

- i) The bid by the consortium is disqualified by the owner.
- ii) The owner awards the contract to some other entity.
- iii) The owner abandons the project.

- iv) Either Party is declared as insolvent or gets wound up by a Court of competent jurisdiction.
- v) Any change in the law which would render execution or implementation of **agreement illegal / impossible.**

11.0 Confidentiality:

- a) All the documents / drawings / technical data and any other information regarding this work shall be treated as top Confidential and should not be used for any other purpose not related to execution of work under this Pre-bid Agreement.
- b) Each party agrees to keep the information confidential shared with it in respect of the Project by the other Party, and not to divulge the same to any third party in subsequent discussions, negotiations, etc. or any other agency in the interest of securing the Project. The parties shall enter into a non-disclosure / confidentiality agreement to this effect separately.

12.0 Indemnities:

- a) Each Party shall indemnify and hold harmless the other party against any and all damages, costs, losses or claims incurred by or made against the other party arising from:
 - i) Any breach, non-observance or failure by the either Party or their servants, agents or subcontractors to carry out and perform its responsibilities;
 - ii) Any negligent act or omission of the either Party or their servants, agents or subcontractors committed during the performance of its obligations.
- b) The Parties shall indemnify and hold harmless the Owner against any financial liability towards any demand from statutory authorities towards deduction of Withholding Tax and/or Interest thereon and authorise the Owner to deduct such amounts from the bills payable and/or enforce the securities available with the Owner and pay the same to the respective Tax Authorities. The Parties shall also indemnify the Owner from any costs towards defense of suits/proceedings brought against the Owner in this regard.

13.0 Force Majeure:

No Party will be responsible for non-performance of any or all of their obligations under this Agreement if such non-performance is due to reasons beyond the reasonable control of the Parties. "Force Majeure" situations are also included in the expression "beyond the reasonable control of the Parties" including, but not, restricted to acts of god, declared or undeclared war, riots, civil wars, fires, floods, epidemics, strikes, freight embargoes, expropriation by Government authorities, rebellion, sabotage, abrupt change political / economical situations, depreciation of currency.

14.0 Amendments:

Any amendments to this Agreement shall be only in writing and such writings shall be signed by the authorized representatives of both the Parties.

15.0 Notices:

All notices and communications which are signed by the Authorized Signatories of either party shall be sent by registered post A.D to the following addresses of the Parties:

M/s. (Name of the Company)

(Address).

.....

.....

.....

M/s. (Name of the Company)

(Address).

.....

.....

.....

M/s. (Name of the Company)

(Address).

.....

.....

.....

M/s. (Name of the Company)

(Address).

.....

.....

.....

16.0 Dispute Resolution:

If any disputes, differences or controversies (collectively a dispute) arise between the Parties in respect of this agreement or the subject matter or interpretation hereof or in respect of any connected matters, then any party may deliver to the other party a notice of dispute in writing adequately identifying and providing details of the dispute (the "Notice of Dispute"). The authorized representative of the parties shall co-operate, in good faith, to attempt to amicably resolve the dispute. If any party believes that such representatives cannot resolve the dispute, such Party may invoke the further dispute resolution procedures of this clause No.15.

All disputes and differences, arising out of or in connection with this Agreement be attempted to be resolved mutually through negotiations between the Parties failing which the same shall be referred to arbitration. The provisions of Arbitration & Conciliation Act 1996 shall be applicable to such arbitration proceedings. The provisions of this clause No.15 shall survive the expiration of this Agreement.

17.0 Jurisdiction and Governing Law:

Incidental to arbitration as hereinabove mentioned, this Agreement shall be governed by the Indian laws and will be subject to the jurisdiction of the Courts in Mumbai, having jurisdiction to entertain the dispute.

18.0 Miscellaneous:

- A. Neither this Agreement nor any interest herein shall be assigned, in whole or in part, by either party hereto to any third party (is) without the prior written consent of the other party.
- B. Each party represents that it has corporate power and authority to under respective governing laws enter into and to perform the obligations set forth in this agreement.
- C. This 'Agreement' constitutes the entire understanding and agreement of the parties with respect to the subject matter hereon and supersedes all prior representations and agreements, oral or written. This Agreement may be modified only upon written instrument executed by the authorized representative of each party.
- D. This Agreement shall not constitute, create or in any way be interpreted to create a joint venture, partnership or formal business organization of any kind among above parties and is applicable and valid only for the sole purpose and the intent expressed as above. The members of the Consortium shall otherwise be free to carry on their independent business of commercial activities for their own respective benefits under their own respective names and styles. This Consortium Agreement is limited in its operation to the specified Project named ... (Name of the Project)

19.0 Notwithstanding anything contained hereinabove, all the provisions of this agreement shall be consistent with the provisions of the bid specification No. DG/BSL U-6/2011/T-1 and/or contract if any awarded by the owner to the consortium. In case of any provisions of this agreement are contradicting to the provisions of the bid specification and/or contract awarded by the owner to the consortium, the provisions of bid specification and/or contract shall prevail over those of agreement.

In witness thereof the parties hereto have set & subscribed their respective hands to this memorandum of Understanding at Mumbai on the day, month and year first herein written above:

Witness:	For M/s. <u> (lead member of consortium) </u>
Signature: _____	(Authorised Signatory)
Name: _____	Name: _____
Office Address: _____	Designation: _____

Witness:	For M/s. <u> (member of consortium) </u>
Signature: _____	(Authorised Signatory)
Name: _____	Name: _____
Office address: _____	Designation: _____

Witness:	For M/s. <u> (member of consortium) </u>
Signature: _____	(Authorised Signatory)
Name: _____	Name: _____
Office address: _____	Designation: _____

Witness:	For M/s. <u> (member of consortium) </u>
Signature: _____	(Authorised Signatory)
Name: _____	Name: _____
Office address: _____	Designation: _____

†Strike out whichever is not applicable

* Insert only if applicable

The Proforma for Contract Agreement, at page No. 116, Section I, Volume-I of the bid specification is modified as under :

Annexure - XII

Proforma for Contract Agreement

(To be executed on Maharashtra non-judicial stamp paper of requisite money value purchased in the name of the contractor)

CONTRACT AGREEMENT NO. DG/BSL U-6/2011/T-1/⁴SUPPLY/ERECTION/CIVIL CONSTRUCTION

This CONTRACT AGREEMENT is made on this ____ day of _____ 20__ between Maharashtra State Power Generation Co. Ltd. (Mahagenco), a company registered under and by virtue of Indian Companies Act 1956 having its registered office at 2nd Floor, 'Prakashgad', Plot No. G - 9, Prof. Anant Kanekar Marg, Bandra (East), Mumbai - 400 051, India and M/s. _____, a company/entity registered under and by virtue of _____ Act of (country) and having its registered office at _____ (hereinafter referred to and called as 'the Contractor')/⁵(Lead Member of Consortium') in consortium with M/s. _____, a company/entity registered under and by virtue of _____ Act of (country) and having its registered office at _____ (Member of Consortium) and M/s. _____, a company/entity registered under and by virtue of _____ Act of (country) and having its registered office at _____ ('Member of Consortium') wherein all the members of the consortium jointly and severally shall be perform the obligations of the contractor and lead member of the consortium is authorised to do all acts and deeds including incurring liabilities ~~and receive payments~~ on behalf of the consortium to give effect to this contract.##.

Whereas the owner, having decided on installation of Bhusawal Thermal Power Station 1x660 MW Unit - 6 on supercritical technology, had invited International Competitive Bids conforming to Bid Specification No. DG/BSL U-6/2011/T-1 and in response to the same, the contractor had submitted its bid vide Bid Proposal No. _____ dated _____. Now, the owner has accepted the bid by the contractor and has awarded the contract for *Supply of all Equipment and Materials including Cement, Steel and other aggregates for Civil, Structural and Architectural Works and Transportation up to Site/Design, Engineering, Handling at Site (Receipt, Storage etc.) Erection, Testing & Commissioning including Performing Performance Guarantee Test of all equipment/Design, Engineering, Civil Construction, Structural and Architectural Works covered under the Bid Specification No. DG/BSL U-6/2011/T-1 read with amendments, agreed deviations thereto by letter of Award dated _____.

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⁴ Strikeout whichever is not applicable

⁵ Insert portion beyond this point and up to ## only if the contractor is the consortium of firms.

NOW THIS AGREEMENT WITNESSES AS UNDER:

1.0 Contract Documents: the following documents shall form the integral part of the contract:

- 1) This agreement
- 2) Volume – I of the Contract Comprising of:
 - a. Notification of Award of the Contract and Schedules 1 to 9 (Section – 1).
 - b. Special Terms and Conditions of the Contract read with agreed deviations thereto (Section – 3)
 - c. General Terms and Conditions of the Contract read with agreed deviations thereto (Section – 2)
 - d. Terms and Conditions of the Contract – *Supply/Site Works and Additional Conditions of the Contract – Civil read with agreed deviations thereto (Section 2A/2B and 2C).
 - e. Consortium Agreement (If applicable)
- 3) Technical Specification, drawings, design documents etc. (Volumes II to VIII) read with agreed deviations thereto.
- 4) All correspondence exchanged between the contractor and the owner from the date of opening of techno-commercial bid till the award of contract as referred to in the Letter of Award.
- 5) Contractor's Bid Proposal Techno-commercial bid (Part -1) in physical form opened on _____ and Price Bid (Part – 2) in electronic form opened online on _____.
- 6) Bid Specification No. DG/BSL U-6/2011/T-1.
- 7) Various sections of Volume-I shall be attached to the contracts as under :

The documents at Sr. No. 4 to 6 are not enclosed with this agreement for the sake of convenience of handling. The documents at Sr. No. 2 and 3 above are initialled by below mentioned representatives of the owner and contractor with their respective official seal:

Name of the Owner's Representative :

Initials :

Name of the Contractor's Representative :

Initials :

2.0 Consideration: The contractor has agreed to perform the contract as per the scope detailed herein and on the terms and conditions set out herein and in consideration of the performance of the obligations of the contractor hereunder, owner hereby agrees to pay contractor the contract price which is aggregate of INR (in figures) (in word INR _____), Foreign Currency 1 (in figures) (in words Foreign Currency 1 _____) and Foreign Currency 2 (in figures) (in words Foreign Currency 2 _____) as per the Payment Terms mentioned herein.

3.0 Effect Date of the Contract: The contract *has/shall come into effect with effect from the date of issuance of the *Letter of Award (LOA)/Notice to Proceed issued by the owner i.e. _____. The contractor has agreed to complete the works under the contract within ____ months thereafter as per the Work Completion Schedule (Schedule - 6).

4.0 Cross-fall-Breach Clause: Breach of any of the terms and conditions of this contract shall be deem breach of other contracts which shall be deem breach of other contracts which will automatically be construed as breach of other contracts which confer right on the owner to terminate the other contract(s) also at the risk & cost of the contractor.

5.0 It is expressly understood and agreed by and between the Contractor and the Owner that **the** Owner is entering into this Agreement solely on its own behalf and not on behalf of any other person or entity. In particular it is expressly understood and agreed that the Government of India and or Govt. of Maharashtra is not a party to this Agreement and has no liabilities, obligations or rights hereunder. It is expressly understood and agreed that the Owner is an Independent legal entity with power and authority to enter into contracts solely on its own behalf under the applicable laws of India and the general principles of Contract Law. The Contractor expressly agrees, acknowledges and understands that the Owner is not an Agent, Representative or Delegate of the Govt. of India and/or Govt. of Maharashtra. It is further understood and agreed that the Government of India and/or Govt. of Maharashtra is/are not and shall not be liable for any acts, omissions, commissions, breaches or other wrongs arising out of the Contract. Accordingly, the Contractor expressly waives, releases and foregoes any

and all actions or claims, including cross claims, impleader claims or counter claims against the Government of India and/or Govt. of Maharashtra arising out of this Contract and covenants not to sue the Government of India and/or Govt. of Maharashtra as to any manner, claim and cause of action or thing whatsoever arising of or under this Agreement.

6.0 Notices: save the provisions made under the Clause No. __, Section 2(B), Volume – I of the contract, the notices to either parties shall be served on below mentioned communication details in the manner stipulated in the contract:

To the Owner:

M/s. Maharashtra State Power Generation Co. Ltd.

[*Insert Address*]

In Attention of:

Fax:

Phone:

Email:

To the Contractor:

M/s. _____

[*Insert Address*]

In Attention of:

Fax:

Phone:

Email:

Either party may change the communication details as mentioned above by giving prior written notice to another party to that effect.

IN WITNESS WHEREOF the Employer and the Contractor have caused this Agreement to be duly executed by their duly authorized representatives the day and year first above written.

Witness: For and on behalf of the Owner

Signature: _____

Name: _____

Office Address: _____

(Signature with Seal)

Name: _____

Designation: _____

Witness: For and on behalf of the contractor

Signature: _____

Name: _____

Office Address: _____

(Signature with Seal)

Name: _____

Designation: _____

Note :

- (i) In case the bidder is an Indian Entity, Volume - I of the Contract shall be Comprising of following sections of the Volume-I of the Bid Specification

Section	Description	To be incorporated in		
		First Contract	Second Contract	Third Contract
2	General Conditions of the Contract	Yes	Yes	Yes
2A	Terms & Conditions of the Contract - Supply	Yes	No	No
2B	Terms & Conditions of the Contract - Site Services	No	Yes	Yes
2C	Additional Conditions of the Contract - Civil	No	No	Yes
3	Special Terms & Conditions of the Contract	Yes	Yes	Yes

- (ii) In case the bidder is a Foreign Entity, Volume - I of the Contract shall be Comprising of following sections of the Volume-I of the Bid Specification

Section	Description	To be incorporated in		
		First Contract	Second Contract	Third Contract
2	General Conditions of the Contract	Yes	Yes	Yes
2A	Terms & Conditions of the Contract - Supply	Yes	Yes	Yes
2B	Terms & Conditions of the Contract - Site Services	No	No	Yes
2C	Additional Conditions of the Contract - Civil	No	No	Yes
3	Special Terms & Conditions of the Contract	Yes	Yes	Yes

Following Schedules are added in the bid specification/modified as under:

Schedule - 1

Proforma for Break-up of Prices

(to be in electronic form on line)

Sr. No.	Particulars	Price			Applicable Taxes	
		INR	FC1	FC2	Tax	Rate
1.	Supply of Equipment, Mandatory Spares and Materials					
1.1	Supply of Indigenous Equipment & Materials				Excise Duty	
					CST	
					M VAT	
1.2	Supply of Indigenous Mandatory Spares				Excise Duty	
					CST	
					M VAT	
1.3	Supply of Imported Equipment, and materials to be directly delivered to the site on CFR basis				Total Customs Duty	
1.4	Supply of Imported Mandatory Spares to be directly delivered to the site on CFR basis				Total Customs Duty	
1.5	Supply of Steel, Cement and other aggregates for Civil, Structural and Architectural Works		NA	NA	Excise Duty	
					CST	
					M VAT	
1.6	Inland Freight for FOR Site Delivery of 1.1 to 1.5 above including taxes thereon, if any		NA	NA	---	---

Sr. No.	Particulars		Price			Applicable Taxes	
			INR	FC1	FC2	Tax	Rate
	<u>1.7</u>	<u>Amount of Taxes & Duties on 1.1 to 1.5 for the purpose of ceiling.</u>		NA	NA	---	---
	Total					---	---
2.	Erection, Testing & Commissioning						
	2.1	Equipment Related Design & Engineering (except for Civil Design & Engineering				Service Tax	
	2.2	Erection, Testing & Commissioning		NA	NA	Service Tax	
	<u>2.3</u>	<u>Amount of Taxes & Duties on 2.1 & 2.2 above, for the purpose of ceiling.</u>		NA	NA		
	Total					---	---
3.	Civil Construction, Structural and Architectural Works						
	3.1	Civil Works related Design Engineering		NA	NA	Service Tax	
	3.2	Civil Construction, Structural and Architectural Works		NA	NA	Service Tax	
	<u>3.3</u>	<u>Amount of Taxes & Duties for the purpose of Ceiling</u>		NA	NA		
	Total			NA	NA	----	----
Grand Total (1+2+3)							

NA = Not Applicable i.e. Foreign Currency bid price and payment not acceptable for the respective element of the bid price. FC1, FC2 = Foreign Currencies of bidders option.

1. We confirm that the taxes at the rates mentioned above are applicable as on record date ~~and considering the prevailing Project Import Regulations. However, the above mentioned Taxes and Duties shall be payable at the rates prevailing considering 1) Deemed Export Benefits and 2) Mega Power Project benefits (including benefits for Expansion Unit of Mega Power Project benefits) shall only be payable to us. the same are payable as per the stipulations of Bid Specification.~~
- ~~2. We confirm that subject to grant of the Mega Power Project/Expansion Unit of Mega Power Project status by the Ministry of Power for the Project (Bhusawal TPS 1x660 MW Unit-6), we shall avail all the benefits of taxes and duties so available to the project as per the prevailing rules and pass on all such benefits on this account to the owner.~~
- ~~3. We confirm that in view of International Competitive Bidding, Deemed Export Benefits as per the current Foreign Trade Policy (FTP) 2009-2014 are available to the project.~~

Note :

Total Foreign currency component indicated in schedule-1, shall not exceed the foreign currency component indicated in Schedule-4, Section - 1, Volume - I of the bid specification.

Schedule - 1A

Projected Cash Flow

(to be submitted in Electronic form)

Month	Projected Cash Flow (In % of bid price)				
	Supply			Erection	Civil
	INR	FC1	FC2	INR	INR
1					
2					
3					
4					
5					
6					
7					
8					
9					
--					
Total	100%	100%	100%	100%	100%

Schedule - 2

Proforma for Break-up of Prices

(to be submitted in electronic form on line by uploading the *.pdf file)

BREAK UP OF PRICES OF MANDATORY SPARES

The Break up of prices of Mandatory Spare as indicated at 1.2 and 1.4 of Price Schedule is as under:

Sr. No.	Item Description	Unit of Measure	Quantity	Rate/Unit		
				INR	FC1	FC2
Indigenously Manufactured Spares						
Total						
Imported Spares to be directly despatched to the site						
				FOB		
				CFR		
				FOB		
				CFR		
Total				FOB		
				CFR		

Note: The description and quantity of mandatory spare shall be as stipulated in the Volume - II of the bid specification and shall be same as indicated in techno-commercial bid.

Following Proforma for Bank Guarantee against Phased Manufacturing Program is being included in the Bid Specification as Schedule-8D

Schedule - 8 (D)

Proforma for Bank Guarantee against Phased Manufacturing Program

(To be submitted on the Stamp Paper of requisite money value purchased in the name of the guarantor bank)

BANK GUARANTEE

In consideration of the Maharashtra State Power Generation Co. Ltd. (Mahagenco), a company incorporated in India, registered under the Companies Act, 1956 and having its registered office at 2nd Floor, Prakashgad, Plot No. G9, Prof. Anant Kanekar Marg, Bandra (East), Mumbai – 400 051, India (hereinafter referred to as “the Owner”), which expression shall, unless repugnant to the context or meaning thereof include its administrators, successors and assigns having awarded to M/s.....(Contractor’s Name)....with its Registered /Head Office at.....(hereinafter referred to as the ‘Contractor’ which expression shall unless repugnant to the context or meaning thereof, include its successors administrators, executors and assigns), a Contract by issue of Letter of Award No.....dated.....and the same having been unequivocally accepted by the contractor, resulting into a Contract bearing No.....dated.....valued at.....for and the Contractor having agreed to provide a Performance Guarantee for the faithful Completion of Phased Manufacturing Program for an amount equivalent to 5% (five percent) of the contract price in. to the Owner.

We.....(Name & Address of the Bank).....having its Head Office at.....(hereinafter referred to as the ‘Bank, which expression shall, unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns) do hereby guarantee and undertake to pay the Owner, on demand any and all monies payable by the Contractor to the extent of Rs.....(equivalent to 5% of the total contract price) as aforesaid at any time during the validity of this Bank Guarantee without any demur, reservation, contest, recourse of protest and/or without any reference to the Contractor. Any such demand made by the Owner on the Bank shall be conclusive and binding notwithstanding any difference between the Owner and the Contractor or any dispute pending before any Court, Tribunal, Arbitrator or any other authority. The Bank undertakes not to revoke this Guarantee during its

currency without previous consent of the Owner and further agrees that the Guarantee herein contained shall be enforceable till six months after expiry of its validity.

The Owner shall have the fullest liberty, without affecting in any way the liability of the Bank under this Guarantee, from time to time to extend the time for performance of the Contract by the Contractor. The Owner shall have the fullest liberty, without affecting this Guarantee, to postpone from time to time the exercise of any powers vested in them or of any right which they might have against the Contractor, and to exercise the same at any time in any manner, and either to enforce or to forbear to enforce any covenants, contained or implied, in the Contract between the Owner and the Contractor or any other course or remedy or security available to the Owner. The Bank shall not be released of its obligations under these presents by any exercise by the Owner of its liberty with reference to the matters aforesaid or any of them or by reason of any other act or forbearance or other acts of omission or commission on the part of the Owner or any other indulgence shown by the Owner or by any other matter or thing whatsoever which under law would, but for this provision, have the effect of relieving the Bank. The Bank also agrees that the Owner at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Contractor and notwithstanding any security or other guarantee that the Owner may have in relation to the Contractor's liabilities.

We shall extend the validity of this Bank Guarantee for the further period of six months, one month prior to its present validity period at the request of the Owner. We further agree that non-extension of the guarantee as above shall be sufficient ground for encashment of the same by the Owner.

Notwithstanding anything contained above:

- i) Guarantor's liabilities under this guarantee shall not exceed ⁶_____.
- ii) This Bank Guarantee valid up to ⁷_____.
- iii) The guarantor is liable to pay the guaranteed amount or any part thereof under this bank guarantee only and only if the owner serve upon us a written claim or demand on or before _____ .

56565660_____

⁶ Add value of BG

⁷ Insert the date of validity of the bank guarantee

IN WITNESS WHEREOF THE GUARANTOR HAS SET ITS HANDS HEREUNTO ON THE DAY, MONTH AND YEAR FIRST HEREINABOVE WRITTEN.

Signed and delivered by _____ name of the bank _____ by the hand of Shri./Smt. _____ its _____ designation _____ and authorized official.

Dated the ____ day of _____

For -----(Name of the Bank) ---

⁸[Authorised Signatory(ies)]

WITNESS:

- Notes: 1) The Bank Guarantee shall be from a Bank as per provisions of Clause No. 15, Section-2 (General Terms and Conditions of the Contract) of the Bid specification (Volume-I).
- 2) The stamp papers of appropriate value shall be purchased in the name of guarantee issuing Bank or the party on whose behalf for BG is being issued. The Bank Guarantee shall be issued on a stamp paper of value as applicable in the State of India from where Bank Guarantee is issued or the State of India from where BG shall be operated, whichever is higher.

57575760_____

⁸ The officer(s) to sign with their Identity Nos. issued by the bank.

Following Proforma for Bank Guarantee against Advance payment is being included in the Bid Specification as Schedule-(8E)

Schedule-8(E)

PROFORMA OF BANK GUARANTEE FOR ADVANCE

(to be submitted on the Stamp Paper of requisite money value purchased in the name of the guarantor bank)

Bank Guarantee No..... & date
(For Rs)

Issue date:

Expiry date:

Claim period:

Name & Address of the Bank

To,

Maharashtra State Power Generation Co. Ltd.,
'Prakashgad', 3rd floor,
Bandra (East),
MUMBAI-400 051

Dear Sirs,

In consideration of Maharashtra State Power Generation Co. Ltd., Mumbai (hereinafter referred to as the Owner, which expression shall unless repugnant to the context or meaning thereof, include all successors, administrators and assigns) having awarded to M/s..... with its Registered/Head Office at (hereinafter referred to as 'Contractor' which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators, executors, and assigns) a contract by issue of Owner's Letter of Award No. dtd. with the contract price of Rs. for(scope of work) (hereinafter called the 'Contract') and the Owner having agreed to make an advance payment to the Contractor for performance of the above contract amounting to Rs. (Rs. only) as an advance against Bank Guarantee to be furnished by the Contractor.

We (Name of the Bank).....having its Office at(address of the Bank)..... (hereinafter referred to as the 'Bank' which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns) do hereby guarantee and undertake to pay to the Owner immediately on demand, any or all amounts payable by the Contractor to the extent of Rs. (Rupees) at any time up to without any demur, reservation, recourse, contest or protest and/or without any reference to the Contractor. Any such demand made by the Owner on the Bank shall be conclusive and binding notwithstanding any difference between the Owner and the Contractor or any dispute pending before any Court, Tribunal, Arbitrators or any other authority. We agree that the Guarantee herein contained shall be irrevocable and shall continue to be enforceable till the Owner discharges this Guarantee.

The Owner shall have the fullest liberty without affecting in any way the liability of the Bank under this Guarantee from time to time to vary the advance or to extend the time for performance of the contract by the Contractor. The Owner shall have the fullest liberty without affecting this Guarantee, to postpone from time to time the exercise of any powers vested in them or of any right which they might have against the Contractor, and to exercise the same at any time in any manner and either to enforce or to forebear to enforce any covenants contained or implied in the Contract between the Owner and the Contractor or any other course or remedy or security available to the Owner. The Bank shall not be released of its obligations under this presents by any exercise by the Owner of its liberty with reference to matters aforesaid or any of them or by reason of any other act or forbearance or other acts of omission or commission on the part of the Owner or any other indulgence shown by the Owner or by any other matter or thing whatsoever which under law would, but for this provision, have the effect of relieving the Bank.

The Bank also agrees that the Owner at its option shall be entitled to enforce this Guarantee against the Bank as a Principal debtor, in the first instance without proceeding against the Contractor and notwithstanding any security or other Guarantee that the Owner may have in relation to the Contractor's liabilities

We shall extend the validity of this Bank Guarantee for the further period of six months, one month prior to its present validity period at the request of the Owner. We further agree that non-extension of the guarantee as above shall be sufficient ground for encashment of the same by the Owner.

Notwithstanding anything contained above –

- i) Our liabilities under this guarantee shall not exceed Rs. ----- .
- ii) This Bank Guarantee valid up to ----- .
- iii) We are liable to pay the guaranteed amount or any part thereof under this bank guarantee only and only if you (MahaGenco) serve upon us a written claim or demand on or before ----- .

In witness whereof We _____ Bank Limited have executed this on this the _____ day of -----.

WITNESS:

Signature	Signature
Name	Name
Designation	Designation

Attorney as per Power of Attorney
No..... Dated.....

Bank's Rubber Seal and
Full Address.

Note :

1. The bank guarantee shall be unconditional, irrevocable and initially valid till Project Completion schedule. Later, the Bank Guarantees shall be extended by a period of Six Months, if demanded by the Owner.
2. The Contractor may, if he so desires, reduce the e of Bank Guarantee(s) submitted against advance payments after every six (6) months to the extent of advance actually adjusted. The application for reduction in the value of the Bank Guarantee shall be submitted to the Project Manager.



**MAHARASHTRA STATE POWER
GENERATION CO. LTD.**

**PROJECTS & PLANNING
DEPARTMENT**

BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1

CORRIGENDUM - XIII



MAHARASHTRA STATE POWER GENERATION CO. LTD.

BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1

CORRIGENDUM - XIII

CORRIGENDUM TO BID SPECIFICATION

VOLUME-I

COMMERCIAL AND GENERAL CONDITIONS OF

CONTRACT



1. Following Clauses of the Bid Specification are amended as under :

Sr No	Section/ Page No/Cl No.	Existing Particulars of Bid Stipulation including amendment/corrigendum thereof			To be read as		
1	Section 1, Page 40/ Cl. No. 19.1	4.	Auxiliary Power Consumption: Total power consumption of all the auxiliaries (as listed under Clause 6.3, Section - 3, Volume - I) at 660 MW load with Zero make up, 76mm of Hg back pressure and 100% unit load (considering lowest quoted Auxiliary Power Consumption as base)	INR 300,000/- (INR Three Hundred Thousand Only) per kWh	4.	Auxiliary Power Consumption: Total power consumption of all the auxiliaries (as listed under Clause 6.3, Section - 3, Volume - I) at 660 MW load with Zero make up, 76mm of Hg(a) or lower guaranteed/design condenser back pressure and 100% unit load (considering lowest quoted Auxiliary Power Consumption as base)	INR 300,000/- (INR Three Hundred Thousand Only) per kW
2	Section 1, Annexure - V(A), Clause No. 2, Page 84	In case of any breach The liability of the Parent Manufacturer hereunder shall, however, be limited to an amount calculated at the rate of USD 221/122/343 Million.....			In case of any breach The liability of the Parent Manufacturer hereunder shall, however, be limited to an amount calculated at the rate of <u>** of Contract Price</u> ** Please insert 1. <u>In case of DJU for SG, 27% of Contract Price</u> 2. <u>In case of DJU for STG, 15 % of the Contract Price</u>		

		MAHARASHTRA STATE POWER GENERATION CO. LTD.		Page4of11
		BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		
		CORRIGENDUM - XIII		
Sr No	Section/ Page No/Cl No.	Existing Particulars of Bid Stipulation including amendment/corrigendum thereof	To be read as	
3	Section 1, Annexure - V(A), Clause No. 8, Page 87	We, the parent Manufacturer, *the parent manufacturer – GS, the ‡subsidiary/Joint Venture Company and the Indian Promoter do hereby undertake and confirm that this Deed of Joint Undertaking shall be initially valid till ninety (90) days beyond the schedule date of completion of Phased Manufacturing Program under the Contract.....	We, the parent Manufacturer, *the parent manufacturer – GS, the ‡subsidiary/Joint Venture Company and the Indian Promoter do hereby undertake and confirm that this Deed of Joint Undertaking shall be initially valid till ninety (90) days beyond the schedule date of completion of <u>the defect liability period of the Equipment or Completion of Phased Manufacturing Program under the Contract (s), whichever occurs later.</u> In case of delay in completion of <u>defect liability period under the Contract(s) or delay in Phased Manufacturing</u>	
4	Corrigendum-X, Page 20 of 60, Annexure – V(B)1, Para 2 of Clause No. 2	The liability of the Collaborator SG hereunder shall, however, be limited to an amount calculated at the rate of 221 Million.....	The liability of the Collaborator SG hereunder shall, however, be limited to an amount calculated at the rate of <u>27% of the Contract Price.....</u>	
5	Section 2A,Page 235/ Cl. No. 10.1	The contract price (excluding taxes, duties, freight, insurance) less advance paid of i) Plant and Equipment, ii) Steel for Civil, Structural Works and iii) Cement shall be subject to adjustment in accordance with the formula stipulated under the Schedule 3 of the contract.	The <u>Indian Rupee Component</u> of contract price (excluding taxes, duties, freight, insurance) less advance paid of i) Plant and Equipment, ii) Steel for Civil, Structural Works and iii) Cement shall be subject to adjustment in accordance with the formula stipulated under the Schedule 3 of the contract.	
6	Section 2A,Page 235/ Cl. No. 10.2	The price adjustment of a particular item shall not exceed ± 20% of the total contract price of the particular item. This ceiling shall be applicable for the contract price of that item and not to the price billed in individual invoices or for individual shipments.	The price adjustment of a particular item shall not exceed ± 20% of the ~~total~~ <u>Indian Rupee Component</u> of contract price ~~of the particular item.~~ This ceiling shall be applicable for the <u>Indian Rupee Component</u> of contract price ~~of that item~~ and not to the price billed in individual invoices or for individual shipments.	
7	Section 2A,Page	70% payment towards the Price Adjustment on supply of	~~70%~~ <u>75%</u> payment towards the Price Adjustment on supply of	

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		BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		
		CORRIGENDUM - XIII		
Sr No	Section/ Page No/Cl No.	Existing Particulars of Bid Stipulation including amendment/corrigendum thereof	To be read as	
	241/ Cl. No. 12.7.1	equipment/mandatory spares along with taxes thereon shall be paid against submission of invoices along with documentary evidence (one original + two copies).	equipment/mandatory spares along with taxes thereon shall be paid against submission of invoices along with documentary evidence (one original + two copies).	
8	Section 2A,Page 242/ Cl. No. 12.7.2	Balance 30% payment of price adjustment shall be released as per the provisions of Clause No. 12.4.4 and Clause 12.6 above.	Balance ~~30%~~ 25% payment of price adjustment shall be released as per the provisions of Clause No 12.4.4 and Clause 12.6 above.	
9	Section 2B,Page 270/ Cl. No. 25.2	The price adjustment shall not exceed ± 20% of the contract price. This ceiling shall be applicable for the contract price not to the price billed in individual invoice.	The price adjustment shall not exceed ± 20% of ~~the~~ <u>Indian Rupee Component of the</u> contract price. This ceiling shall be applicable for the <u>Indian Rupee Component of</u> contract price ~~of that item~~ and not to the price billed in individual invoices or for individual shipments.	
10	Section 2B,Page 273/ Cl. No. 27.5.1	70% payment towards the Price Adjustment on supply of equipment/mandatory spares services rendered along with taxes thereon shall be paid within 30 days from the date of submission of invoices along with documentary evidence (one original + two copies).	~~70%~~ 75% payment towards the Price Adjustment on <u>site works</u> ~~supply of equipment/mandatory spares~~ along with taxes thereon shall be paid against submission of invoices along with documentary evidence (one original + two copies).	
11	Section 2B,Page 273/ Cl. No. 27.5.2	Balance 30% payment of price adjustment shall be released as per the provisions of Clause No. 27.3.3 and Clause No. 27.4 above.	Balance ~~30%~~ 25% payment of price adjustment shall be released as per the provisions of Clause No. 27.3.3 and Clause No. 27.4 above.	
12	Section 3,Page 331/ Cl. No. 8.4	For not achieving the Phased Manufacturing Programme, total Liquidated Damages (over and above and independent of the Liquidated Damages payable against Clause No. 30, Section – 2, Volume – I) to the extent of 5% of the contract price shall be payable by the contractor.	For not achieving the Phased Manufacturing Programme, total Liquidated Damages (over and above and independent of the Liquidated Damages payable against Clause No. 30, Section – 2, Volume – I) to the extent of ~~5% of the contract price~~ <u>INR 900 Million for each SG and INR 650 Million for each STG</u> shall be payable by the contractor.....	
13	Section 3,Page 331/ Cl.	The Liquidated Damages against this clause shall be recovered within 10 weeks from the delay of respective	The Liquidated Damages against this clause shall be recovered within 10 weeks from the delay of respective milestone either from	



Sr No	Section/ Page No/CI No.	Existing Particulars of Bid Stipulation including amendment/corrigendum thereof	To be read as
	No. 8.5	milestone either from the bills of the contractor by en-cashing the bank guarantee submitted by the contractor against security of the Phased Manufacturing Programme.	the bills of the contractor or by en-cashing the bank guarantee submitted by the contractor against security of the Phased Manufacturing Programme. <u>However, in case the Contractor/Consortium Partner having already undertaken commitments for PMP in line with the advisory from CEA in this regard in the order(s) for respective Supercritical Equipment (SG and/or STG) for 660 MW project in India and submitted bank guarantees for security for default against specified PMP:</u> i) <u>The Contractor shall not be required to furnish the bank guarantees for security for default against specified PMP as indicated in Clause 8.3 above.</u> ii) <u>After completion of time periods indicated under Clause No. 8.3 above from the Date of Award of the first order against which such bank guarantee is submitted, the Contractor/Consortium Partner shall be required to undertake manufacturing activities as indicated in Clause No. 8.3 above in the Indigenous manufacturing facilities set up under the PMP for the supplies to be made against this contract and the same shall be demonstrated to the entire satisfaction of the owner, failing which, Liquidated Damages as stipulated under Clause No. 8.4 at the rates stipulated under Clause No. 8.3 above shall be recovered forthwith from the bills of the Contractor.</u>

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Page 7 of 11
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	
	CORRIGENDUM - XIII	

2. Following Typographical errors/omissions are corrected as shown in column No. (3) below :

Sr No.	Clause No./Sr No. of Bid Specification/Corrigendum/Amendment	Corrected as
(1)	(2)	(3)
1.	Sr. No. 3 of Corrigendum-X (Loading for evaluation on account of Duration offered) : INR 3,600,000/- (INR Three Million Six Hundred Thousand Only)	INR 3,600,000/- (INR Three Million Six Hundred Thousand Only) <u>per day</u>
2.	Sr. No. 2 of Corrigendum-III : "per Kcal/kW"	"per Kcal/kWh"
3.	Sr. No. 34 of Corrigendum-X : "per kWh"	"per kW"
4.	Sr. No. 23 of Corrigendum-X	Sr No. of the Clause shall be read as 12.13 instead of 12.12
5.	Sr. No. 28 of Corrigendum-X	Sr No. of the Clause shall be read as 27.10 instead of 27.9
6.	Table Sr. No. (i) under Cl. 31.6, Sec.-1, Vol-I of Bid Specification	Shall be read as "Price for entire scope of work as per the Bid Specification including Amount of taxes and Duties quoted by the bidder"

All other stipulations of the Vol-I of the Bid Specification shall remain unchanged

3. Following foot note is added for para 2 of Clause 1, Annexure-V (A), Section-I, Volume-I, Page 84 of Bid Specification :

Note :

Not applicable in case of the Subsidiary/Joint Venture company established before Ten years as on the date of opening of bids and the minimum subscribed and paid up share capital of such Subsidiary/Joint Venture company as on the date of opening of bid is minimum INR 500 Million (INR 50 Crores) and net worth as on the last day of previous financial year as on date of Techno-commercial bid opening is minimum INR One Billion (INR 100 Crores).

4. Following clearance is added to the Table-1 (Responsibilities of the Owner and the Contractor to obtain clearances required for the project), Page 333, Section-3, Volume-I

Sr No.	Clearance	Authority	Responsibility
45 (a)	Structural Stability Certificate as per Maharashtra Factories Rules 1983, Rule 3(a) (Form No. 1 A)	Competent Person defined in said Rules	Contractor

5. Clause No. 8.3 (The Phased Manufacturing Program shall be read as under) , Section 3, Volume-I, Page 328 of the Bid specification is modified as under :

Table A: For Steam Generator (SG):

Sr. No.	Equipment	Indicative Facilities Requirement	To be established latest by (Months from date of LOA)	Weightage factor (%age) for LD
1	Pressure Parts (straight water wall & spiral water wall)	• Straight tube butt welding facility • Automatic welding facility for panel processing • NDT facilities • Hydro testing • Continuous heat treatment furnace • Gang/panel bending facility (for straight water wall & spiral water wall tube panels)	36	35
2	Pressure Parts (Economiser, super heater and re-heater coils and panels)	• System bend facility • Welding facility • NDT facilities • Hydro testing • Continuous heat treatment furnace • Jigs & fixtures for assembly and layout checking facility • Portable equipment for material / grade identification	42	30
3	Pressure Parts (headers)	• Welding • Machining & drilling	42	20



Sr. No.	Equipment	Indicative Facilities Requirement	To be established latest by (Months from date of LOA)	Weightage factor (%age) for LD
		- Heat treatment - Hydraulic testing - NDT facilities - Pressing facility for end caps & tees - Material identification facility - Facility for high alloy (P5 and above) continuous welding		
4	Separator (shell and dished ends)	- Rolling facility / pressing Facility - Machining & drilling - Welding - Heat treatment - Hydraulic testing - NDT facilities - Pressing arrangement for dished ends	48	15
TOTAL				100

Table B: for Steam Turbine & Generator:

Sr. No.	Equipment	Indicative Facilities Requirement	To be established latest by (Months from date of LOA)	Weightage factor (%age) for LD
1	Turbine Casings and Valves machining	• LP outer Casing fabrication • HP / IP / LP Casing Machining & blading • Heat Treatment / Stress Relieving • Turbine valve machining & assembly testing	36	20
2	Turbine Rotor machining	• Rotor machining including grooves & Fir Tree machining. • Rotor assembly and balancing • Turbine assembly	42	20
3	Rotating blades machining	• Rotating Blade machining & finishing	52	20
4	Generator Core and stator manufacturing	• Core stamping, fabrication facility, Heat Treatment / Stress Relieving. • Generator Stator Fabrication and Core building facility • Stator bar manufacturing and heavy machining facility for fabricated items.	40	20
5	Generator Rotor	• Rotor machining including slotting • Rotor assembly and balancing	42	15



MAHARASHTRA STATE POWER GENERATION CO. LTD.

BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1

CORRIGENDUM - XIII

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Sr. No.	Equipment	Indicative Facilities Requirement	To be established latest by (Months from date of LOA)	Weightage factor (%age) for LD
		- Exciter manufacturing & testing - Rotor winding facility		
6	Generator Assembly	Generator assembly and testing	48	5
TOTAL				100

CONSULTANT : PROCON ENGINEERS

CORRIGENDUM - XIV

BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1

DEPARTMENT

PROJECTS & PLANNING

GENERATION CO. LTD.

MAHARASHTRA STATE POWER

MAHAGENCO



 MAHAGENCO	MAHARASHTRA STATE POWER GENERATION CO. LTD.	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	CORRIGENDUM - XIV	Page 3 of 7
	CONTENTS			
	SR. NO.	PARTICULARS	PAGE NO.	
1.0	VOLUME VIA	: TECHNICAL SPECIFICATIONS FOR CIVIL, STRUCTURAL & ARCHITECTURAL WORKS	01	

CORRIGENDUM TO BID SPECIFICATION
VOLUME-VIA



MAHARASHTRA STATE POWER GENERATION CO. LTD.

BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1

CORRIGENDUM - XIV

1. Following Clauses of the Bid Specification are amended as under :	
MAHARASHTRA STATE POWER GENERATION CO. LTD. BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1 CORRIGENDUM - XIV Page 7 of 7	
Sr No	1
Section/ Page No/CI No.	Vol.VI-A, Corrigen dum -I, Page 138 of 247, CI. No. 1.1.1
Equipment	Length of Bridge
Existing Particulars of Bid Stipulation including amendment/corrigendum thereof	Railway Bridge Portion : Two span of 20 to 25 M Total length of Bridge in Railway portion is approximately 50 M. Non-Railway Bridge Portion : 10 spans of 25.00M each i.e. @ 250.00 meters. Total length of viaduct in Non- Railway portion is 250.00 M.
To be read as	Railway Bridge Portion: Nos. of span of 20 to 25 M as required. Total length of Bridge in Railway portion is approximately 165M. Non-Railway Bridge Portion : 10 spans of 25.00M each i.e. @ 250.00 meters. Total length of viaduct in Non- Railway portion is 250.00M. Balance Sloping portion of Approach Shall be Reinforced earth wall on either side.



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BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1

CORRIGENDUM - XV

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<u>SR.NO</u>	<u>DESCRIPTION</u>
1.0	VOLUME -II : MASTER SPECIFICATIONS
2.0	VOLUME -III- B : STEAM TURBINE GENERATOR &AUXILIARIES
3.0	VOLUME -III- C : COAL HANDLING SYSTEM
4.0	VOLUME -III- D : ASH HANDLING SYSTEM
5.0	VOLUME -III- E-1 : WATER TREATMENT SYSTEM
6.0	VOLUME -III- F : PIPING SPECIALTIES AND THERMAL INSULATION
7.0	VOLUME III-G : COMPRESSED AIR, AIR-CONDITIONING & VENTILATION SYSTEMS
8.0	VOLUME -III- H : FIRE PROTECTION AND DETECTION SYSTEMS
9.0	VOLUME -III- I : MATERIAL HANDLING AND MISCELLENEOUS EQUIPMENT
10.0	VOLUME -IV-A : ELECTRICAL EQUIPMENT & ACCESSORIES
11.0	VOLUME -IV-B : ELECTRICAL EQUIPMENT & ACCESSORIES.
12.0	VOLUME -V : CONTROL AND INSTRUMENTATION
13.0	VOLUME -VI A : CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS
14.0	VOLUME -VII A : BID PURPOSE DRAWINGS (MECHANICL)

VOLUME II: MASTER SPECIFICATIONS

...

Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment/System	Existing Particulars	To be read as	
1.0	Section-3, Page 43 of 555	Supply of Equipment and Systems -Electrical System	Cranes, elevators, workshop equipment, laboratory equipment within power plant area	Cranes, elevators, laboratory equipment within power plant area	
2.0	Sect-4 / Page 98 of 555/ Clause 2.8 Annexure – B	General Technical Requirement - Criteria For Layout	Temporary storage areas, workshops, offices, residence etc. required at the time of erection work.	Temporary storage areas, offices, residence etc. required at the time of erection work.	
3.0	Section - 9 Pages 244 of 555, Annexure-A Clause23- 1.6	Mandatory Spare Parts – STG & Auxiliaries - Condenser	Condenser tubes - 10%	Deleted.	
4.0	Sect-9/ Page 257 of 555/ Clause 1.8	Coal Handling Systems - Rota Side Wagon Tippler		To be added. For Variable Frequency Drive	
				Thyristor	12 nos.
				Ignition transformers	12 nos.
				Firing cards	4 nos.
				Control transformers	2 nos.
				Auxiliary contactors	4 nos. each.
5.0	Sec- 9 / Page 258 of 555 / Clause 3.7and Corrigendum-I / Sr. no. 17 /	Coal Handling Systems - Apron Feeder	Apron Feeder Hydraulic Drive	Apron Feeder Variable Frequency Drive	
				Thyristor	12 nos.
				Ignition transformers	12 nos.

Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment/System	Existing Particulars	To be read as	
				Firing cards	4 nos.
				Control transformers	2 nos.
				Auxiliary contactors	4 nos. each.
6.0	Sec- 9 / Page 260 of 555 Clause 4.3.1/ and Corrigendum-I / Sr. no. 18	Coal Handling Systems - Stacker-Reclaimer	Bucket Wheel Complete set of Hydraulic drive Unit - One (1) set	Bucket Wheel Complete set of Drive Gear Box Unit - One (1) set	
7.0	Sec- 9 / Page 265 of 555 Clause 6.9 and Corrigendum-I / Sr. no. 29	Coal Handling Systems - Conveyor Belt	Mandatory spares for Hydraulic Drive System for conveyors	Deleted.	
8.0	Sect-9/ Page 286 of 555/ Clause 23.0 Cl.no.23.1 Cl.no 23.2 Cl.no 23.3 Cl.no. 23.4 Cl.no. 23.5 Cl.no. 23.6	Ash Handling System - Instrument Air Compressor	Complete set of Instrument Air Compressor - One (1) Complete Rotor Assembly with shaft - One (1) Set Complete Gear Box- One (1) Set Bearing (DE & NDE) - Two (2) Sets Seal Kit -One (1) Set Coupling (Motor to Gear box & gear box to Compressor) -One (1) Set	Deleted.	

CORRIGENDUM - XV

Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment/System	Existing Particulars	To be read as
	Cl.no 23.7, Corrigendum - I, /Sr. no.41, Page 28 of 247		Drive Motor -One (1) Set	
9.0	Sect -9 / Page 287 of 555/ / Cl. No.24 Cl.no.24.1 Cl.no 24.2 Cl.no 24.3 Cl.no. 23.4 Cl.no. 24.5 Cl.no. 24.6 Corrigendum - I, /Sr. no.42, Page 28 of 247	Ash Handling System - Conveying Air Compressor	Complete set of Conveying Air Compressor- One(1) Complete Rotor Assembly with shaft - One (1) set Complete Gear Box - One (1) set each type Bearing (DE & NDE)- Two(2) set each type Seal Kit - One (1) set each type Drive Motor - One (1) set each type	Deleted.
10.0	Section - 9 Page 320 of 555, 1.15.2	Mandatory Spare Parts - Pipings, Specialties & Thermal Insulation	Each type, size and class above 100 NB - 20% or Two (2) whichever is higher	Each type, size and class above 100 NB - 20% or One (1) whichever is higher.
11.0	Section - 11, Page 488 of 555, Clause 2(34) (f)	List of Approved Vendors	Coal Handling Plant TECHPRO	Coal Handling Plant TECHPRO - Deleted.

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Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment/ System	Existing Particulars	To be read as
12.0	Section - 11 Page 488 of 555 Clause 2(38) (a)	List of Approved Vendors	Ash Handling Plant TECHPRO ASHTECH	Ash Handling Plant Deleted.
13.0	Corrigendum - II / Annexure - II Page 197 of 247 and clarification dtd. 07.07.12 Sr. no. 3.4 & 3.5	Workshop Equipment	Workshop Equipment	Deleted.
14.0	Corrigendum -II, Page 228 of 274, Annexure-II clause 2.4.5 (a) (v)	Workshop equipment	Electrode Drying Oven Inner Size: 80(D)x80(W)x450 (H) m	Electrode Drying Oven Inner Size: 80(D)x80(W)x450 (H) mm - Deleted
15.0	Corrigendum -II, Page 234 of 274, Annexure-II clause 2.4.9 (a) (v)	Workshop equipment	Hydraulic Puller with Hydraulic Unit - Two (2) nos	Hydraulic Puller with Hydraulic Unit - One (1) each - Deleted.
16.0	Section-11, Page 507 of 555	List of Approved Vendors - Electrical	(New)	ONLINE INSULATION MONITORING & FAULT LOCATION SYSTEM - BENDER INDIA LTD.
17.0	Section-11 Page 507 of 555	List of Approved Vendors - Electrical	(New)	FAST DEPRESSURIZATION SYSTEM - SERGI INDIA - TRANSFORMER PROTECTOR Corporation ,USA.

**VOLUME III - B : STEAM TURBINE GENERATOR AND
AUXILIARIES**

Sr. no.	Sec. No/ Page No/ Cl. No.	Equipment/ System	Existing Particulars	To be read as
1.0	Section - 1 Page 30 of 308, Clause 6.2.4	Turbine Design & Construction - Rotor	Critical speed of composite rotor and blade assembly shall not be within $\pm 15\%$ of operating speed	Critical speed of composite rotor and blade assembly shall not lie within a range of $\pm 10\%$ of the operating speed of 3000 rpm.
2.0	Section - 3 Page 121 of 308, Clause 3.1.25 Clarification dtd. 09.10. 13 / Sr. no. 18 and Clarification dtd. 07.07. 12 /Sr. no. 211	General Performance Requirement	The Boiler Feed Pumps shall be capable of coasting down safely to standstill after it is tripped in the event of a sudden interruption of suction flow. The Bidder shall demonstrate this capability by a suitable dry-running test at his works and shall furnish full details of this proposed test including its duration etc. in the bid. The dry running test shall not be less severe than closing of the isolation valve on the feed pump suction and tripping the pump simultaneously. In this condition, the pump shall be capable of coasting down safely to standstill without any damage and shall be capable of being in normal service.	The Boiler Feed Pumps shall be capable of coasting down safely to standstill after it is tripped in the event of a sudden interruption of suction flow. The Bidder shall demonstrate this capability by a suitable dry-running test at his works as per CEA guidelines and shall furnish full details of this proposed test including its duration etc. in the bid. The dry running test shall not be less severe than closing of the isolation valve on the feed pump suction and tripping the pump simultaneously. In this condition, the pump shall be capable of coasting down safely to standstill without any damage and shall be capable of being in normal service. However, if the tests (Pressure Pulsation, Dry

Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment/ System	Existing Particulars	To be read as
				Running, Thermal Shock, and Visual Cavitation) are not performed as per manufacturer's standard practice, Bidder shall submit the test results earlier carried out on identical design except dry run test.
3.0	Section - 3 Page 155 of 308, Data Sheet A Clause 1.7 (a)	Specific Design Criteria for Condensate Extraction Pumps	Total dynamic head (TDH) at design capacity - While establishing the design TDH the following shall be considered : 125% of de-aerating feed water heater operating pressure at TG VWO (1% Make-up and design CWT)	Total dynamic head (TDH) at design capacity - While establishing the design TDH the following shall be considered : As per CEA guidelines, 110% of de-aerating feed water heater operating pressure at TG VWO (1% Make-up and design CWT)

VOLUME III - C : COAL HANDLING SYSTEM

Sr. no.	Sec. No/ Page No/ Cl. No.	Equipment/Sy stem	Existing Particulars	To be read as
1.0	Page no. 11 of 245 Clause no. 2.1.12, Corrigendum -II, Sr. 21 and Clarification dtd.07.07.12 / Sr. no. 4	System Description	For blending operation, imported coal shall be reclaimed by conveyor 8 with the help of necessary hopper & pay loader. Capacity of Ground hopper shall be 150 Tonnes. Rated Capacity of Conv.8 shall be 450 TPH. Design Capacity of Conv.8 shall be 500 TPH.	For blending operation, imported coal shall be reclaimed by conveyor 8 with the help of necessary hopper & pay loader. Design and Rated Capacity of Conv.8 shall be 750 TPH.
2.0	Page 14 of 145/Clause no. 2.3	System Capacity	Two streams of conveyors and equipment (2x100%) with rated capacity of 1500 TPH shall be provided for coal handling system	Two streams of conveyors and equipment (2x100%) with Design capacity of 1500 TPH shall be provided for coal handling system
3.0	Page 14 of 145/ Clause 3.1.1	Wagon Tippler Complex	Rota side Wagon Tippler complete with all accessories including hydraulic drive system complete with hydraulic motor directly coupled to drive pinion (without any gear box), -----in data sheet enclosed.	Rota side Wagon Tippler complete with all accessories including Electro-Mechanical drive system (VFD) as specified in Volume-IV-A, coupled to drive pinion -----in data sheet enclosed.
4.0	Page 15 of 145/Clause no. 3.1.5	Wagon Tippler Complex	One (1) Operator's Cabin cum control room common for both wagon tipplers for controlling the	One (1) Independent Operator's Cabin cum control room for each wagon tippler for controlling the

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Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment/System	Existing Particulars	To be read as
			operation of Wagon Tippers in conjunction with side arm charger and weight recorder with totaliser.	operation of Wagon Tippers in conjunction with side arm charger and weight recorder with totaliser.
5.0	Page 15 of 145/ Clause no. 3.1.7	Wagon Tippler Complex	One (1) set of Apron Feeder --- for evacuating ROM Coal at the rate of 1500 TPH from Wagon Tippler Hopper.	One (1) set of Apron Feeder --- for evacuating ROM Coal at the Design rate of 1500 TPH from Wagon Tippler Hopper.
6.0	Corrigendum - I/ # 5	Wagon Tippler Complex	One portable oil filtration machine in each of the following areas to filter oil of two (2) microns and minimum of Eight (8) lpm capacity shall be provided for conveyors.	Deleted.
7.0	Page 15 of 145/ Clause 3.1.14	Wagon Tippler Complex	One portable oil filtration machine in each of the following areas to filter oil of two (2) microns and minimum of Eight (8) lpm capacity shall be provided. (a) W.T. & Side arm charger (b) Apron feeder below W.T. complex (c) Stacker Reclaimer	One portable oil filtration machine in each of the following areas to filter oil of two (2) microns and minimum of Eight (8) lpm capacity shall be provided. (a) W.T. complex (b) Stacker Reclaimer
8.0	Page 16 of 145/ Clause 3.1.15	Wagon Tippler Complex	Online oil filtration system shall be provided for side arm charger and W.T. with	Online oil filtration system shall be provided for each of the hydraulically operated

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Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment/System	Existing Particulars	To be read as
			dedicated hydraulic power packs.	equipment of CHP.
9.0	Page 18 of 145/ Clause no. 3.5.4	Chutes and Supporting Structures	One (1) portable hydraulic press --- ---- supplied. The machine shall be suitable for vulcanising 2200 mm belt used --- in the plant i.e. Belt Feeder.	One (1) portable hydraulic press --- ---- supplied. The machine shall be suitable for vulcanising 1800 mm belt used --- in the plant i.e. Belt Feeder.
10.0	Page 19 of 145 / Clause 3.9.6 Clarification dtd. 07.07.12 / Sr. no. 26	Miscellaneous	One (1) Grizzly hopper with Vibro feeder for feeding coal to Conveyor 8. Vibro-feeder capacity - 450TPH	One (1) Grizzly hopper with Vibro feeder for feeding coal to Conveyor 8. Vibro-feeder capacity - 750TPH - Design / Rated
11.0	Page 28 of 145 / Clause No. 5.1.10(a) to (d)	Design and Constructional Requirements	Mechanical Equipment / System Conveyor Drive	Deleted.
12.0	Page 29 of 145/ Clause 5.1.11 (b) Clarification dtd. 07.07. 12 /Sr. no. 51 and Clarification dtd. 09.10. 13/Sr. no. 7	Design and Constructional Requirements	Gear box Except belt feeder and reversible belt feeders all conveyor drives shall be hydraulic.	Gear box All conveyor drives shall be electro-mechanical.
13.0	Page 33 of 145/ Clause 5.1.12 Clarification dtd. 07.07. 12 /Sr. no. 51 and Clarification dtd. 09.10. 13/Sr. no. 7	Design and Constructional Requirements	Fluid Coupling Except belt feeder and reversible belt feeders all conveyor drives shall be hydraulic.	Fluid Coupling All conveyor drives shall be electro-mechanical

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Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment/System	Existing Particulars	To be read as
14.0	Page 34 of 145/ Clause 5.1.13 Clarification dtd. 07.07.12 /Sr. no. 51 and Clarification dtd. 09.10.13/ Sr. no. 7	Design and Constructional Requirements	Couplings Except belt feeder and reversible belt feeders all conveyor drives shall be hydraulic.	Couplings All conveyor drives shall be Electro-Mechanical.
15.0	Page 38 of 145/ Clause 5.1.18 (a)	Design and Constructional Requirements	Hoppers, Chutes & Skirt Boards	To be added Before Wobbler Feeder, Banana Chute / Deflector Plate in chute shall be provided to avoid direct impact on wobbler bars.
16.0	Page 40 of 145/ Clause No. 5.2.2	Belt Feeders / Reversible Belt Feeders	Width of belt feeder in crusher house shall be ----- to screen. Belt speed shall be 3.0 m/sec. However, in no case the belt width should be less than 2000 mm.	Width of belt feeder in crusher house shall be -- ----- to screen. Belt speed shall be 3.0 m/sec. However, in no case the belt width should be less than 1600 mm.
17.0	Page 43 of 145/ Clause 5.4.1	Wagon Tippler	The Wagon Tippler shall be hydraulically operated Rota-side type having hydraulic clamping system for all box type open wagons.	The Wagon Tippler shall be Electro-Mechanically (VFD)) operated Rota-side type having hydraulic clamping system for all box type open wagons.
18.0	Page no. 44 of 245 Clause no. 5.4.5	Wagon Tippler	The tippler structure --- ----- ----in the process of tipping. Shock absorbing spring shall	The tippler structure ---- ----- ----in the process of tipping. Shock absorbing spring /

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Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment/System	Existing Particulars	To be read as
			be provided to ensure smooth sitting of the cradle. Top and side supports of wagon.	Roller & cup arrangement shall be provided to ensure smooth sitting of the cradle. Top and side supports of wagon.
19.0	Page 45 of 145/ Clause 5.4.10	Wagon Tippler	Tippler shall be driven by suitable separate hydraulic systems for operation of hydraulic motors and hydraulic clamp cylinders. The individual hydraulic power pack to be located away from tippler shall be provided inside a room at ground floor of MCC/WT Control room. Wagon tippler drive shall be comprising of independent hydraulic motor each mounted directly on the shaft of drive pinion meshing with cast steel rakes bolted to the periphery of one end section of wagon tippler. All hydraulic motors shall be provided with disc brakes to hold the tippler at any position during rotation.	Tippler shall be driven by suitable Electro-Mechanical system (VFD) as specified in Volume-IVA and separate hydraulic systems for operation of hydraulic clamp cylinders shall be provided. The individual hydraulic power pack to be located away from tippler shall be provided inside a room at ground floor of MCC/WT Control room. Appropriate breaking arrangement shall be provided to hold the trippler at any position in case of failure of drive or failure of electric supply.
20.0	Page 46 of 145 / Clause 5.5.6	Apron Feeder	The hydraulic drive system ----- minimize pressure drop in pipelines.	Deleted. Instead of Hydraulic drive, Electro-Mechanical Drive (VFD) as specified in Volume-IV A shall be provided.

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Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment/System	Existing Particulars	To be read as
21.0	Page 47 of 145 / Clause 5.5.7	Apron Feeder	The hydraulic motor output in terms of speed and torque shall be monitored using a suitable electronic controller installed in the power pack, which receives speed signal from the machine PLC. In turn, the controller supplies signals to the machine PLC regarding actual speed, hydraulic pressure etc. -----	The Electro Mechanical Drive (VFD) output in terms of speed and torque shall be monitored, which receives speed signal from the machine PLC. In turn, the controller supplies signals to the machine PLC regarding actual speed etc. -----
22.0	Page 47 of 145 / Clause 5.5.9	Apron Feeder	Hydraulic Motor The hydraulic motor shall be of fixed displacement ----- and start-up condition.	Drive unit Deleted.
23.0	Page 47 of 145 / Clause 5.6.2	Wobbler Feeder	This shall ----- gear boxes. The shaft shall be fitted with spherical roller bearings, which are mounted on heavy structural frame.	This shall ----- gear boxes. The shaft shall be fitted with concealed type spherical roller bearings, which are mounted on heavy structural frame.
24.0	Page 47 of 145 / Clause 5.6.3	Wobbler Feeder	Bearings shall be well protected from inside dust and against heavy vibrations.	Bearings shall be concealed type, well protected from inside dust and against heavy vibrations.
25.0	Page 51 of 145/Clause no. 5.7.16	Side Arm charger	The equipment shall be ----- R.C.C foundation. The SAC shall be operated automatically and	The equipment shall be -----R.C.C foundation. The SAC shall be operated automatically and

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Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment/System	Existing Particulars	To be read as
			controlled from common W.T. control room.	controlled from respective W.T. control room.
26.0	Page 53 of 245 / Clause No. 5.8.17, Data Sheet-A/ Sr.no.3.4	Crusher	The housing is divided ----- stiffened suitably. SS Liners shall be arranged inside the housing.	The housing is divided - ----- stiffened suitably. Mn steel Liners shall be arranged inside the housing.
27.0	Page 56 of 145 / Clause 5.9.8	Stacker - Cum-Reclaimer (Bucket Wheel Type)	The slewing mechanism shall have hydraulic drives.	The slewing mechanism shall have Electro-Mechanical drives, as specified in Volume-IV-A.
28.0	Page 56 of 145 / Clause 5.9.9	Stacker - Cum-Reclaimer (Bucket Wheel Type)	The slewing movement shall be limited by operation & backup limit switch. Slewing shall be around ± 105 deg. Slew Hydraulic Motors: Radial Piston Cam Curve type. Number of pistons shall be even to eliminate unbalanced radial loads on hydraulic motor shaft bearing.	The slewing movement shall be limited by operation & backup limit switch. Slewing shall be around ± 105 deg.
29.0	Page 57 of 145 / Clause 5.9.15	Stacker - Cum-Reclaimer (Bucket Wheel Type)	The bucket wheel drive shall be through high torque low speed hydraulic motor without reduction gear unit.	The bucket wheel drive shall be through Electro-Mechanical Drive system, as specified in Volume-IV-A.
30.0	Page 76 of 245/ Clause	Belt Vulcaniser	Splicing of 2000 mm belt or widest belt used in the plant i.e.	Splicing of 1800 mm belt .

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Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment/System	Existing Particulars	To be read as
	5.22.8(e)		belt feeder.	
31.0	Page 102 of 145/ Clause 5.34 Corrigendum - I/Sr # 28 and Clarification dtd. 07.07.12/Sr. no. 50	Annunciation	Hydraulic motor driven conveyors	Deleted.
32.0	Page 102 of 145/ Clause 8.1.9 Corrigendum - I /Sr. no. 31	Performance Tests and Guarantee	Bidder shall guarantee the performance requirement of all coal handling paths for the specified capacity of 1500 TPH for each stream considering loaded start of conveyors and equipment, as applicable.	Bidder shall guarantee the performance requirement of all coal handling paths for the designed capacity of 1500 TPH for each stream considering loaded start of conveyors and equipment, as applicable.
33.0	Page 129 of 245 / Data Sheet-A Sr. no. 5	Idler	Rate of flow - 1500 TPH (Rated)	Rate of flow - 1500 TPH (Design)
34.0	Page 133 of 245 / Data Sheet-A Sr. no. 1.5	Hopper Chutes & Skirt Board	Belt width - 1800mm / 2000mm	Belt width - 1400mm / 1600mm
35.0	Page 133 of 245 / Data Sheet-A Sr. no. 1.7	Hopper Chutes & Skirt Board	Rate of flow - 1500 TPH (Rated)	Rate of flow - 1500 TPH (Design)
36.0	Page 145 of 245 / Data Sheet-A	Belt Feeder / Reversible Belt Feeder	Capacity - Rate of flow - 1500 TPH (Rated)	Capacity - Rate of flow -

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Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment/System	Existing Particulars	To be read as
	Sr. no. 1.5			1500 TPH (Design)
37.0	Page 149 of 245 / Data Sheet-A Sr. no. 1.6	Fixed tripper	Rate of flow - 1500 TPH (Rated)	Rate of flow - 1500 TPH (Design)
38.0	Page 157 of 245 / Data Sheet-A Sr. no. 1.6	Fixed tripper	Capacity - 1500 TPH (Rated)	Capacity - 1500 TPH (Design)
39.0	Page 180 of 245 /Data Sheet-A Sr. no. 4.4 (a)	Stacker-Cum-Reclaimer (Bucket Wheel Type)	Type of drive Hydraulic motor directly mounted on the drive shaft without any gear box unit.	Type of drive Electro-Mechanical Drive
40.0	Page 180 of 245 /Data Sheet-A Sr. no. 4.9	Stacker-Cum-Reclaimer (Bucket Wheel Type)	Slewing Mechanism of Boom Shall consist of horizontal ring bearing with geared rim. Drive shall consist of hydraulic motor and power pack unit without any gear box.	Slewing Mechanism of Boom Shall consist of horizontal ring bearing with geared rim. Drive shall be of Electro-Mechanical (VFD) as specified in Volume-IV- A
41.0	Page 191 of 245 /Data Sheet-A Sr. no. 3	Wagon Tippler	Type of drive : Hydraulic drive	Type of drive : Electro-Mechanical (VFD)
42.0	Page 194 of 245 /Data Sheet-A Sr. no. 11	Apron Feeder and Dribble Conveyor	Drive Details: Hydraulic motor directly mounted on the drive shaft without any gear box unit.	Drive Details: Electro-Mechanical (VFD) as specified in Volume-IV- A
43.0	Addendum - VI	SHFTABLE HEAD	SERVICE REQUIREMENT	SERVICE REQUIREMENT

CONSULTANT : PROCON ENGINEERS

Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment/Sy stem	Existing Particulars	To be read as
	Data sheet - A		Type Electrically/Hydraulic ally operated	Type Electrically operated

VOLUME III-D: ASH HANDLING SYSTEM

Sr. no.	Sec. No/ Page No/ Cl. No.	Equipment /System	Existing Particulars	To be read as
1.0	Page 20 of 175, Clause 3.9.1 Clarification dtd. 07.07.12 / Sr. no.20	System Description	Water Supply System	To be added : The system shall be designed without ETP RO requirements. Based on the type of system operational requirements, Zero Liquid Discharge shall be achieved.
2.0	Page 32 of 175 / Clause 4.15 Clarification dtd. 07.07.2012 / Sr. no. 50 & 51	Make -Up Water - DMCW System	One plate type heat exchanger with all accessories. PHE shall be designed considering heat load of ash conveying compressors, IA compressors, fluid coupling of Ash Slurry Pumps and HCSD Pump under working condition. Bidder shall explore the possibility of using DMCW system for Boiler Island. For detailed specification of PHE, please refer Volume-III-E.	Two (1W+1S) plate type heat exchanger with all accessories. PHE shall be designed considering heat load of Ash Conveying compressors, AHP IA compressors, fluid coupling of Ash Slurry Pumps and HCSD Pump under working condition. For detailed specification of PHE, please refer Volume-III-E.
3.0	Page 32 -33 of 175/ Clause 4.16	Make -Up Water - DMCW System	One DM water storage tank with all accessories. Capacity of DM Water tank shall be such that it can accommodate one hour cooling water requirements considering requirement of ash	One DM water storage tank with all accessories. Capacity of DM Water tank shall be such that it can accommodate one hour cooling water requirements considering requirements of Main Plant Service Compressors, Main Plant

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Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment /System	Existing Particulars	To be read as
			conveying compressors, IA compressors, fluid coupling of Ash Slurry Pumps and HCSD Pump. For detailed specification of DMCW tank, please refer Volume-III-I.	Instrument Air (IA) Compressors, Coal Mill Reject Handling System Compressors, Ash Conveying compressors, AHP IA compressors, fluid coupling of Ash Slurry Pumps and HCSD Pump under working condition. For detailed specification of DMCW tank, please refer Volume-III-I.
4.0	Addendum - VI, Page 10 of 175	Hydro - Ejector System	Hydro-Ejector Fly Ash Evacuation System for first two fields of ESP hoppers	Hydro-Ejector Fly Ash Evacuation System for first two fields of ESP hoppers Alternatively, bidder can provide Fly Ash Evacuation System that would directly go to common Ash Slurry Sump through jet pumps below ESP hoppers.
5.0	Page 12 of 175 Clause 3.1.2	Bottom Ash Removal System	Bottom ash generated in -----Bottom ash generation shall be calculated at 100%PLF considering generation of bottom ash as 25% of total ash with worst coal.	Bottom ash generated in --- --Bottom ash generation shall be calculated at 100% PLF considering generation of bottom ash as 20% of total ash with worst coal.
6.0	Page 39 of 105 Clause 5.0(g) (i)	Ash Handling Plant -	Bottom Ash generation per shift (8 hours) considering worst coal at 100% PLF with 25% of total ash generation.	Bottom Ash generation per shift (8 hours) considering worst coal at 100% PLF with 20 % of total ash generation.

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Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment /System	Existing Particulars					To be read as				
	Page 40 of 175 Cl. No. 5.1.1 (c)		Input Data	Basis of Design	Quantity (TPH)			Input Data	Basis of Design	Quantity (TPH)		
		Ash collection data	Bottom Ash Collection (% of total ash)	25%	45.96			Bottom Ash Collection (% of total ash)	20%	36.78		
	Page 40 of 175	Design Capacity For Ash Handling System Description	Unit	Bottom Ash	Eco. Zone	AH Zone	ESP Zone	Unit	Bottom Ash	Eco. Zone	AH Zone	ESP Zone
	Clause 5.2 (a)	Percentage of collection rate	%	25	5	5	90	TPH	20	5	5	90
	Clause 5.2 (b)	Ash collection rate	TPH	45.96	9.2	9.2	165.47	TPH	36.78	9.2	9.2	165.47

VOLUME III-E1: WATER TREATMENT SYSTEMS

Sr. no.	Sec. No/ Page No/ Cl. No.	Equipment /System	Existing Particulars	To be read as
1.0	Section -2 / page 41 & 42 of 313, Annexure-I	Analysis of Raw Water	-	To be added. Note: DM plant shall be designed considering total silica [i.e. Colloidal + reactive] and shall be less than 50% of BTG requirement. For example if BTG requirement is 0.02 ppm, it shall be less than 0.01 of BTG requirement. The same shall be included in Auxiliary Power Consumption.

VOLUME III-F: PIPING, SPECIALTIES & THERMAL INSULATION

Sr. no.	Sec. No/ Page No/ Cl. No.	Equipment /System	Existing Particulars	To be read as
1.0	Section -2/ 85 of 158 / Annexure- I/ C - 1 & 2	Specification n of Pipes For Different Services	Service: De-mineralised Water, Service and Instrument air piping less than and equal to 40 NB Materials of Pipes: Stainless Steel as per ASTM A-312 Gr 304. Thickness schedule 40S as per ANSI-B 36.19	Services : De-mineralised Water System less than and equal to 40 NB. Materials of Pipes: Stainless Steel as per ASTMA 312 Gr 304. Thickness schedule 40S as per ANSI-B 36.19 Services : Instrument & Service Air System : As per IS-1239 (GI) Heavy Grade up to 150 NB. The pipes shall be galvanized as per IS: 4736.
2.0	Section -2/ 85 of 158 / Annexure- I/ D - 1 & 2	Specification n of Pipes For Different Services	Service: De-mineralised Water, Service and Instrument air piping for sizes equal to or greater than 50 NB. Materials of Pipes: Stainless steel as per ASTM A-312 Gr 304. Size up to 250 NB as per schedule 10S, ANSI B 36.19	Service: DM Water System: Materials of Pipes: Stainless steel as per ASTM A-312 Gr 304. Size up to 250 NB as per schedule 10S, ANSI B 36.19 Instrument & Service Air System : IS-3589 for sizes above 150 NB. The pipes shall be

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Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment /System	Existing Particulars	To be read as
				galvanized as per IS: 4736.
3.0	Section -2/ 102 of 158 /Clause 5.1.2	Design and Construction Large Diameter Piping	Pipe thickness shall be calculated based on AWWA standard (AWWA -M 11, chapter - 4) for internal pressure, external pressure, deflection and buckling criteria considering water filled pipe as well as vacuum condition that may prevail, transient / surge conditions, truck load, rail load and weight density for compacted soil etc. as applicable in line with relevant code. Contractor shall furnish pipe thickness calculations justifying the thickness selected.	Pipe thickness shall be calculated based on AWWA standard (AWWA -M 11, chapter - 4) for internal pressure, external pressure, deflection and buckling criteria considering water filled pipe as well as vacuum condition that may prevail, transient / surge conditions, truck load, rail load and weight density for compacted soil etc. as applicable in line with relevant code. Besides above, additional Design criteria for Large Diameter piping as per Annexure - III, shall also be considered while designing underground LD pipelines. Contractor shall furnish pipe thickness calculations justifying the thickness selected.

VOLUME III-G: COMPRESSED AIR, AIR-CONDITIONING & VENTILATION SYSTEMS

Sr. no.	Sec. No/ Page No/ Cl. No.	Equipment /System	Existing Particulars	To be read as
1.0	Section -3, Page 120 of 171 , Clause 3.16.16	Technical requiremen ts - Extent of Package	Ventilation provision for Auxiliary Buildings in various locations shall be done as follows: Toilet area of Fire Station Building : Wall mounted exhaust fans	Ventilation provision for Auxiliary Buildings in various locations shall be done as follows: Deleted.
2.0	Section -3, Page 121 of 171 , Clause 3.21	Technical requiremen ts - Extent of Package	Ventilation provision for Auxiliary Buildings in various locations shall be done as follows: Work shop Building	Ventilation provision for Auxiliary Buildings in various locations shall be done as follows: Deleted.
3.0	Section -3, Page 121 of 171 , Clause 3.30	Technical requiremen ts - Extent of Package	Ventilation provision for Auxiliary Buildings in various locations shall be done as follows Fire Station Building	Ventilation provision for Auxiliary Buildings in various locations shall be done as follows Deleted.
4.0	Section -3, Page 124 of 171 , Clause 5.1.2 (n)	Technical requiremen ts - Areas To Be Covered Under Ventilation System:	Other areas such as, Fire station, Workshop, Store etc, which are not covered by Air-Conditioning system.	Other areas such as, Store etc, which are not covered by Air-Conditioning system.

VOLUME III-H: FIRE PROTECTION & DETECTION SYSTEM

Sr. no.	Sec. No/ Page No/ Cl. No.	Equipment /System	Existing Particulars	To be read as
1.0	Page 11 of 123 Clause 3.1(o)	System Description	Hydrant Systems Cylinder shed & fire station area.	Hydrant Systems Cylinder shed
2.0	Page 13 of 123 Clause 3.2.2	System Description - Category - B	High Velocity Water Spray System (Hvw System) The operation of Deluge Valves shall be annunciated in the Local Zone Fire Alarm Panel as well as in the Central Fire Detection and alarm Panel with repeat alarm at Fire Station Buildings.	High Velocity Water Spray System (Hvw System) The operation of Deluge Valves shall be annunciated in the Local Zone Fire Alarm Panel as well as in the Central Fire Detection and alarm Panel with repeat alarm at Existing Fire Station Building of 2x500MW units.
3.0	Page 13 of 123 Clause 3.3	System Description	Medium Velocity Water Spray System (MVWS System) This system essentially consists of a network -- ---- with repeat alarm at Fire Station Buildings.	Medium Velocity Water Spray System (MVWS System) This system essentially consists of a network ----- with repeat alarm at Existing Fire Station Building of 2x500MW units.
4.0	Page 18 of 123 Clause 3.11(h)	System Description	All pump houses namely CW/ACW Pump House, Raw water / Fire water pump house, ---- F.O. Pump House and HCSD pump house etc.	All pump houses namely, CW/ACW Pump House, Raw water/Fire water pump house, ----- F.O. Pump House and HCSD pump house , condensate & Boiler Fill pump house etc

CORRIGENDUM - XV

Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment /System	Existing Particulars	To be read as
5.0	Page 24 of 123 Clause 4.4.1	Functional requirement of various panels in Fire Protection System	PLC based Local Fire Water Control Panel ----- as well as in Fire Station Building -----	PLC based Local Fire Water Control Panel -- ----- as well as in Existing Fire Station Building of 2x500MW units -----
6.0	Page 25 of 123 Clause 4.4.5	Operational Philosophy -	One Repeater Fire Alarm Panel and one Operating cum engineering station with 24" TFT colour Monitor with Printer located in Fire Station, which shall receive:	One Repeater Fire Alarm Panel and one Operating cum engineering station with 24" TFT colour Monitor with Printer located in Existing Fire Station Building of 2x500MW units which shall receive:
7.0	Page 34 of 123 Clause 5.4.4	Scope of Work Electrical	Repeater Fire Alarm to be located in the Fire Station.	Repeater Fire Alarm to be located in the Existing Fire Station Building of 2x500MW units.
8.0	Page 34 of 123 Clause 5.4.6	Scope of Work Electrical	Main Fire Detection and Alarm Panels in CCR, local Fire Alarm Panels and Repeater Fire Alarm Panel in Fire Station shall be integrated-----	Main Fire Detection and Alarm Panels in CCR, local Fire Alarm Panels and Repeater Fire Alarm Panel in Existing Fire Station Building of 2x500MW units shall be integrated ----- -----
9.0	Page 34 of 123 Clause 5.4.8	Scope of Work Electrical	Two (2) sets (1 working & 1 standby, 100% capacity) ----- Repeater Fire Alarm Panel in Fire Station.	Two (2) sets (1 working & 1 standby, 100% capacity) --- ----- Repeater Fire Alarm Panel in Existing Fire Station Building of 2x500MW units.
10.0	Page 41 of 123 Clause 6.2.2	Scope of Work Design	The fire detection and alarm system shall essentially ----- -with LCD Key Board	The fire detection and alarm system shall essentially ----- with LCD Key Board

CORRIGENDUM - XV

Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment /System	Existing Particulars	To be read as
		Basis and Input - Electrical	Station located in Fire Station,-----	Station located in Existing Fire Station Building of 2x500MW units.
11.0	Page 41 of 123 Clause 6.2.4	Scope of Work Design Basis and Input - Electrical	The Fire Detection and Alarm Panels shall also be connected to a Master Fire Alarm Panel, to be installed in Fire Station for repetition ----- -	The Fire Detection and Alarm Panels shall also be connected to a Master Fire Alarm Panel, to be installed in Existing Fire Station Building of 2x500MW units for repetition -----
12.0	Page 42 of 123 Clause 6.2.6(b)	Scope of Work Design Basis and Input - Electrical	Notify automatically central fire station.	Notify automatically central fire station (Existing) Building of 2x500MW units.
13.0	Page 61 of 123 Clause 7.9.1 (d)	Design and Construction	Battery and Battery Charger All controls, interlocks, indications, ----- and the Master Panel (located in Fire Station), shall -----	Battery and Battery Charger All controls, interlocks, indications, ----- and the Master Panel (located in Existing Fire Station Building of 2x500MW units , shall -----
14.0	Page 63 of 123 Clause 7.10.1.3	Fire Panels	Repeater Fire Alarm Panel in Fire Station	Repeater Fire Alarm Panel in Existing Fire Station Building of 2x500MW units.
15.0	Page 68 of 123 Clause 7.10.2.3	Fire Panels	Repeater Fire Alarm Panel in Fire Station	Repeater Fire Alarm Panel in Existing Fire Station Building of 2x500MW units.

CORRIGENDUM - XV

Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment /System	Existing Particulars	To be read as
16.0	Page 76 of 123 Clause 7.14.2	Fire Panels - Microprocessor Based Fire Alarm System	Detector System Selection of type and number of detectors shall be ----- along with repeat display at fire alarm panel in Fire Station.	Detector System Selection of type and number of detectors shall be ----- along with repeat display at fire alarm panel in Existing Fire Station Building of 2x500MW units.
17.0	Clarification dtd.07.07.12 / Sr. no. 26 Corrigendum -I / Sr. No. 3 and Section-3, Page 43, of 555 Clause 1.11.6 Clarification dtd. 07.07. 12 /Sr. No. 26 & 27	Fire Detection and Fire Protection Systems	5.1.32 Transformers of 220 KVA and above shall be Provided with Nitrogen Injection based Fire Protection System in addition to HVW Spray system. Nitrogen Injection based Fire Protection system shall be provided to Generator transformer, Station transformer and Unit Aux. Transformer, in addition to HVW Spray system.	5.1.32 Transformer Protector Based on Dynamic Pressure rise (Explosion Preventor) Protection system shall be provided to Generator transformer and Station transformer in addition to HVW Spray system. The specification is attached as Annexure -I. Nitrogen blanketing System shall be provided for Unit Transformers in addition to HVW Spray system.

VOLUME III-I: MATERAIL HANDLING EQUIPMENT AND ACCESSORIES

Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment / System	Existing Particulars	To be read as
1.0	Section-I/ C / Page 106 of 328 Annexure-I	Material Handling Equipment And Accessories	List of Location for Monorail Hoists Condensate Transfer Pump House	List of Location for Monorail Hoists Condensate Transfer Pump House/Condensate pump & Boiler Fill pump room

VOLUME IV-A: ELECTRICAL EQUIPMENT & ACCESSORIES

Sr. no.	Sec. No/ Page No./ Cl. No.	Equipment /System	Existing Particulars	To be read as
1.0	Section-1 / Page 16 of 440 / Clause 1.7(m)	Scope Of Supply & Work	Cranes, elevators, workshop equipment, laboratory equipment within power plant area	Cranes, elevators, laboratory equipment within power plant area
2.0	Section-1 / Page 27 of 440 / Clause 5.5.9	System Description	L.V. SYSTEM A separate room shall be provided power plant EPC Vendor to house fire alarm and annunciation panels and equipment.	L.V. SYSTEM Power plant EPC Vendor shall house fire alarm and annunciation panels and equipment in Existing Fire Station Building of 2x500MW units.

VOLUME IV-B: ELECTRICAL EQUIPMENT & ACCESSORIES

Sr. no.	Sec. No/ Page No/ Cl. No.	Equipment /System	Existing Particulars	To be read as
1.0	Section-7 Page 242 of 457 Annexure-A (m)	Electrical Equipment & Accessories	Broad List of Areas to be Illumined DG & Compressor BLDG.	Broad List of Areas to be Illumined (i) DG Room (ii) Compressor Building
2.0	Section-7 Page 242 of 457 Annexure-A (v)	Electrical Equipment & Accessories	Broad List of Areas to be Illumined Work shop	Broad List of Areas to be Illumined Deleted.
3.0	Section-7 Page 243 of 457 Annexure-A (kk)	Electrical Equipment & Accessories	Broad List of Areas to be Illumined Fire station	Broad List of Areas to be Illumined Deleted.
4.0	Section-7 Page 243 of 457 Annexure-A	Electrical Equipment & Accessories		To be added Broad List of Areas to be Illumined - Condensate & Boiler Fill Pump house -
5.0	Section-8 / Page 338 of 440 Clause 1.32 Annexure-A	Indicative List of 415V PCCS/PM CCS/MCC s / DBS/ SVBS /FBS/DC Starters	415V Work shop MCC 1 no.	Deleted.
6.0	Section- 8 / Page 338 of 457 Annexure-A	Electrical Equipment & Accessories	Indicative List of 415V PCCs/PMCCs/ MCCs/ DBs/ SVBs/FBs/DC Starters	Indicative List of 415V PCCs/PMCCs/ MCCs/ DBs/ SVBs/FBs/DC Starters Condensate and Boiler Fill Pump house - One (1)

CORRIGENDUM - XV

7.0	Section-10 / Page 300 of 457 / Clause 2.3	Installation of Cabling, Grounding and Lightning Protection System	Material for electronics earthing system (electronics earth electrode, earthing bus and single core copper cable from earth pit to electronic earthing bus) shall be of hard drawn copper wire as per equipment vendor supplier's requirement. Connection from electronic earth bus to individual equipment shall be with minimum 6 sq. mm. copper cable or equipment supplier recommendation whichever is higher.	For electronic earthing , Earth pit shall be prepared with 100 NB C.I pipe electrode and filled with Bentonite (i.e. volcanic ash) material with watering arrangement. 1) Four no of treated earth pit shall be connected in parallel for BTG area earthing. For BTG area earthing electronic earth pits to grounding bus / grounding cubical and or distribution board shall be connected with single core copper cable of following size a) 70 mm ² for length < 120 mtrs b) 95 mm ² for length < 180 mtrs c) 120 mm ² for length < 250 mtrs 2) For BOP area electronic (PLC) earthing two no of earth pits with 100 NB C.I pipe electrode shall be used. Earth pit shall be filled with Bentonite material and watering arrangement shall be provided. Two no of earth pits shall be connected in parallel. From earth pit to common grounding bus cu cable of 16 sq mm shall be used.

VOLUME - V: CONTROL AND INSTRUMENTATION

Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment /System	Existing Particulars	To be read as
1.0	Section – 4 / Page 214 of 718 Clause 14	Fire Detection & Alarm System (for entire plant)	Control through HMI (Control, Monitoring & Programming) One (1) no. OS+ One (1) no. ES in CCR and One (1) no. OS cum ES in Fire station	Control through HMI (Control, Monitoring & Programming) One (1) no. OS+ One (1) no. ES in CCR and One (1) no. OS cum ES in Existing Fire station of 2x500MW units.
2.0	Section – 4 / Page 214 of 718 Clause 14	Fire Detection & Alarm System (for entire plant)	Remarks One(1) no main panel in CCR. One (1) no. Repeater panel in fire station. Fire alarm & detection panel shall also be provided at CHP, AHP, WTP, ESP, Fuel oil area.	Remarks One(1) no main panel in CCR. One (1) no. Repeater panel in Existing fire station of 2x500MW units. Fire alarm & detection panel shall also be provided at CHP, AHP, WTP, ESP, Fuel oil area
3.0	Section-5 Page 440 of 718 Corrigendum -I , Clause 13.0	Special Requirements of Instrumentation based on Energy Audit Programme – Coal	Coal Station Coal Measurement (Coal Receipt Measurement)	Coal Station Coal Measurement (Coal Receipt Measurement) Please refer Annexure-II
4.0	Section-7A Page 499 of 718 Annexure-A Clause 13.0	Types of Telephone System Equipment - Desk Top Push Button Operated TYPE - X -	Areas of Use Various areas in including : Control Room In-charge's ---- and Laboratory for DM Plant, Fire Station, --	Areas of Use Various areas in including : Control Room In-charge's - --- and Laboratory for DM Plant, , -----

CORRIGENDUM - XV

Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment /System	Existing Particulars	To be read as
5.0	Section-7A Page 502 of 718 Annexure-B Clause 13.0	Instrument ation & Control	List of Distribution of Telephone Extension Sets Fire Station Building	List of Distribution of Telephone Extension Sets Existsing Fire Station Building of 2x500MW units.
6.0	Section-7A Page 502 of 718 Annexure-B Clause 14.0	Instrument ation & Control	List of Distribution of Telephone Extension Sets Workshop	Deleted.
7.0	Section-7A Page 502 of 718 Annexure-B		List of Distribution of Telephone Extension Sets New Clause	To be added - DG set Room
8.0	Section-7A Page 502 of 718 Annexure-B		List of Distribution of Telephone Extension Sets New Clause	To be added - Condensate & Boiler Fill Pump house

**VOLUME -VI A: CIVIL, STRUCTURAL AND ARCHITECTURAL
WORKS**

CORRIGENDUM - XV

Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment /System	Existing Particulars	To be read as
1.0	Section-1, Page 47 of 639, Clause 3.4(b)	Auxiliary Plant / Non Plant Buildings	Fire Station, Work Shop , Construction / Fabrication Yard (temporary / permanent structure if any)	Construction / Fabrication Yard (temporary / permanent structure if any)
2.0	Section-1, Page 108 of 639, Clause 4.7.20.2	Plant structures / component : Tower Design Consideration	Size and Shape Hb is the vertical distance from the throat to basin sill level and 'D' is the base diameter at basin sill level. However, ----- the Owner reserves the right to accept / reject the shell profile.	Size and Shape Hb is the vertical distance from the throat to basin sill level and 'D' is the base diameter at basin sill level. Please refer - IV attached with Corrigendum -XV. However, ----- the Owner reserves the right to accept / reject the shell profile.
3.0	Section-2, Page 207 of 639, Clause 10.0	Specific Design Requirements - Civil	New Clause	To be added: Besides above, additional Design criteria for Large Diameter piping as per Annexure - III, shall also be considered while designing underground LD pipelines.
4.0	Section-2, Page 316 of 639, Clause 5.6 (a) to (e) of Exhibit - IV	Specific Design Requirements - Civil-Finish items - Painting	(a) Ensure that the surface are blast cleaned to near white metal surface (SA 2.5) (b) Painting with inorganic zinc silicate primer (DFT-75 microns) (c) Ist coat of epoxy based finish	The painting specifications under Clause 5.6 of Exhibit IV of Section -2 of Volume – VIA stands replaced by the specifications given in Annexure -V attached with Corrigendum -XV.

CORRIGENDUM - XV

Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment /System	Existing Particulars	To be read as
			polyamide cured painting, DFT - 75 micron (d) 2nd Coat of epoxy based finish polyamide cured painting, DFT-75 micron. (e) Polyurethane finish paint DFT - 25 micron	
5.0	Section-3, Page 368 of 639, Clause 1.7	Specific Design Requirement - Structural	Shop primer paint will be single coat of red oxide zinc- chromate primer conforms to IS-2074 ---- paint shall not be less than 110 microns.	Please refer Specification under Annexure - V attached with Corrigendum-XV.
6.0	Section-4, Page 411 of 639, Clause 2.28(aa)	Design Requirements - Miscellaneous Work	Steel work, which is encased in concrete or galvanized, ----- surfaces shall be Aliphatic Polyurethane composed of 56% solids by volume and of 40 - 50 DFT.	Please refer Specification under Annexure- V attached with Corrigendum-XV.
7.0	Section-4, Page 444 of 639, Clause 5.1.13(f)	Design Data for Architectural Works - Painting	All structural steel ----- to IS-2074 and shall have minimum 110 micron DFT.	Deleted.
8.0	Section-4, Page 460 of 639, Clause 6.0(kk)	Interior Finish Schedule for Buildings	Fire station Building - Fire Tender Parking area (provision of 3 nos. of fire tenders).	Deleted.
9.0	Section-4,	Interior	Fire Station Building -	Deleted.

CORRIGENDUM - XV

Sr. no.	Sec. No./ Page No./ Cl. No.	Equipment /System	Existing Particulars	To be read as
	Page 460 of 639, Clause 6.0(II)	Finish Schedule for Buildings	Offices, Lobby, Control room, Rest room,	
10.0	Section-4, Page 460 of 639, Clause 6.0(mm)	Interior Finish Schedule for Buildings	Fire Station Building - Toilets	Deleted.
11.0	Section-4, Page 464 of 639, Clause 6.1(o)	Doors / Windows Schedules	Fire Station building	Deleted.
12.0	Section-4, Page 464 of 639, Clause 7.0(a)	Minimum Sizes of Non-Plant Buildings	Fire Station building	Deleted.
13.0	Section-4, Page 465 of 639, Clause 7.0(b)	Minimum Sizes of Non-Plant Buildings	Canteen Building - Approximate Plan Area - 25m X 15m	Canteen Building - Approximate Plan Area - 20m X 15m
14.0	Section-4, Page 465 of 639, Clause 7.0(e)	Minimum Sizes of Non-Plant Buildings	Work shop	Deleted.
15.0	Section-6, page 197 of 247, Clause 5.1.17.12 (a) Corrigendum -I,	ROB Work at Railway Crossing - Laying of Open Ducts	Open ducts with suitable removable covers shall be preferred in sub stations, switch rooms, plant rooms, workshop etc.	Open ducts with suitable removable covers shall be preferred in sub stations, switch rooms, plant rooms, etc.
16.0	Corrigendum -II, / Sr. no. 107	Workshop	Capacity of EOT Crane shall be 10 T.	Deleted.

VOLUME -VII A : BID PURPOSE DRAWINGS

Sr. No.	Page No./Sr. No.	Dwg. No.	Revision	TITLE
1.0	VII A1	PE-189-GA-101	P9	PLOT PLAN
2.0	VII A2	PE-189-PF-209	P4	PROCESS FLOW DIAGRAM : COOLING WATER & AUXILIARY COOLING WATER SYSTEM
3.0	VII A2	PE-189-PF-210	P1	PROCESS FLOW DIAGRAM : CLOSED CYCLE COOLING WATER SYSTEM
4.0	VII A2	PE-189-PI-237	P5	P & I DIAGRAM : BOTTAM ASH HANDLING SYSTEM
5.0	VII A2	PE-189-PI-241	P2	P & I DIAGRAM : HIGH CONCENTRATION SLURRY DISPOSAL SYSTEM

o.	Sec. No/ Page No/ Cl. No.	Equipment /System	Existing Particulars	To be read as
1.0	Plot Plan 1.12	Power Block Area	Air Compressor Building / DG Building / Cond. Pump and Boiler Fill Pumps Area - 24mx52m	Air Compressor Building / Mill Reject Compressors and Control room. - 14m x 48m
				DG Room (To be added) - 20m x 26m
				Cond. Pump and Boiler Fill Pumps Area(To be added) - 7.5m x 15m
2.0	Plot Plan 9.1	Non- Plant Building	Service Building - 15m x 48m	Service Building - 12m x 42m
3.0	Plot Plan 9.3	Non- Plant Building	Lube Oil Storage Shed with Storage yard - 30m x 15m	Lube Oil Storage Shed with Storage yard - 15m x 15m
4.0	Plot Plan 9.8	Non- Plant Building	Canteen - 15m x 25	Canteen - 15m x 20
5.0	PE-189-PF- 202, E4	Process Flow Diagram: Power Cycle System Condensate	Main condensate control station is 2 x 100% pneumatic control valve and 1 x 100% motorized ball valve.	Condensate level control valves shall be 1 x 30% pneumatic control valve + 1 x 100% pneumatic control valve + 1 x 100% motorized ball valve.

ANNEXURE - I

Transformer Protector Based on Dynamic Pressure rise (Explosion Preventor) Protection System

Supply, Installation, Testing and commissioning of Explosion and Fire Prevention System for Transformer including Main Tank, On Load Tap Changer, Oil Cable Boxes and Oil Bushing Cable Boxes.

The transformer shall be equipped with, Explosion and Fire Prevention System for Transformer including Main tank, On Load Tap Changer, Oil Cable Boxes and Oil Bushing Cable Boxes. The system shall be complete in all aspects to perform the required functions and shall include not only of the transformer main tank explosion prevention and fire protection but also of the On-load tap changers, Oil bushing Cable boxes and Oil cable boxes, as applicable for transformers, using the principle of a Fast Depressurization System as mentioned in the NFPA Codes 850 & 851, Edition 2010. The system shall include a Nitrogen injection to evacuate the explosive gases in a remote area, after an incident occurs. The depressurization process shall operate mechanically, without need of any actuator.

For Power transformers having the Oil filtration or filter units for the OLTC or cable Box, the same should be completely isolated from the OLTC/OCB during insert gas injection. The system shall ensure a complete protection for the transformer main tank, On load tap changer, Oil bushing cable boxes, Oil cable Boxes, as applicable for transformers, from any explosion in case of occurrence of internal short-circuits.

The principle of operation shall be such that in the event of high intensity fault resulting to excessive energy or dielectric oil over pressure, the system shall initiate the depressurization process within milliseconds after the fault occurrence. The depressurization shall be performed thanks to the first dynamic pressure peak of the shock wave, activating the depressurization set. After depressurization, nitrogen flow shall forbid the self -inflammable gases contact with the air (oxygen). However, nitrogen injection process shall operate only with the presence of the following signals.

- The activation of any of the integrated rupture disk explosion detector confirming the over pressure state and the beginning of the depressurization process and;

- The activation of any of the electrical protection signal, confirming the electrical fault of the protected transformer.

The system operation shall be properly coordinated with the required input to avoid mal-operation and malfunction of the total system. Activation of only one signal among the conditions stated in above paragraph shall prevent the operation of nitrogen injection process and shall only generate remote annunciation/signal at the control room. Only at the presence of both signals shall the electrical actuator triggers the nitrogen injection process.

The nitrogen injection function shall:

- Start after a period of time but before the maintenance team open the transformer;
- Immediately stop the explosive and flammable gas production (hydrogen, methane, acetylene etc.);
- Evacuate the explosive hydrogen stocked in the tank upper parts;
- Replace the generated explosive and inflammable gases by a nitrogen atmosphere inside the vessel;
- Avoid air oil contact by slightly pressurizing the transformer with the nitrogen gas;
- Limit the damage caused by temperature gradient in the metal parts;
- Completely cool down the transformer by injecting nitrogen at the required time (normally 45 minutes) to bring the short circuit parts temperature down below the oil flash point.

The design of the nitrogen injection process shall also include manual activation of the nitrogen in the event that the DC power supply source for the transformer protector system fails.

All alarm signals associated with the transformer protector system i.e. AC, DC power supply failure, nitrogen cylinder low pressure alarm, system actuation audible alarm, etc. shall be sent to the control room at the control board annunciator system.

The depressurization system of the offered system shall be activated by the first dynamic pressure peak of the shock wave, avoiding transformer

explosion before static pressure increases and should not be dependent on the activating signals from the Transformer accessories for prevention.

The design of the Transformer, On Load Tap Changer, Oil Cable Boxes and Oil Bushing Cable Boxes system shall be such that in maintaining the power transformer, the system can be isolated without affecting any of its components. All accessories necessary for this purpose shall be included in the scope of supply for the Transformer, On Load tap Changer, Oil Cable Boxes and Oil Bushing Cable Boxes System.

If required in the Technical Data Sheet of the transformer, the explosion and fire prevention shall be backed with Nitrogen Fire Extinguishing system. The principle shall consist of injecting nitrogen at the transformer base to extinguish fire.

Just like Explosion and Fire Prevention System, injection of nitrogen can be activated only in the presence of the following signals:

- The activation of any Linear Heat Detector (LHD) confirming the occurrence of fire and
- The activation of any of the electrical protection signal, confirming the electrical fault of the protected transformer.

The system operation of the backup system shall be properly coordinated with the required input to avoid mal-operation and mal-function of the backup system. Activation of only one signal among the two mentioned below:

- The activation of the LHD confirming the occurrence of fire; and
- The activation of any of the electrical protection signal, confirming the electrical fault of the protected transformer.

shall prevent the operation of nitrogen injection process and shall only generate remote annunciation/signal at the control room. Only at the presence of both signals shall the electrical actuator trigger the nitrogen injection process.

LHD for the backup system shall be located at the appropriate location in the tank, OLTC, Oil cables Boxes and Oil Bushing Cable Boxes, as applicable.

The design of the whole system shall be submitted to the Owner for review and approval before any manufacturing has to be done for the Transformer Explosion Prevention and Fire Prevention System.

The whole system shall be installed and tested by the Transformer Manufacturer or Contractor under the supervision of Equipment manufacturer and shall be commissioned by the Equipment manufacturer.

Contractor or Transformer manufacturer should ensure that the necessary provisions to adapt this system are considered in the Transformer design.

Also, pipes, valves, cables, Oil gas separation tank and other accessories which is deemed necessary for completion of the installation of system are in the scope of Transformer manufacturer or Contractor.

The OEM of the offered equipment should have design and field experience of the similar system at least for the period of 5 years. Activation / experience certificate issued by the users evidencing this should be submitted in their bid.

This is considered to be critical equipment which needs to respond at appropriate time and well design for each transformer. Further, failure of this system at the time of need reflect in huge loss to the user. Contractor shall be exclusively responsible for any mishap in this regard and shall replenish the equipment without any additional cost to Mahagenco. Confirmation on this should be submitted by the bidder from the OEM at the time of submission of this tender.

An official test certificate from recognized and independent high voltage laboratory shall be provided by the supplier. Transformer, On load Tap Changer, Oil cable Boxes and Oil Bushing cable Boxes Explosion and Fire Prevention System be designed as per recommendation given in the National Fire Protection Association for Fast Depressurization system.

ANNEXURE - II

13.0 SPECIAL REQUIREMENTS OF INSTRUMENTATION BASED ON ENERGY AUDIT PROGRAMME

13.1 INTRODUCTION

Measurement of important parameters which affect the input costs like coal, oil, water need to be measured and not estimated. Both receipt and consumption need to be separately monitored and reconciled through computerized system. There must not be human intervention in the measurement and recording systems of coal, fuel oil and water resources which affect the station input costs. Supply chain optimization of raw material inputs through modernization of technology needs to be taken up. Transit loss, specific fuel consumption and GCV are interlined and realistic quantification of these will only be possible if a fuel monitoring system is in place.

The system should aim at procurement of digital instrumentation which can be seamlessly integrated into a DDCMIS. Intelligent Electronic Devices (IEDs) must be the preferred Instrumentation Systems. Information and communication system needs to be got audited for obtaining a holistic picture of its structure and efficiency.

13.2 COAL

13.2.1 Unit Coal Measurement (Coal Consumption Measurement)

- (a) The coal entry into the boilers shall be measured. The various technologies for coal measurement are given elsewhere in this section.
- (b) An online process (without any human intervention) which would give the online coal consumption with uncertainties of $\pm 1.0\%$ shall be envisaged and the technology for the same must be well proven and established. The conventional stacking method can be used for reconciliation of data/cross verification only and not for coal consumption measurement.
- (c) The stacking inventory procedure shall not be used for measurement of coal for declaring the station heat rate. Instead the use of fully automated, tamper-proof modern instrumentation without human intervention for on-line coal inflow and consumption shall be envisaged.

- (d) The difference in belt weighers/gravimetric feeders and receiving end coal measurements must not exceed more than 0.06 kg/kWh (0.03 kg/kWh for increase in moisture from tripling to bunkering, stones weights and 0.03 kg/kWh for handling loss).
- (e) Based on an assessment of the different technologies the following are recommended:
 - (i) Installation of Belt Weighers for all coal conveyors. The offered system shall monitor the time elapsed by a belt over a given bunker and which involves integration of the output of the Belt Weighers over the total bunkers of the unit in a given period of time. The bidder must come out with a viable and innovative scheme for monitoring the bunker wise coal from the belt weigher data.
 - (ii) Microwave or Ultrasonic Bunker Level Monitoring System with digital data output, communication of data to system server or control room is required.
 - (iii) Coal flow for the plant shall be monitored by gravimetric feeders which provide accurate and authentic coal flow measurements, in addition to belt weighers. The differences in the two are to be within 0.5%. The data from the belt weighers and the gravimetric feeder can be cross verified, calibrated and reconciled. Necessary signal exchange shall be considered by the bidder.
 - (iv) Necessary software shall be included in the offer for online coal energy management in the plant. The software shall take input data from the various field instruments for coal receipt from various sources and coal consumption at various bunkers.
 - (v) Computation of unit coal consumption. This is purely from the reading of the belt weigher and bunker monitoring system. This coal consumption is to be used for computation of unit and station heat rate for normal and cycling operations.

In all the above instruments, the following must be considered:

- (i) The instruments must function as Intelligent Electronic Devices (IEDs) by digitally communicating with DDCMIS/ control room through down loading of data continuously.

(ii) The instruments must have provisions for communication of digital data.

(iii) The instruments and the digital conversion systems must have a very high reliability in terms of SAIFI (System Average Interruption Duration Index) of 0.5 interruptions per year and SAIDI (System Average Interruption Frequency Index) of 4 hours per year.

By this process the coal consumption will depend on the unit performance and not vice-versa.

13.3 FUEL OIL (Receipt and Consumption Monitoring)

13.3.1 Oil Receipt Measurement

The following are to be considered:

- (a) Fully automatic ultrasonic level indicators with provision for conversion of signals into digital signals and communication through a media to DDCMIS shall be installed for all oil tanks. The digital signals must be downloadable into a data base on a continuous basis.
- (b) A fuel oil monitoring software package is to be in place for on line calculation and logging of the oil receipts, etc.

13.3.2 Oil Consumption Measurement

The following are to be considered:

- (a) Differential pressure orifice plate or nozzle type or mass based oil flow meters with provision for continuous digital data transfer shall be installed.
- (b) The oil gun on-off operation data must be recorded through a time based system automatically to give a time trace of when the guns are on and when the guns are not in service. This will be useful for performance optimization group to study the operator to operator variations, coal to coal variations, variation in different seasons, etc.

13.3.3 Integrated Fuel Oil Receipt and Consumption Monitoring

A Fuel Oil Monitoring software Package shall be provided. When ultrasonic level measurement for tanks is used, the software package shall calculate the oil receipts.

13.3.4 DM Water and Associated Water Systems

On-line monitoring of DM water flow and unit make up with integrators shall be envisaged to control the energy efficiency as the make-up is directly proportional to the steam lost from the system and affects the unit heat consumption and heat rate. Hence, it is envisaged to go in for fully automatic on line measurement of water consumption for both production and consumption measurement of raw water, DM water, soft water and drinking water.

The following are to be considered for DM (De-mineralized) and associated water systems:

- (a) Both DM water production and DM water consumption must be separately measured and audited.
- (b) Installation of differential pressure orifice plate or nozzle type flow meters with digital output, communication media to relay the data to the DM control room computer and provision for downloading the data into a data base for on line monitoring of make-up especially during cycling operations. On line monitoring would help in control of unit heat rate as well as give an accurate account of the chemicals consumed for DM water production.
- (c) Water Monitoring Software Package shall be provided. The package must have capability to draw inputs from the various field instruments and make an on-line continuous data base grid of the information for generation various types of information such as consumption per shift, consumption during cycling operations, operator-wise consumption, etc. to enable the performance optimization group to take control action on the areas of wastage and

excessive consumption. Consumption and production shall be separately monitored.

13.4 METHODS OF MEASUREMENT OF COAL USED IN THE BOILERS

- (a) Belts weightment at the entrance of the raw coal bunkers.
- (b) Bunker level calibration and flow measurement based on bunker level.

- (c) Volumetric measurement based on raw coal feeder speed.
- (d) Volumetric measurement based on pulverized coal feeder speed.
- (e) Gravimetric measurement at outlet of raw coal feeder.
- (f) Pressure drop across pulverized coal pipe leading to the burner through fixed geometry devices.
- (g) (Variable orifice dampers.
- (h) Dirty pitot tube measurement in the coal pipe leading to the burner.
- (i) Passive Electrostatic Sensors
- (j) Screw-in Microware Sensor.
- (k) Passive Acoustic Sensors
- (l) Laser through beam or retro reflex sensors
- (m) Calibration of mills as a function of their power input.

13.5 SPECIFICATIONS OF BELT WEIGHER

13.5.1 Particulars Of Belt Weighers

- (n) Micro Processor based electronic belt weighers with communication facility to continuously transmit the data to a control room as well as local reading.
 - (i) Type : Electronic, Multi-idler type
 - (ii) Location : Refer mechanical specification of Coal Handling Plant
 - (iii) Belt Speed : Refer mechanical specification of Coal Handling Plant
- (o) Coal Properties and Capacity
 - (i) Bulk density : Refer mechanical specification of Coal Handling Plant
 - (ii) Capacity : Refer mechanical specification of Coal Handling Plant

(p) Duty Conditions

(i) Moisture : Refer mechanical specification of Coal Handling Plant

(ii) Dust : Refer mechanical specification of Coal Handling Plant

(iii) Rain and high RH : Refer mechanical specification of Coal Handling Plant

(q) Accuracy : $\pm 0.25\%$ or better of actual flow rate (dynamic). Weigh idler deflection less than 0.025 mm at full load.

(r) Reliability Index : SAIDI (System Average Interruption During Index) : 48 hours/year or better
SAIFI (System average interruption frequency index): 2 times/year or better.

(s) Overload Capacity : Up to 25% with 100% overload protection

(t) Capacity range of accuracy : 0 to 100%

(u) Electronic Components : Electronic digitiliser / monitors, cable, totalizer, sub- totalizer, tacho generator, printer, transmission of the impulse of flow rate as well as total quantity conveyed to control room through communication media. Fully digital with microprocessor and battery back-up memory.

(v) Mode of weightment primary sensors : Super precision stainless steel strain gauge load cell applied in tension for highly accurate load measurement.

Hermetically enclosed measuring device, compact designed, suitable for all customary belt widths.

- Speed measurement: Brushless digital tachometer provides accurate measurement of speed.
- (w) Outputs : Electronic signals to control room and to local instrument display.
- Status Annunciator for set points.
- (x) Printout weigh, total and error reports : Provision for zero setting on empty belt and further calibration. Special electronic calibration facility for frequent calibration checks without handling standard weights.
- (y) Special trunion bushes to absorb normal shocks and transverse forces.
- (z) Fully automatic tare and span calibration.
- (aa) Self-checking diagnostics for fault indications.

ANNEXURE - III

In addition to above, following points shall also be considered while designing the underground L.D. Pipe Lines.

- (a) The design ground table at 1.0m below finished ground level shall be considered for design of pipes.
- (b) The suitability of local soils for structural backfill around pipes shall be established by conducting laboratory / field tests and suitable modulus of soil reactions of corresponding backfill soil for submerged condition shall be considered while designing the pipes.
- (c) Backfilling of pipes shall be done with non-expensive soils only. If the natural soils are having medium to high expensive characteristics, the same shall be replaced by suitable non-expensive soil for backfilling around pipes.
- (d) If soils having medium to high plasticity i.e. having liquid limit more than 50% is to be used for backfilling around pipes; in such cases the modulus of soil reaction shall be considered as 'O' while designing the pipe i.e. no strength of such soils shall be considered for design of underground pipes.
- (e) To ensure quality control for backfilling work of pipeline at site, Field Quality Plans for quality of filling soil & bedding materials, construction activities like laying of bedding layer / backfilling layers, optimum moisture content of back soil, type of compaction equipment, method of compaction, relative degree of compaction etc. including laboratory & field tests to be conducted prepared during execution of work shall be prepared & got approved from Owner / Consultant and work shall be carried out strictly in accordance with approved Field Quality Plans.
- (f) The micro grading of nearby area of pipe corridor shall be carried out such that no storm water will flow towards pipe corridor area and accordingly storm water drainage arrangement of areas around pipe corridor shall be provided.
- (g) Adequate numbers of thrust blocks, anchors, etc. shall be provided as per requirement to prevent displacement, uplift movement of underground pipes.

- (h) Transient analysis of CW / ACW pipelines shall be carried out from recognized institute and locations of air release valves, etc. shall be decided accordingly and the details shall be submitted to Owner / Consultant for review / information.
- (i) The procedure for hydro testing of pipes shall be prepared and got approved from Owner / Consultant and hydro testing of pipes shall be carried out in accordance with approved procedures.

ANNEXURE - IV

Design Specification for Dimensions of Natural Draft Cooling Tower

(This paragraph shall be considered before last paragraph of Clause No. 4.7.20.2 – Size and shape, Page no. 108, Section -1, Volume-VI A)

The following method shall be used to evaluate the minimum height required for Natural Draft Cooling Tower (NDCT).

- 1.0 Design shall be in confirmation with BS: 4485. Air properties published by BS would be used for evaluation.
- 2.0 Performance number KaV/L
 - (a) Demand / Required KaV/L shall be calculated using Tchebycheff's integration method described in CTI: ATC-105/ BS: 4485.
 - (b) Supply KaV/L
 - (i) Fill KaV/L shall be calculated using Fill Manufacturer's curve for given L/G. Designer shall submit Fill characteristic curve along with sizing calculations.*
 - (ii) Fill KaV/L shall constitute at least 90% of total KaV/L of tower.
 - (c) Supply KaV/L shall be more than 'Or' equal to design KaV/L.

3.0 Draught Loss Calculations

Losses in air path will be calculated using the formulae:

$$H = \sum_{1}^n h_x = \sum_{1}^n k_x \rho \times \frac{V_x^2}{2} \dots \dots \frac{N}{m^2}$$

Where H=Total Draught. Loss .in. mmwc

..... .h=Draught. Loss. in. particular. zone. in. mmwc

.....K=Empherical. Coefficient. in. that. zone.

.....K1 =5.0.... for.. air. inlet. (including. rain. below. fill)

.....K2. for.. fill=As. per. Manufacturer. data*

.....K3 = 1.5....for. Water. Spray. above. Fill

.....K4.. for. Drift. Eliminator....=As. per. Manufacturer. Data

.....K5 = 1.0....for.. Stack. Top

.....ρ = Air.Density.in.that.zone.in.kg/cu.m

.....V = Air. Velocity.in. m/sec

4.0 Minimum required tower height shall be calculated using BS: 4485 formulae.

* -- If published curves are available in literature, conservative among them would be considered for evaluation.

ANNEXURE - V

The Specifications for Painting of Steel Structures Pertaining to Civil Works

Structural Steel which is encased in concrete or galvanized shall not be painted. All other steel members of buildings & structures shall be provided with suitable painting as Protective coating against corrosion considering the exposure to the atmosphere pollution conditions.

For sheltered steel structures, where sides of the structures are not fully covered such as deaerator floor, bunker building, etc. both exterior & interior steel structures shall be considered as exposed to non-polluted inland atmosphere condition.

For other steel structures exterior structures shall be considered as exposed to non-polluted inland atmosphere condition and interior structures shall be considered as normally dry condition.

- (a) The painting scheme for steel structures exposed to non-polluted inland atmosphere condition shall be provided in line with Clause No. 2.28(aa), Section-4, Vol.-VI-A as below:
 - i. Minimum total 75 micron DFT of Inorganic zinc primer composed of 85% zinc (by volume) shall be applied in two coats over blast cleaned surfaces of the structure. One coat of primer minimum 35 micron DFT shall be applied as shop primer paint and second coat of primer shall be applied after erection and final alignment of the erected structures.
 - ii. Minimum total 125 microns DFT of polyamide epoxy paint composed of 77% solids (by volume) shall be applied in three coats as intermediate and finishing coat.
 - iii. Minimum 50 micron DFT of Aliphatic polyurethane composed of 56% solids (by volume) shall be applied as top finishing coat.
- (b) The painting scheme for steel structures exposed to normally dry condition shall be provided in line with Clause No. 2.28(aa) , Section-4, Vol.VI-A as below:

CORRIGENDUM - XV

- (i) Minimum total 75 micron DFT of Inorganic zinc primer composed of 85% zinc (by volume) shall be applied over blast cleaned surfaces of the structure. One coat of primer of minimum 35 micron DFT shall be applied as shop primer paint and second coat of primer shall be applied after erection & final alignment of the erected structures.
- (ii) Minimum total 150 micron DFT of polyamide epoxy paint composed of 77% solids (by volume) shall be applied in three coats as finishing coat over primer coat.
- (c) The painting scheme for all internal steel doors, ventilators, louvers, rolling shutters, etc. shall be provided in line with clause No. 1.7 of Section - 3 of Vol.-VI-A as below:
 - (i) Shop primer paint shall be single coat of red oxide / zinc chromate primer conforming to IS-2074 shall be applied after surface preparation in accordance with IS-1477 (Part-I& II). Second coat of primer shall be applied after erection and final alignment of the structure.
 - (ii) Two coats of synthetic enamel paint conforming to IS: 2932 of approved shade and quality shall be applied after erection on primer coat.
 - (iii) Total dry film thickness of finished paint shall not be less than 110 microns.
- (d) The painting specifications for steel structures pertaining to chimney, cooling tower, structures exposed to chemical fumes, etc., shall be as per painting specifications given under relevant Sections of Vol.-VI-A.
- (e) The painting specifications of E&M equipment, structural steel of Boiler & ESP shall be as per corresponding E&M bid specifications.



**MAHARASHTRA STATE POWER
GENERATION CO. LTD.**

**PROJECTS & PLANNING
DEPARTMENT**

BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1

CORRIGENDUM - XVI



MAHARASHTRA STATE POWER GENERATION CO. LTD.

BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1

CORRIGENDUM - XVI

CORRIGENDUM TO BID SPECIFICATION

VOLUME-I

COMMERCIAL AND GENERAL CONDITIONS OF

CONTRACT

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Following Clauses of the Bid Specification are amended as under :

Sr. No	Section /Page No/Cl. No.	Provision of the Bid Specification updated so far	Amendment to the Clause - To be read as -
1	Section 1, Page 128/ Schedule-3, Cl. No. 1.5	In the event of the shipment beyond scheduled date of supply completion of respective Equipment/Spare/Material as the case may be, for the reasons not attributable to the Contractor, the price adjustment shall be worked out based on i) the scheduled date of supply completion of respective Equipment /Spare/Material and ii) the actual date of supply completion of the same and whichever is beneficial to the Owner shall be payable.	In the event of the shipment beyond scheduled date of supply completion of respective Equipment/Spare/ Material as the case may be, for the reasons attributable to the Contractor, the price adjustment shall be worked out based on i) the scheduled date of supply completion of respective Equipment /Spare/Material and ii) the actual date of supply completion of the same and whichever is beneficial to the Owner shall be payable.
2	Section 1, Page 130 / Schedule-3, Clause 3.2	In the event of the work performed beyond scheduled date of completion of the respective activity, for the reasons not attributable to the Contractor, the price adjustment shall be worked out based on i) the scheduled date of completion of respective activity and ii) the actual date of completion of the activity and whichever is beneficial to the Owner shall be payable.	In the event of the work performed beyond scheduled date of completion of the respective activity, for the reasons attributable to the Contractor, the price adjustment shall be worked out based on i) the scheduled date of completion of respective activity and ii) the actual date of completion of the activity and whichever is beneficial to the Owner shall be payable.
3	Section 1, Page 152 / ,Schedule 8(C)	-----we, the guarantor do hereby guarantee and undertake to pay to the Owner on demand any and all monies to the extent of _____ ² only as aforesaid at any time upto six months from the date of the validity of the bank guarantee without any demur, reservation, context, recourse or protest and/or without any references to the consultant on whose behalf this Bank Guarantee is issued. Any such demand made by the ----- other Authority. The guarantor undertakes not to revoke this guarantee during its currency without previous consent of the Owner and further agrees that the guarantee herein contained shall be enforceable till ninety six months after	-----we, the guarantor do hereby guarantee and undertake to pay to the Owner on demand any and all monies to the extent of _____ ² only as aforesaid at any time upto six months from the date of the validity of the bank guarantee without any demur, reservation, context, recourse or protest and/or without any references to the consultant on whose behalf this Bank Guarantee is issued. Any such demand made by the ----- other Authority. The guarantor undertakes not to revoke this guarantee during its currency without previous consent of the Owner and further agrees that the guarantee herein contained shall be enforceable till six months after expiry of its validity.

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Sr. No	Section /Page No/Cl. No.	Provision of the Bid Specification updated so far	Amendment to the Clause - To be read as -	
		expiry of its validity.		
4	Section 2, Page 167 / Cl. No. 3.0	Definition of Terms: v. "Contract Period"/"Work completion period" shall mean the time for completion of works as stated in the contract commencing from the Zero Date	Definition of Terms: v. "Contract Period"/"Work Completion Period"/" Work Completion Schedule " shall mean the time for completion of works as stated in the Schedule-6 of Contract commencing from the Zero Date, as amended for the reasons not attributable to the Contractor pursuant to provisions of the Contract.	
5	Section 2, Page 174 / Cl. No. 6.2	The contractor shall be deemed to have inspected the site and its surrounding and ----- obligations / responsibilities to be discharged and performed under the contract as per schedule within the contract price.	The contractor shall be deemed to have inspected the site and its surrounding and ----- obligations / responsibilities to be discharged and performed under the contract as per schedule within the contract price. However, any Asbestos material found during excavation etc., the same shall be disposed by the Owner at its own risks and costs.	
6	Section 2, Page 178 / Cl. No. 12.1	Unless otherwise stated in the contract, the notices to be given under this contract shall be in writing in English language and shall be delivered by a hand delivery, registered post/speed post/air mail, special courier, cable or telefax to the applicable communication details of the relevant party as set out in the contract with following provisions.	Unless otherwise stated in the contract, the notices to be given under this contract shall be in writing in English language and shall be delivered by a hand delivery, registered post/speed post/air mail, special courier or telefax to the applicable communication details of the relevant party as set out in the contract with following provisions:	
7	Section 2, Page 178 / Cl. No. 12.1.1	Any notice sent by cable, telefax shall be confirmed within two days of despatch by notice sent by hand delivery, registered post/speed post/air mail or courier.	Any notice sent by telefax shall be confirmed within two days of dispatch by notice sent by hand delivery, registered post/speed post/air mail or courier.	
8	Section 2, Page 178 / Cl. No. 12.1.2	The notice sent by registered post/speed post/air mail, courier shall be deemed (in absence of earlier receipt) to have been delivered within ten (10) days from the date of issuance of the same.... recipient.	The notice sent by registered post/speed post/air mail, courier shall be deemed (in absence of earlier receipt) to have been delivered within ten (10) working days from the date of issuance of the same.... recipient.	

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9	Section 2, Page 179/Cl. No. 12.1.3	The notice delivered by Cable or by telefax shall be deemed to have been delivered on the date of its despatch	The notice delivered by telefax shall be deemed to have been delivered on the date of its dispatch.	
10	Section 2, Page 181 / Cl. No. 18.2	All costs, damages or expenses that the owner may have incurred, for which under the contract the contractor is liable, shall be recovered by the owner as and when they are incurred from the contractor's bills becoming due under this contract or any other contract awarded by the Owner to the Contractor. Such recoveries shall be supported by appropriate documents or explanations, to enable the contractor to properly identify such claims. These amounts may be recovered by actions of law or otherwise, if the contractor fails to satisfy the owner of such claims.	All costs, damages or expenses that the owner may have incurred, for which under the contract the contractor is liable, shall be recovered by the owner as and when they are incurred from the contractor's bills becoming due under this contract or any other contract awarded by the Owner to the Contractor. Such recoveries shall be supported by appropriate documents or explanations in writing to enable the contractor to properly identify such claims. These amounts may be recovered by actions of law or otherwise, if the contractor fails to satisfy the owner of such claims.	
11	Section 2, Page 183 / Cl. No. 21.8	Add New Clause	Making Regular payments to the Sub-contractors is a matter of paramount importance for ensuring smooth and timely execution of the Project. The Contractor shall submit Sub-contractor wise Reconciliation Statement of Payments made to respective Sub-Contractor jointly signed by the authorised representatives of the Contractor and the Sub-contractor depicting therewith details of invoices raised by the Sub-contractor, recoveries/retentions if any, amounts due, their due dates, dates of payments made, balance payment etc. The format for such statement shall be finalised during the execution of the Contract. In the event any Sub-contractor approaches the Owner complaining delay in payments by the Contractor and the Owner is convinced that such delay is hampering or likely to hamper the progress of the Project, without prejudice to the provisions of Clause No. 30.1	

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Sr. No	Section /Page No/Cl. No.	Provision of the Bid Specification updated so far	Amendment to the Clause - To be read as -	
			below (Clause related to Delay LD), the Owner may directly pay Sub-contractor the payments due to the Sub-contractor as per the Reconciliation Statement submitted and any further payments those may have become due subsequent to submission of the Statement and recover from the amounts due or becoming due to the Contractor such payments made along with interest at the prevailing rate of borrowings for the Project for the period commencing from date of making payment to the Sub-contractor till the date of recovery.	
12	Section 2, Page 192 / Cl. No. 31.1	In case the Contractor's performance is delayed due to any act or omission on the part of the owner/ his authorised agents or other contractors appointed by the owner, then the contractor shall be given due extension of time for the completion of works to the extent such omission has caused delay in the contractor's performance of his work. Regarding reasonableness or otherwise of the extension of time, the decision of the Engineer shall be final subject to arbitration as provided for in the contract.	In case the Contractor's performance is delayed due to any act or omission on the part of the owner/ his authorised agents or other contractors appointed by the owner, then the contractor shall be given due extension of time for the completion of works to the extent such act or omission has caused delay in the contractor's performance of his work. Regarding reasonableness or otherwise of the extension of time, the decision of the Engineer shall be final subject to arbitration as provided for in the contract.	
13	Section 2, Page 192 / Cl. No. 31.2	Apart from the extension of time as above, no compensation shall be payable to the contractor on account of such delay except as provided under Clause No. 36, Section 2B, Volume - I of the contract.	In addition, the Contractor shall be entitled to claim demonstrable and reasonable compensation if such delays have resulted in any increase in the cost. The Owner shall examine the justification for such a request for claim and if satisfied, the extent of compensation shall be mutually agreed depending upon the circumstances at the time of such an occurrence.	

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14	Section 2, Page 192 / Cl. No. 32.0	32.0 Suspension of the Work: 32.1 The Owner reserves the right to suspend and reinstate execution of the whole or any part of the contract without invalidating the provisions of the contract. Orders for suspension or reinstatement of the works shall be issued by the Engineer to the Contractor in writing. The time for completion of the works shall be extended for a period equal to the duration of the suspension. 32.2 The owner, however, shall not grant such extension of work completion period if suspension or delay is due to default on the part of the contractor or his sub-contractor.	32.1 Suspension by the Owner: 32.1.1 The Owner/Project Manager, by notice to the contractor, may order suspension of performance of any or all his obligations under the contract. Such notice shall specify the obligation of which the performance is to be suspended, effective date of the suspension and the reasons there for. The contractor shall thereupon suspend the performance of such obligation, except those obligations necessary for care or preservation of the Works, Materials, until the order in writing to resume such performance by the Owner/Project Manager. 32.1.2 If by virtue of such suspension order, other than by reasons of Contractor's default or breach of the contract, Contractor's performance of any of its obligation is suspended for an aggregate period of more than one hundred and twenty (120) consecutive days or two hundred and forty (240) in aggregate, then at any time thereafter and provided at that time such performance is still suspended, the Contractor may give notice to the Owner/Project Manager requiring that, Owner shall, within 28 days from the date of receipt of such notice, order resumption of such performance or request and subsequently order variation in accordance with Clause No. 46.0 below, excluding the performance of such obligations from the Contract. 32.1.3 If the Owner fails to do so within such period, the Contractor may, by a further notice to the Owner, elect or treat such suspension, where it affects the part only of the works under the contract, as deletion of such part in	

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			accordance with the Clause No. 46.0 below or, where it affects the whole of the work, as termination of the Contract under Clause No. 61.3, Termination for Owner's Convenience. 32.2 Suspension by the Contractor: If a) the Owner has failed to pay the Contractor any sum due under the Contract within the specified period, has failed to approve any invoice or supporting documents without just cause or commits a substantial breach of the Contract, the Contractor may give a notice to the Owner that requires payment of such sum, requires approval of such invoice or supporting documents, or specifies the breach and requires the Owner to remedy the same, as the case may be. If the Owner fails to pay such sum, fails to approve such invoice or supporting documents or give its reasons for withholding such approval, or fails to remedy the breach or take steps to remedy the breach within fourteen days (14) days after receipt of the Contractor's notice or b) the Contractor is unable to carry out any of its obligations under the Contract for any reason attributable to the Owner, including but not limited to the Owner's failure to provide possession of or access to the Site or other areas, or failure to obtain any governmental permit necessary for the execution and/or completion of the works which the Owner is required to obtain as per provisions of the Contract; then the Contractor may by fourteen (14) days' notice to the Owner suspend performance of all or any of its	

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			obligations under the Contract, or reduce the rate of progress. 32.3 If the Contractor’s performance of its obligations is suspended or the rate of the progress is reduced pursuant to this Clause No. 32.0, then the time for completion shall be extended by such period as shall be fair and reasonable in all circumstances and as shall fairly reflect the delay or impediment sustained by the contractor, and any and all additional costs and expenses incurred by the contractor as a result of such suspension or reduction shall be paid by the Owner to the Contractor in addition to the Contract Price, except in case of suspension order or reduction in rate of the progress by reasons of the Contractor’s default or breach of the contract. 32.4 During the period of suspension, the contractor shall not remove from the site any of Plant and Equipment, any part of the Works or any Contractor’s equipment, without the prior written consent of the Owner.	
15	Section 2, Page 193 / Cl. No. 35.1	Clause No. 35.0: Change in Quantity: 35.1 The owner reserves the right to vary the quantities of items or groups of items ordered, as may be necessary, during the execution of the contract without change in unit price or other terms & conditions. The variation in contract price due to this change in quantity shall be limited to increase or decrease by up to 15% (fifteen percent only) of the original contract price. In case unit prices are not available the prices for the items added or deleted shall be mutually agreed	Clause No. 35.0: Change in Quantity: 35.1 The owner reserves the right to vary the quantities of items or groups of items <u>covered under Schedule - 6 or Mandatory Spares or if ordered 3 Years O&M Spares (Recommended Spares)</u>, as may be necessary, during the execution of the Contract without change in unit price or other terms & conditions. The variation in Contract Price due to this change in quantity shall be limited to increase or decrease by up to 15% (fifteen percent only) of the original Contract Price. In case unit prices are not available the prices for the items added or deleted	

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Sr. No	Section /Page No/Cl. No.	Provision of the Bid Specification updated so far	Amendment to the Clause - To be read as -	
		upon.	shall be mutually agreed upon.	
16	Section 2, Page 198/ Cl. No. 41.1	The owner shall accord final acceptance of the unit and takeover the unit from the contractor for commercial operation only if: - The trial operation of the unit in accordance with the provisions of the contract is completed successfully. - The Performance Guarantee Test is successfully completed (All the tests covered under LD clauses and under corrections). - Submission of Performance Guarantee Test reports by the contractor and acceptance of the same by the Owner. - All permits required to operate and maintain the Unit/Block/Plant which are to be obtained by the Contractor have been so obtained. - All documents/manuals required under the contract to start up, operate and maintain the plant are delivered to the owner. - All the mandatory spares and special tools and tackles to be supplied against the contract are delivered to the owner. - Contractor has successfully completed the training programme for Operation and Maintenance personnel	The owner shall accord final acceptance of the unit and takeover the unit from the contractor for commercial operation only if: - The trial operation of the unit in accordance with the provisions of the contract is completed successfully. - The Performance Guarantee Test is successfully completed (All the tests covered under LD clauses and under corrections). - Submission of Performance Guarantee Test reports by the contractor and acceptance of the same by the Owner. - All permits required to operate and maintain the Unit/Block/Plant which are to be obtained by the Contractor have been so obtained. - All documents/manuals required under the contract to start up, operate and maintain the plant are delivered to the owner. - The mandatory spares and special tools and tackles <u>ordered against the Contract and which Owner considers essential</u> to be supplied <u>before Taking Over of Plant for uninterrupted Operation of the Plant</u> are delivered to the owner. - Contractor has successfully completed the training programme for Operation and Maintenance personnel	

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17	Section 2, Page 200 / Cl. No. 42.1	Operating the Plant Before Taking Over:42.1 Owner reserves the right to take possession of and use for any intended purpose, any portion or all of any delivered but as yet unaccepted Plant. The taking of possession at any time or use of any of such portion of Plant shall not be deemed to be an acknowledgement of owner acceptance of Unit or the Plant, and shall not be exclusive with respect to the contractor until owner acceptance of the Plant, has occurred. Owner shall provide contractor with reasonable and timely access to complete its obligations hereunder. It is the expectation of the parties that any such modifications or repairs will be accomplished by Contractor with minimal interference with operation of the Plant, and that reduction in and shutdowns of Plant operations will be required only when necessary.	Clause No. 42.0: Operating the Plant before taking Over: 42.1 Owner reserves the right to take possession of and use for any intended purpose in larger public interest pursuant to National or State directives, emergencies and not for commercial gain , any portion or all of any delivered but as yet unaccepted Plant. The taking of possession at any time or use of any of such portion of Plant shall not be deemed to be an acknowledgement of owner acceptance of Unit or the Plant, and shall not be exclusive with respect to the contractor until owner acceptance of the Plant, has occurred. Owner shall provide contractor with reasonable and timely access to complete its obligations hereunder. It is the expectation of the parties that any such modifications or repairs will be accomplished by Contractor with minimal interference with operation of the Plant, and that reduction in and shutdowns of Plant operations will be required only when necessary.	

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18	Section 2, Page 203 / Cl. No. 45.1	The contractor shall also ensure that before going out of production of spare part of the equipment covered under the contract, he shall give the owner at least 12 (twelve) months advance notice so that the latter may order his bulk requirement of spares, if he so desires. The same provision shall also be applicable to the sub- contractors. Further, in case of discontinuance of manufacture of any spares by the Contractor or his sub- contractor, the contractor shall provide the owner, one year in advance, with full manufacturing drawings, material specification and technical information required by the owner for the purpose of manufacture of such items.	Clause No. 45.0, Long Term Availability of Spares: 45.1 The Contractor shall ensure the long term availability of spares to the owner for the full life of the equipment covered under the contract. The contractor shall also ensure that before going out of production of spare part of the equipment covered under the contract, he shall give the owner at least 12 (twelve) months advance notice so that the latter may order his bulk requirement of spares, if he so desires. The same provision shall also be applicable to the sub- contractors. Further, in case of discontinuance of manufacture of any spares by the Contractor or his sub- contractor, the contractor shall provide the owner, one year in advance, with full manufacturing drawings, material specification and technical information required by the owner for the purpose of procurement of such items.	
19	Section 2, Page 205 / Cl. No. 46.3	In any case in which the contractor has received instructions from the Engineer as to the requirement of carrying out the altered or additional substituted work which either then or later on will, in the opinion of the contractor, involve a claim for additional payments, the contractor shall immediately and in no case later than 30 (thirty) days after receipt of the instructions aforesaid and before carrying out the instructions, advise the Engineer to that effect, the parties shall agree to the extent of any change in the contract price. But the Engineer shall not become liable for the payment of any charges in respect of any such variations unless, the instructions for the same shall be confirmed by the Engineer.	In any case in which the contractor has received instructions from the Engineer as to the requirement of carrying out the altered or additional substituted work which either then or later on will, in the opinion of the contractor, involve a claim for additional payments and/or extension for Time for Completion , the contractor shall immediately and in no case later than thirty (30) days after receipt of the instructions aforesaid and before carrying out the instructions, advise the Engineer to that effect, the parties shall agree to the extent of any change in the contract price and/or extension for Time for Completion . But the Owner shall not become liable for the payment of any charges and/or extension of Time for Completion in respect of any such variations unless, the instructions for the same shall be confirmed by the	

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			Engineer.	
20	Section 2, Page 205 / Cl. No. 46.4	If any variation in works results in increase or reduction of Contract Price, the parties shall agree, to the extent of any change in the contract price. Any agreed difference in cost occasioned by any such variation shall be added to or deducted from the contract price as the case may be. In all such cases, in the event of a disagreement as to the reasonableness of the said sum, the decision of the Engineer shall prevail subject to arbitration as provided for in the contract.	If any variation in works results in increase or reduction of Contract Price and/or Time for Completion , the parties shall agree, to the extent of any change in the Contract Price and/or Time for Completion . Any agreed difference in cost occasioned by any such variation shall be added to or deducted from the Contract Price as the case may be and the time for Completion shall be extended to by such period which in all circumstances reflects the delay or impediment sustained by the contractor due to such variation. In all such cases, in the event of a disagreement as to the reasonableness of the said sum and/or the extension of Time for Completion , the decision of the Engineer shall prevail subject to Arbitration as provided for in the Contract.	
21	Section 2, Page 208 / Cl. No. 52.0	Add New Clauses 52.4 & 52.5 after Cl. No. 52.3 as	Clause No. 52.0 Contractor's Documents, Drawings & Instruction Manuals: To add following clauses under Clause No. 52.3 52.4 : The Copyright in all the Drawings, Documents and other material containing data and information generated by the Contractor and furnished to the Owner by the Contractor shall remain vested in the Contractor, or if they are furnished to the Owner directly or through the Contractor by any third party, including suppliers of materials, the Copyright in such materials shall remain in such third parties. The Owner shall however be free to reproduce all the drawings, documents and other material furnished to the Owner for the purpose of the Contract, including, if required, for operation and maintenance of the Plant and Equipment covered under the Contract. 52.5 : Notwithstanding anything contained hereinabove, the Copyright of all the non-plant buildings, Plot Plan etc., irrespective	

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			whether generated by the Contractor or any third party, shall remain vested in the Owner and the Owner will have the right to use these designs and drawing at some other places or at other power stations with or without modification, alterations etc. without any payments of royalty, fees etc. to the Contractor for the same.	
22	Section 2, Page 211 / Cl. No. 61.1	61.1.1 Occurrence of either of the following circumstances shall constitute Contractor's Default: a) The contractor refuses honour the award of the contract issued by the owner or fails to submit the performance security deposit within the period stipulated/extension granted by the owner for this purpose. b) The contractor assigns or sublets the contract to any other entity violating the provisions of Clause No. Error! Reference source not found. above. c) The contractor, in judgement of the owner has indulged in fraudulent or corrupt practices in connection with execution of the contract. d) The contractor abandons the contract or without valid reasons or suspends the execution of the contract for the period of more than 30 days. e) Persistently fails/neglects to execute the contract and/or its perform its obligations in accordance with terms and conditions of the contract and neglects the owner's written notices in this regard. f) The contractor fails to maintain the progress of execution of the project as per agreed work completion	61.1 Termination for Contractor's Default 61.1.1 The Owner, without prejudice to rights and remedies it may posses, may terminate the contract forthwith in the following circumstances by giving the notice of Termination and its reasons therefor to the Contractor referring to this Clause No. 61.1: a) if the Contractor becomes bankrupt or insolvent, has a receiving order issued against it, compounds with its creditors, or, if the Contractor is a corporation, a resolution is passed or an order is made for its winding up (other than a voluntary liquidation for the purpose of amalgamation or reconstruction), a receiver is appointed over its undertaking or assets or if the Contractor takes or suffers any other analogous action in consequence of debt. c) If the Contractor assigns or transfers the Contract or any right or interest therein in violation of provisions of the Clause No. 20.0 above. d) If the Contractor, to the judgment of the Owner has indulged into Fraudulent or Corrupt practice in competing or in executing the Contract. For the purpose of this Clause: "Corrupt practice" means offering, giving, soliciting anything of value to influence the action of the employees, agents, consultants of the Owner in the procurement process or in execution of	

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		schedule except for the reasons beyond its control and on receipt of the notice from the owner in this regard, fails or neglects to take actions to the satisfaction of the owner the satisfaction of the owner to increase the pace of the execution of the project. g) The contractor becomes bankrupt or being a company, goes into liquidation for the reasons other than reconstruction or amalgamation. 61.1.2 In case any one of the situation as stipulated under Clause 0 above arises, the owner may, without prejudice to other remedies available under the contract, give notice to the contractor stating the nature of the default(s) and requiring the contractor to remedy the same. 61.1.3 If the contractor fails to remedy or take steps to remedy such default(s) within fourteen days from the date of receipt of such notice, the employer may terminate the contract forthwith at risk and costs of the contractor by giving notice of Termination of the Contract to the Contractor. 61.1.4 In the event of termination of the contract for Default of the Contractor, the owner may complete the balance works by itself or by employing another agency. In such an event, the owner take possession of contractor's construction	the Contract. “Fraudulent practice” means misrepresentation of the facts in order to influence the procurement process or execution of the contract to the detriment of the Owner and includes collusive practice among the Bidders (prior or after bid submission) designed to establish the bid price at artificial non-competitive levels and to deprive the Owner form the benefits of free and open competition. 61.1.2 If the Contractor: a) refuses to honour the Award of the Contract issued by the Owner or fails to submit the performance security deposit within the period stipulated/extension granted by the owner for this purpose b) has abandoned or repudiated the contract c) has without valid reasons has failed to commence the works promptly or has suspended the progress of performance of the contract (other than pursuant to Clause No. 32.2 above) for more than twenty-eight (28) days after receiving written instruction from the Owner to proceed d) persistently fails to execute the Contract in accordance with the Contract or persistently neglects to carry out its obligation under the contract without just clause e) refuses or unable to provide sufficient materials, service or labour to execute the works in the manner specified in the Work Completion Schedule appended to the Contract at the rate that give reasonable assurance to the Owner that the Contractor can attain completion of the work within the Time for Completion as amended Then the Owner may, without prejudice to any rights and remedies it may	

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		equipment at site for use either by itself or through another agency so employed by making payment of reasonable rent for the same to the contractor for completion of the balance work. All expenses for maintenance and/or making good the damages to the equipment during the possession of owner shall be to the owner's account. 61.1.5 The contractor shall be entitled to be paid the costs of work executed till the date of termination of the contract subject to recoveries, if any. 61.1.6 If the sum payable to the contractor as per Clause 61.1.5 and the costs incurred by the owner in execution of the balance works by pursuant to this clause exceed the contract price, the contractor shall be liable for such excess. 61.1.7 In addition, such action by the Owner as aforesaid shall not relieve the Contractor of his responsibility to pay liquidated damages for delay in completion of the works as defined in this contract. 61.1.8 In the event of Termination of the contract for Default of the Contractor, the owner may debar the contractor from participating in bids invited by the owner for the period of three years. However, in case of Default due to Fraudulent Behaviour/Corrupt Practices,	possess under the Contract, give notice to the Contractor stating the nature of the default and the Contractor requiring remedy the same. If the Contractor fails to remedy or take steps to remedy the same within fourteen (14) days of its receipt of the notice, then the Owner may terminate the Contract by giving notice of Termination that refers to this Clause No. 61.1. 61.1.3 Upon receipt of the notice of termination under Clauses 61.1.1 or 61.1.2 above, the Contractor shall, either immediately or upon such date specified in the notice of termination, (a) cease all further work, except for such works as specified by the Owner for sole purpose of protecting the works already executed, or the works required for leaving the site in safe and clean condition (b) terminate all subcontracts, except those to be assigned to the Owner pursuant to paragraph (d) below (c) deliver the Owner, the parts of the Works already executed upto the date of termination (d) to the extent legally possible, assign to the Owner all rights, title and benefits of the Works and to Plant and Equipment as at the date of termination, and, as may be required by the Owner, in any subcontracts concluded between the Contractor and its subcontractors (e) Deliver to the Owner all drawings, specifications and other documents prepared by the Contractor and its subcontractors as at the date of termination in connection with the execution of the Contract. 61.1.4 The Owner may enter upon the site, expel the Contractor and Complete the	



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		the contractor shall be blacklisted. 61.1.9 The termination of the contract under this clause shall not entitle the Contractor to reduce the value of the performance guarantee nor the time thereof. The performance guarantee shall be valid for the full value and for the full period of the contract and 90 days period after the end of the guarantee period.	Works itself or by employing third party. In such an event, the Owner may take possession of Contractor's construction equipment at site, by making payment of reasonable rent for the same to the Contractor and with an indemnification by the Owner for all liability including damage or injury to persons arising out of use of such equipment by the Owner, for use either by itself or through another agency so employed for completion of the balance work. All expenses for maintenance and/or making good the damages to the equipment during the possession of owner shall be to the Owner's account. Upon completion of the works or at such earlier date the Owner thinks appropriate, the Owner shall give notice to the Contractor that such Contractor's equipment shall be returned to the contractor at site or near the site and shall return such Contractor's equipment to the Contractor in accordance with such notice. The Contractor shall thereafter, without delay and its cost shall remove or arrange removal of the same from the site. 61.1.5 Subject to Clause 61.1.6 below, the Contractor shall be entitled to be paid the costs of works executed as at the date of termination and the costs, if any, incurred in protection of the work executed and leaving the site in clean and safe condition pursuant to paragraph (a) of Clause 61.1.3 above. Any sums due to the Owner accruing prior to the date of termination shall be deducted from the amounts to be paid to the Contractor under this Contract. 61.1.6 If the Owner completes the works under the Contract, the costs of

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			completing the works shall be determined. If the sum, the Contractor is entitled to be paid pursuant Clause 61.1.5 above, plus the costs incurred by the Owner in completing the works, exceeds the Contract Price, the Contractor shall be liable for such excess. If such excess if greater than the sums due to the Contractor under to Clause 61.1.5 above, the Contractor shall pay the balance to the Owner, and, if such excess is less than the sums due to the Contractor under to Clause 61.1.5 above, the Owner shall pay balance to the Contractor. 61.1.7 In addition, such action by the Owner as aforesaid shall not relieve the Contractor of his responsibility to pay liquidated damages for delay in completion of the works as defined in this contract. 61.1.8 In the event of termination of the contract pursuant to Clause 61.1.2 above, the Owner may debar the Contractor from participating in the bids invited by the Owner for the period of three (3) years. However, in case the Contract is terminated pursuant to Clause No. 61.1.1 above, the contractor shall be blacklisted. 61.1.9 Termination of the Contract under this Clause No. 61.1 shall not entitle the Contractor to reduce the value of the performance guarantee nor the time thereof. The performance guarantee shall be valid for the full value and for the full period of the contract and 90 days period after the end of the guarantee period.	

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23	61.3	61.3 Termination for the Owner's Convenience: 61.3.1 The owner may, at any time during the execution of the contract, terminate the contract by giving 30 days notice of termination to the contractor referring to this Clause No. 61.3. 61.3.2 The Contractor upon receipt of such notice shall discontinue the work on the date and to the extent specified in the notice, make all reasonable efforts to obtain cancellation of all orders and contracts to the extent they are related to the Owner, stop all further sub-contracting or purchasing activity related to the work terminated, and assist the Owner in protection and disposition of the works acquired under the contract by the owner. 61.3.3 In the event of such termination, the Contractor shall be eligible for compensation, equitable and reasonable, dictated by the circumstances prevalent at the time of termination. In such cases, the Engineer's decision shall be final and binding on the Contractor subject to arbitration as provided for in the contract. 61.3.4 Notwithstanding the anything stipulated above, such compensation shall not exceed	61.3 Termination for Owner's Convenience: 61.3.1 The Owner may at any time terminate the Contract for any reason by giving contractor a notice that refers to this Clause 61.3. 61.3.2 Upon receipt of the notice under the Clause No. 61.3, the Contractor shall either immediately or upon date notified in the notice of termination (a) cease all further work, except for such works as specified by the Owner for sole purpose of protecting the works already executed, or the works required for leaving the site in safe and clean condition (b) terminate all subcontracts, except those to be assigned to the Owner pursuant to paragraph (d) (ii) below (c) remove all Contractor's equipment from the site, repatriate Contractor's and Subcontractors' personnel from the site, remove from the site any wreckage, rubbish and debris of any kind from the site and leave the whole site in safe and clean condition. (d) In addition, subject to payment mentioned under Clause 61.3.3 below, the Contractor shall (i) Deliver to the Owner the parts of the Works executed by the Contractor as at the date of termination. (ii) to the extent legally possible, assign to the Owner all right, title and benefit to the Contractor to the Works and to the Plant and Equipment as at the date of Termination, and, as may be required by the Owner, in any subcontracts concluded between the Contractor and his Subcontractors (iii) Deliver to the employer all non-proprietary drawings, specifications	

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		the contract price minus the sums already paid to the contractor against this contract and recoveries, if any from the contractor.	and other documents prepared by the Contractor and its Subcontractors as at the date of termination in connection with the Contract. 61.3.3 In the event of termination of the Contract under Clause No. 61.3, the Owner shall pay to the Contractor the following amounts: (a) the Contract Price, properly attributable to the Works already executed by the Contractor as at the date of termination (b) the Costs reasonably incurred by the Contractor for removal Contractor's equipment from the site and in the repatriation of Contractor's and Subcontractors' personnel (c) any amounts to be paid by the Contractor to its Subcontractors in connection with the termination of any subcontracts, including any cancellation charges (d) costs incurred by the Contractor in leaving the site in clean and safe condition pursuant paragraph (a) of Clause 61.3.2 above (e) the costs of satisfying all other obligations, commitments and claims that the Contractor may have undertaken in good faith with third parties in connection with the contract and that are not covered in paragraphs (a) through (d) above. Notwithstanding the anything stipulated under this Clause, total amount payable under paragraphs (a) through (e) above shall not exceed the Contract price minus the sums already paid to the contractor against this contract and recoveries, if any from the contractor.	



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24	Section 2, Page 214 / Cl. No. 62	62.2 Either party shall, within 15 (fifteen) days from the occurrence of such a cause, notify the other in writing of such causes. Unless otherwise directed by the owner in writing, the contractor shall continue to perform its obligations under the contract as far as reasonably practical and shall seek all reasonable alternative means for performance not prevented by the Force Majeure event. 62.3 The contractor or the owner shall not be liable for delays in performing their respective obligations resulting from any Force Majeure cause as referred to and / or defined above. The date of completion shall be extended by a reasonable time even though such cause may occur after the contractor's performance of his obligations has been delayed for other causes. 62.4 However, for delay by the contractor or his sub-contractor which may result directly or indirectly from his negligence, mistakes, improper co-operation or failure to supply full information, the work completion period shall not be extended.	Clause No. 62: Force Majeure: 62.1 Remain unchanged 62.2 If either party is prevented, hindered or delayed from or in performing any of its obligations under the Contract by an event of Force Majeure, then it shall notify the other of the occurrence of such event and circumstances thereof within fifteen (15) days after the occurrence of such event. 62.3 The party giving such notice shall be excused from performance or punctual performance of its obligations under the Contract for so long as the relevant event of Force Majeure continues and to the extent that such party's performance is prevented, hindered or delayed. The time for Completion shall be extended to the extent of such period. 62.4 The party or the parties affected by the event of the Force Majeure shall use reasonable efforts to mitigate the effect there of upon its or their performance of the Contract and to fulfil its or obligations under the Contract, but without prejudice to either party's right to terminate the Contract under Clause 62.6 below. 62.5 No delay or non performance by either party hereto caused by the occurrence any event of Force Majeure shall (a) constitute a default or breach of the Contract (b) give rise to any claim, damages or additional cost or expenses occasioned thereby if and to the extent that such delay or non-performance is occasioned by any event of Force Majeure. 62.6 If performance of the Contract is substantially prevented, hindered or

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			delayed for the single period more than one hundred and eighty (180) days on account of one or more reasons of Force Majeure during the currency of the Contract, the parties will attempt to develop a mutually satisfactory solution, failing which the dispute shall be resolved in accordance with Clause 63.0, Settlement of Disputes stipulated hereunder. 62.7 Notwithstanding Clause 62.5, the Force Majeure shall not apply to Owner's obligation to make payments to the Contractor herein.	
25	Section 2A, Page 226 / Cl. No. 3.1	The inspection of goods to be supplied by the owner/owner's authorised representative shall be generally carried out as stipulated hereunder at pre-identified customer hold points as per the approved Quality Plan. However, the owner or his authorised representative shall have unrestricted access to the premises of contractor/subcontractor where goods to be supplied against this contract are being manufactured during the process of manufacturing of goods.	The inspection of goods to be supplied by the owner/owner's authorised representative shall be generally carried out as stipulated hereunder at pre-identified customer hold points as per the approved Quality Plan. However, the owner or his authorised representative shall have unrestricted access to the area of the plant of contractor/subcontractor, where goods to be supplied against this contract are being manufactured during the process of manufacturing of goods.	
26	Section 2A, Page 226 / Cl. No. 3.2.2	The contractor, at-least one month prior to expected date of attaining the respective stage of manufacturing/readiness of the goods, shall submit the inspection call indicating the date of inspection to the Controller of the Quality appointed by the owner/IIA under intimation to the Controller of Quality.	The contractor, at-least 21 days prior to expected date of attaining the respective stage of manufacturing/readiness of the goods, shall submit the inspection call indicating the date of inspection to the Controller of the Quality appointed by the owner/IIA under intimation to the Controller of Quality.	
27	Section 2A, Page 228 / Cl. No. 3.3.4	Offshore Supplies: The contractor, at least two months before the expected date of attaining such stage of manufacturing/readiness of goods, shall intimate the Chief Engineer (P&P). The Chief	The contractor, at least 45 days before the expected date of attaining such stage of manufacturing/readiness of goods, shall intimate the Chief Engineer (P&P). The Chief Engineer.....of visa etc.	

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		Engineer.....of visa etc.		
28	Section 2A, Page 233 / Cl. No. 8.11	The contractor shall be solely responsible for payment of all taxes & duties including the taxes and duties stipulated above applicable to for supplies against this contract to appropriate authorities and shall indemnify the owner from any law, suits and litigation whatsoever that arise due to non-compliance of payment of taxes & duties by the contractor -----	The contractor shall be solely responsible for payment of all taxes & duties including the taxes and duties stipulated above applicable to for supplies against this contract and assessable against Contractor/Sub-contractor to appropriate authorities and shall indemnify the owner from any law, suits and litigation whatsoever that arise due to non-compliance of payment of taxes & duties by the contractor -----	
29	Section 2A, Page 234/ Cl. No. 8.13	No tax applicable as on record date other than stipulated under this clause No. 8.0 -----however be limited to the amount of taxes & duties indicated in the price schedule.	No tax applicable as on record date other than stipulated under this clause No. 8.0 ----- however be limited to the amount of taxes & duties indicated in the price schedule. However, increase/decrease in amount of taxes and duties owing to foreign currency variation and taxes and duties payable on Price Adjustment shall accrue to the Owner. Such Increase/decrease in taxes and duties shall be apart from the amount of taxes and duties indicated in the price schedule.	
30	Section 2A, Page 236 / Cl. No. 11.12.1	Mandatory Spares and Special Tools & Tackles: The deliveries of Mandatory Spares and Special Tools & Tackles -----in accordance with Clause No. 41, Section- 2, Volume - I.	Mandatory Spares and Special Tools & Tackles: The deliveries of Mandatory Spares and Special Tools & Tackles -----in accordance with Clause No. 41, Section- 2, Volume - I. However, imported spares may be supplied alongwith respective equipment.	

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31	Section 2A, Page 243 / Cl. No. 13.1.5	In case of delay in supply of Mandatory Spares and if ordered the 3 Year's O&M (Recommended) Spares, Liquidated Damages @ ½% per week of delay or part thereof on the contract value (excluding taxes and duties thereon) and the amount of the price adjustment of delayed spares shall be payable by the contractor. However, total Levy of Liquidated Damages on account of delay in supply shall not exceed 10% of contract value (excluding the taxes and duties) and the amount of the Price Adjustment of Mandatory Spares or Recommended Spares, as the case may be ordered against this contract.	13.1.5 In case of delay in supply of Mandatory Spares and if ordered the 3 Year's O&M (Recommended) Spares, Liquidated Damages @ ½% per week of delay or part thereof on the amount of Contract Value (excluding taxes and duties thereon) of delayed spares plus the amount of the price adjustment thereon shall be payable by the Contractor. However, total Levy of Liquidated Damages on account of delay in supply of Mandatory Spares and if ordered, the 3 Year's O&M (Recommended Spares), shall not exceed 10% of Contract Price (excluding the taxes and duties thereon) of Mandatory Spares or the Recommended Spares, as the case may be, ordered against contract plus the amount of the Price Adjustment thereon.	
32	Section 2B, Page 253 / Cl. No. 2.2	Regulations of Local Authorities and Statute	All registration and statutory inspection fees, if any, in respect of his work pursuant to this Contract shall be to the account of the Contractor. However, the Contractor shall not be liable for such expenses for items mentioned in Table-1, Section-3 where the Owner is responsible.	
33	Section 2B, Page 257 / Cl. No. 7.1	~ If the Works of the contractor is delayed because of any acts or omission of another contractor, the Contractor shall have no claim against the owner on that account other than an extension of time for completing his works.'	~ If the Works of the Contractor is delayed because of any acts or omission of another Contractor, the provisions of Clause No. 31.0, Section - 2 shall apply.	
34	Section 2B, Page 266 / Cl. No. 19.1	~. The Engineer may impose such restrictions on the facilities provided to the Contractor such as electricity, water etc. as he may think fit in the interest of the Owner and the Contractor shall strictly adhere to such restrictions and co-operate with the Engineer.	~. The Engineer may impose such restrictions on the facilities provided to the Contractor such as electricity, water etc. at such places as he may think fit in the interest of the Owner and the Contractor shall strictly adhere to such restrictions and co-operate with the Engineer.	

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		CORRIGENDUM - XVI		
Sr. No	Section /Page No/Cl. No.	Provision of the Bid Specification updated so far	Amendment to the Clause - To be read as -	
35	Section 2B, Page 269 / Cl. No. 23.6	The total amount payable to the contractor as per the rates of Taxes & Duties at Clause 23.1 to 23.5 above applicable as on record date shall however be limited to the amount of taxes & duties indicated in the price schedule.	The total amount payable to the contractor as per the rates of Taxes & Duties at Clause 23.1 to 23.5 above applicable as on record date shall however be limited to the amount of taxes & duties indicated in the price schedule. However, increase/decrease in amount of taxes and duties owing to foreign currency variation and taxes and duties payable on Price Adjustment shall accrue to the Owner. Such Increase/decrease in taxes and duties shall be apart from the amount of taxes and duties indicated in the price schedule.	
36	Section 2B, Page 275 / Cl. No. 30.1	The Contractor shall be responsible for any damage resulting from his operations. He shall also be responsible for protection of all persons including members of public and employees ~	The Contractor shall be responsible for any damage resulting from his operations. He shall also be responsible for protection, from any damage resulting from his operation of all persons including members of public and employees ~	
37	Section 2B, Page 283 / Cl. No. 36.0	Compensation for Over run Period: 36.1 The entire works against this contract are required to be completed within the contractual completion period from the commencing from the zero date as per the Project Completion Schedule. 36.2 The Contractor shall not be liable for any compensation if the works get prolonged for 6 (six) months beyond the contract period due to the nonfulfillment of the obligations on the part of the Owner and this 6 (six) months period will be treated as free over run period to the Owner. 36.3 The Contractor shall be liable for compensation, only if the contract period gets extended beyond 6 (six) months from the scheduled date of completion due to non-fulfillment of the obligations by the owner/or his authorised representative/other agencies under his control at the rate of	Clause No. 36.0 of Section 2B is deleted	

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		INR 1,500,000/- (In words INR One Million Five Hundred Thousands only) per month and prorata for part of the month. This rate shall be firm.		
38	Section 2C, Page 293 / Cl. No. 8.1	All works under this contract, unless specified otherwise, shall conform to the latest revision and/or replacement of Indian Standard Specification and Codes of Practice. In case specifically Indian Standard Specification does not cover any particular aspect of work, any other standard practice may be specified by the Engineer shall be followed.	All works under this contract, unless specified otherwise, shall conform to the latest revision and/or replacement of Indian Standard Specification and Codes of Practice as on "Record Date" . In case specifically Indian Standard Specification does not cover any particular aspect of work, any other standard practice may be specified by the Engineer shall be followed.	
39	Section 2C, Page 294 / Cl. No. 12.1	The owner reserves the right to make any changes in the design and plans of the works and the contractor shall be bound to carry them out. No claim or compensation would be allowed on this account.	Clause No. 12.1 deleted. The provisions of Clause No. 46 read with Clause 25 shall be applicable	
40	Section 2C, Page 295 / Cl. No. 13.6	The approval to the design and drawing submitted by the contractor shall generally be given with	Clause 13.6 deleted. The provisions of Clause No. 25.0, Section 2 shall be applicable.	
41	Section 2C, Page 295 / Cl. No. 13.10	It may also be noted that after the payment have been made to the contractor for drawings and design as per ...	Clause to be deleted. Refer proposed amendment to Clause 52.0, Section 2.	
42	Section 2C, Page 300 / Cl. No. 22.1	Notification of Delivery / Despatch: The notification of delivery or dispatch in regard to each and every consignment shall be made by Fax and by detailed letter to the Owner's Engineer at Site Bombay-400 019.	The notification of delivery or dispatch in regard to each and every consignment shall be made by Fax or e-mail and by detailed letter to the Owner's Engineer at Site..... Mumbai - 400 019.	
43	Section 3, Page 309 / Cl. No.	The contractor shall guarantee 90% availability of the plant for one (1) year from the date of trial operation. In case this is not achieved, such period shall	1.3 The Contractor shall guarantee 90% availability of the plant for one (1) year from the date of Taking Over of the plant in terms of the Contract . In case this is not	

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	1.3	be further extended to one year from the date of repair of the equipment, until such availability is achieved till such time Contract Performance Security shall required to be extended. The contractor shall maintain full fledged supervisory staff until such period.	achieved, such period shall be further extended to one year from the date of repair of the equipment, until such is achieved till such time Contract Performance Security shall required to be extended. The availability of the plant shall be calculated as under <u>:</u> % Availability = (OT + IT)/ 8760 Where - OT = Actual operating hours of the Plant during the one (1) year period (8760 hours) starting from the date of Taking Over of the plant IT = Time in hours when the Plant may be idle in the one (1) year period (8760 hours) due to reasons not attributable to the Contractor. The Plant's 'Availability' guarantee will be based on the following conditions: a) Operation and Maintenance shall be done as per applicable Standard Operating Procedures, O&M manuals and OEM recommendations. b) Outage of the equipment/ system shall be taken as and when indicated by the Contractor to prevent extensive damage. c) Loss of availability due to natural calamities, inclement weather conditions such as heavy rainfall, flood etc. shall treated as reasons not attributable to the Contractor d) The shutdown period for arranging Performance Test and other tests required as per the Contract shall not be counted as an outage. Period for	

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			planned maintenance including statutory inspection time shall be considered as Plant Available period. e) The Contractor shall be given unrestricted access to operational records/trends/data/history maintained in the systems by the Owner during the one year period to assess the general condition of the plant and suggest steps to improve the plant availability. f) The Contractor at their discretion may maintain necessary staff in the general shift, specifically for event monitoring. Contractor shall not provide technical advice or supervise Operation & Maintenance. Role of Contractor's personnel shall be limited to observing/ tracking of the O&M of the plants/systems and bring to the notice of the Owner any departures/deviations thereof.	
44	Section 3, Page 322/ Cl. No. 4.1	Currently, no benefits of exemption of taxes and duties for supply of goods to power plant are available to this project.	Currently, no benefits of exemption of taxes and duties for supply of goods to power plant are available to this project except for allowing imports on payment of Customs Duty at concessional rate pursuant to provisions of Customs Notification No. 12/2012 as amended. The owner shall arrange for Essentiality Certificate or any other certificate(s) at the request of the Contractor for the same to enable it to clear the goods required for the project on payment of concessional rate of Customs Duty. However, Owner's responsibility shall be limited to arrangement of the Certificates as required and the Contractor shall be responsible for availing such benefit. The Customs Duty on the goods directly dispatched to the site paid by Contractor as per the concessional rate	

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			applicable as on date of customs clearance or Record Date, whichever is lower, shall be reimbursed to the Contractor against documentary evidence admissible as per the Statute in force. Provisions of Clause No. 8.1.1, Section - 2A are modified to this extent.	
45	Section 3, Page 322/ Cl. No. 4.2.2	In the event, benefits of exemptions (part or complete) of taxes & duties including but not limited to, those on input raw materials required to manufacture the equipment are extended to this project during the execution of contract, the contractor shall pass on such benefits to the owner. The owner shall issue, if he is empowered to do so, necessary certificates/declarations as may be required under the statute in force so as to enable the contractor to claim such benefits.	In the event, benefits of exemptions (part or complete) of taxes & duties including but not limited to, those on input raw materials required to manufacture the equipment are extended to this project or it is revealed that such exemption (part or complete) or any other concession are available for this project, during the execution of contract, the contractor shall pass on such benefits to the owner. The owner shall issue, if he is empowered to do so, necessary certificates/declarations as may be required under the statute in force so as to enable the contractor to claim such exemption / concession.	

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5.0 <u>LIST OF APPROVED VENDORS – CIVIL</u>				
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	<u>NDCT</u>			
1.0	FILL	(a)	BRENTWOOD	
		(b)	MUNTERS EUROFORM	
		(c)	PAHARPUR	
		(d)	HAMON	
		(e)	MMAQUA	
		(f)	COOLDECK	
2.0	FILL GLUE	(a)	AS PER FILL MANUFACTURER'S RECOMMENDATION	
3.0	TESTING AGENCY FOR PVC FILL	(a)	SRIRAM LABS, NEW DELHI	
		(b)	CIPET, CHENNAI	
4.0	SLIDE GATES	(a)	GMW	
		(b)	MACMAT	
		(c)	MAHINDRA ASSOCIATES	
5.0	STEEL	(a)	SAIL	
		(b)	TATA	
		(c)	JINDAL	
		(d)	VIZAG STEEL	
6.0	PVC PIPES	(a)	FINOLEX	
		(b)	SUPREME CHEMPLAST	
		(c)	PRINCE	
7.0	PUSH TROLLEY, CHAINPULLEY BLOCK, HOOK & CHAIN	(a)	WMI	
		(b)	INDEF	
8.0	RED OXIDE ZINC CHROMATE	(a)	'APCOMIN' OF ASIAN PAINTS	

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	PRIMER	(b)	BISON UNIVERSAL OF BRITISH PAINTS
		(c)	'3100' OF JANSON & NICHOLSON
		(d)	SYNTHETIC ZINC CHROMATE OF SHALIMAR PAINTS
9.0	EPOXY PRIMER	(a)	HINDUSTAN CIBA GEIGY
		(b)	DR.BECK & CO
		(c)	CHEM.E.LEEK
		(d)	EQUIVALENT
10.0	EPOXY PAINT	(a)	HINDUSTAN CIBA GEIGY
		(b)	DR.BECK & CO
		(c)	EQUIVALENT
11.0	AVIATION WARNING LIGHTS	(a)	FLASH TECHNOLOGY
		(b)	USA
		(c)	AVAIDS TECHNOVATORS PVT LTD
		(d)	GURGAON OR EQUIVALENT.
12.0	NOZZLES	(a)	ZEMCAL (INDIA)
		(b)	VALQUA PRODUCTS CHENNAI OR EQUIVALENT.
13.0	AC PIPES	(a)	KANORIA
		(b)	CHARMINAR
		(c)	MRK PIPES, JAIPUR OR EQUIVALENT.
	<u>VENDORS FOR OTHER CIVIL WORKS</u>		
1.0	TMT REINFORCEMENT BAR	(a)	STEEL AUTHORITY OF INDIA LTD (SAIL)
		(b)	TATA IRON & STEEL CO. LTD
		(c)	RASHTRIYA ISPAT NIGAM LTD (RINL)

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		(d) M/S. SHYAM STEEL INDUSTRIES LIMITED, KOLKATA
		(e) ESSAR STEEL.
		(f) JSW STEEL.
2.0	CEMENT	(a) THE ASSOCIATED CEMENT COMPANIES LTD. (ACC)
		(b) AMBUJA CEMENT LTD.
		(c) ULTRA TECH CEMENT LTD.
		(d) M/S ANDHRA CEMENT
		(e) M/S. INDIANA CEMENTS LIMITED.
		(f) MANIKGAD CEMENTS
		(g) ORIENT CEMENTS
3.0	STRUCTURAL STEEL	(a) STEEL AUTHORITY OF INDIA LTD (SAIL)
		(b) TATA IRON & STEEL CO. LTD
		(c) RASHTRIYA ISPAT NIGAM LTD (RINL)
		(d) JINDAL STEEL
		(e) ESSR STEEL.
4.0	STAINLESS STEEL	(a) STEEL AUTHORITY OF INDIA LTD. (SAIL)
5.0	GROUTING MATERIAL	(a) FOSROC CHEMICALS (I) PVT LTD.
		(b) M/S BASF (INDIA)
		(c) SIKA QUALCRETE PVT LTD.
		(d) CICO TECHNOLOGIES LTD
		(e) M/S BLACK CAT ENTERPRISES
		(f) M/S PIDILITE INDUSTRIES
6.0	PLASTICISER IN WATER PROOFING MATERIAL	(a) FOSROC CHEMICALS (I) PVT LTD
		(b) SIKA QUALCRETE PVT LTD

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		(c)	CICO TECHNOLOGIES LTD
		(d)	M/S. BLACKCAT ENTERPRISES
		(e)	M/S BASF CONSTRUCTION CHEMICALS
		(f)	M/S PIDILITE INDUSTRIES
7.0	WELDING ELECTRODES	(a)	M/S. ESAB INDIA LIMITED
		(b)	M/S. ADOR WELDING LIMITED
		(c)	M/S. GENERAL ELECTRODES & EQUIPMENTS LIMITED
		(d)	M/S. MODI ELECTRODES LIMITED
		(e)	M/S. MORGARDSHARMMER INDIA LTD., DELHI.
		(f)	M/S. WELDWELL ELECTRODES, NAGPUR.
8.0	ROOF WATER PROOFING – BITUMINOUS MEMBRANE	(a)	SHALIMAR TAR PRODUCTS LTD
		(b)	TEXA
9.0	ROOF WATER PROOFING – ELASTOMERIC MEMBRANE OR CHEMICAL (PAINT/ ADMIXTURE/COMPOUND)	(a)	TEXA
		(b)	ICHNOCHEM PVT LTD
		(c)	LLOYD
		(d)	SIKA INDIA PVT. LTD.
		(e)	ZYDEX
10.0	ROOF INSULATION – OVER DECK FOAM CONCRETE EXTRUDED POLYSTYRENE BLOCK	(a)	SIPOREX
		(b)	SUPREME INSUBOARD
11.0	FALSE CEILING-		
	(A) ALUMINIUM	(a)	LLOYD
		(b)	ARMSTRONG
		(c)	LUXALON BY HUNTER DAUGLAS,

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	(B) MINERAL FIBRE / GYPSUM BOARD	(a)	ARMSTRONG
		(b)	INDIA GYPSUM
		(c)	AMF
		(d)	EVEREST
12.0	ALUMINIUM EXTRUDED SECTIONS	(a)	HINDALCO
		(b)	DOMAL-HYDRO SYSTEMS
13.0	STEEL DOOR	(a)	NCL ALTEK & SECCOLOR LTD
		(b)	AGEW STEEL MFRS P LTD
		(c)	GANDHI ENTRANCE AUTOMATION PVT LTD.
		(d)	GODREJ
14.0	STEEL GATE	(a)	GANDHI ENTRANCE AUTOMATION PVT LTD.
15.0	FIRE DOOR	(a)	GODREJ
		(b)	NAVAIR
		(c)	GANDHI ENTRANCE AUTOMATION PVT LTD.
		(d)	PROMAT
16.0	STEEL WINDOW	(a)	NCL ALTEK & SECCOLOR LTD
17.0	DOOR HARDWARE	(a)	HAFELE
		(b)	GODREJ
		(c)	DORMA
18.0	STEEL REINFORCED PVC DOORS & WINDOWS	(a)	FENESTA BY DSC LTD.
19.0	ROLLING SHUTTER	(a)	DITEC-GANDHI ENTRANCE AUTOMATION PVT. LTD
20.0	PAINTS	(a)	ICI
		(b)	BERGER
		(c)	ASIAN PAINTS

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		(d)	NEROLAC
		(e)	SNOWCEM
21.0	GRANULAR TEXTURED FINISH	(a)	VINERATEX
		(b)	HERITAGE OF BAKELITE HYLAM
22.0	SYNTHETIC PLASTER	(a)	RENOVO
23.0	ALUMINIUM COMPOSITE PANELS- NAME OF SYSTEM PROVIDER-	(a)	ALUDECOR
		(b)	EUROBOND
		(c)	ALU BOND
24.0	METAL CLADDING – INSULATED AND NON INSULATED	(a)	LLOYD INSULATIONS (INDIA) LTD
		(b)	TATA BLUE SCOPE STEEL
		(c)	CRIL
		(d)	METECHNO
25.0	METALLIC FLOOR HARDENER NON METALLIC FLOOR HARDENER	(a)	IRONITE
		(b)	SIKA INDIA PVT. LTD.
26.0	SELF LEVELLING EPOXY FLOORING	(a)	SIKA INDIA PVT. LTD.
27.0	VITRIFIED TILES	(a)	MARBONITE
		(b)	"FERRASTONE" OR "HARDSTONE" OF "BOSS PROFILE LTD"
		(c)	RESTILE
		(d)	ENDURA" OF H & R JONSON (INDIA) PVT. LTD
		(e)	KAJARIA
		(f)	NITCO
28.0	CHEMICAL RESISTANT TILES	(a)	CHEMSTONE OF BOSS PROFILES LTD
		(b)	RESTILE CERAMICS LTD

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		(c)	FOSROCK
29.0	CHEMICAL RESISTANT THERMO PLASTIC PPG LINING ROLLS	(a)	CRESCENT TECHNOLOGIES PVT. LTD
30.0	VINYL FLOORING	(a)	ARMSTRONG
		(b)	WONDER FLOOR
		(c)	KRISHNA VINYL
31.0	GLASS	(a)	PILKINGTON GLASS INDIA PVT. LTD.
		(b)	AIS OF ASAHI INDIA GLASS LTD
		(c)	MODI GLASS
32.0	POLY CARBONATE SHEET WITH SUB-STRUCTURE SYSTEM PROVIDER	(a)	MCCOY ARCHITECTURAL SYSTEMS PVT. LTD.
		(b)	CITADEL ARCHITECTURAL SOLUTIONS PVT. LTD.
33.0	STAINLESS STEEL SINK WITH INTEGRATED DRAIN-BOARD		FRANKE
34.0	TOILET FIXTURES	(a)	KOHLER
		(b)	HINDWARE
		(c)	PARRYWARE
		(d)	NYCER
		(e)	CERA
35.0	TOILET FITTINGS	(a)	KOHLER
		(b)	JAQUAR
		(c)	ESCO
		(d)	ESS ESS
36.0	EXPANSION JOINT CONTROL	(a)	C/S ALLWAY BY MCCOY SILICONES LTD.

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37.0	SILICÓN SEALANT	(a)	MCCOY SILICONES LTD.	
38.0	INSULATION	(a)	TWIGA- FOR GLASS WOOL INSULATION	
		(b)	MINERAL ROCK FIBERS LTD.- FOR MINERAL FIBER WOOL INSULATION	
		(c)	INSUBOARD" BY THE SUPREME INDUSTRIES LTD – FOR EXTRUDED POLYSTYRENE FOAM INSULATION	

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