6.1.5 There shall be at least two (2) main access doors, one on either side of each building, of which one shall be minimum three (3) meters wide with rolling shutters for equipment entry. For multistoried buildings, at least two (2) regular staircases diagonally opposite to each other shall be provided connecting all the floors and roof. These minimum requirements shall be augmented as required depending on the floor area, statutory requirements and TAC recommendations.

6.1.6 All buildings shall have provision for toilet and associated effluent discharge system together with facility for drinking water. The criteria for ventilation, fire protection and illumination of building spaces specified elsewhere in this specification shall be complied with.

6.1.7 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.

6.1.8 Cubicle for operating personnel shall be located at safe place near the equipment.

6.1.9 Cable racks / pipe racks shall have hand railings in walkways on both sides at appropriate heights.

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.

6.2 The following requirements for equipment layout shall be complied with:

6.2.1 The regular basement floor is not acceptable in Boiler & Mill Bunker bay building. Further, local pits/trenches shall be avoided as far as possible.

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.

6.2.3 Interconnecting walkways (minimum 2 m width) between main plant building and boiler (on either side of boiler) at Ground, Mezzanine, Operating, PRDS and Deaerator floor levels shall be provided. Also inter-connecting platform between Boiler and Coal Tripper floor level and roof of Mill maintenance floor level, Feeder floor level, Bunker Building at Mill bay shall be provided. Number of interconnecting platforms between Boiler and Coal Bunker building for each level / floor specified above shall be two (2) on each side of Boiler i.e. four (4)/floor.

6.2.4 Two of the landing levels of the Goods Elevator shall preferably coincide with the feeder and tripper floor elevations. In case of difference in levels, electric hoists to shift goods from elevator floors to feeder/ tripper floors shall be provided.

6.2.5 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.

6.2.6 Clear walkways along A-row & B-row of TG building shall be provided as indicated below:

(a) 1.5 m at all levels of AB Bay.

(b) 3.5 m along B-row at operating floor level for interconnection with service Building & in front of control room.

6.2.7 The layout of the steam turbine unit shall permit sufficient lay down area for all the parts/components to enable carrying out maintenance and overhauling operations.

6.2.8 Steam turbine and generator (except stator) and other equipments located in the turbine hall shall be accessible by the EOT cranes for their handling during erection and maintenance. For all other equipment/components, suitable handling arrangement for erection and maintenance shall be provided.

6.2.9 In TG bay at crane rail level, walkway with handrails is envisaged for entire column sectional depth for full length of the building. In addition, it shall be ensured that on A-row and B-row columns, through walkway (without hindrance) of minimum 600 mm clear width is available from the face of the column to the handrail of the platform.

6.2.10 Layout of facilities and equipment shall allow removal of Generator Stator, Generator transformers, Station & Unit transformers without disturbing equipments, piping, cabling, duct routed in the area.

6.2.11 Adequate space and handling arrangement shall be provided for handling/ removal of pumps, heaters, heat-exchanger, fans, mills during maintenance.

6.2.12 Valves shall be located in accessible positions and operating/maintenance platforms shall be provided along with approach ladders & handrails for the same.

6.2.13 While developing the layout, all fresh air ventilation louvers shall be considered 1000 mm from floor level and directed downwards at an angle. Ventilation fans on AB bay roof shall be kept staggered and shall not be near the centerline of turbo generator set.

6.2.14 Each equipment room shall be provided with alternate exits in case of fire/ accidents as per requirements of factory Act and Statuary bodies/Insurance companies.

6.2.15 All other safety requirements as per the factories Act, Rules/regulations made under Electricity Act, 2003 and applicable codes/standards shall be observed while developing the layout.

7.0 OPERATION, MAINTENANCE & AVAILABILITY CONSIDERATIONS

7.1 Equipment/works offered shall be designed for high availability, high reliability, low maintenance and ease of operation & maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability, availability, operability and ease of maintenance. He shall also furnish details of availability records in plants stated in his experience list.

7.2 Ample space for ease of operation and maintenance including equipment removal, tube bundle / cartridge / rotor pulling etc shall be provided. All valves, gates, dampers and other devices shall be located and oriented in such a way that they are accessible from operating floor levels. Where this cannot be adhered to, platforms and walkways with access ladders shall be provided to facilitate operation and maintenance.

7.3 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.

7.4 Lifting devices like lifting tackles, slings etc. to be connected to hook of the hoist/crane shall be provided by the Bidder for lifting the equipment, accessories covered under this specification.

7.5 All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same material and workmanship as the corresponding parts of the equipment. Where ever feasible, common components shall be employed in different pieces of equipment in order to optimize the spares inventory and utilization.

8.0 MATERIALS

8.1 In selecting materials of construction of equipment, the Contractor shall pay particular attention to the atmospheric conditions existing at the Site and the nature of material/ fluid handled. Wherever deviations are taken in respect of materials specified, the reasons shall be spelt out clearly in the proposal.

All materials shall be new, and shall be of the quality most suited to the proposed application.

8.2 In as far as is possible; materials shall be in accordance with Indian or international standard specifications and shall be used in accordance with Indian or International codes of practice. Where such standards or codes of practice are not available, sufficient information shall be provided to allow the Engineer to assess the suitability of the material for the particular application.

All materials used shall have performed lengthy satisfactory service in similar or more arduous conditions to those proposed by the Contractor.

8.3 All parts which could deteriorate or corrode under the influence of the atmospheric, meteorological or soil conditions at the Site, or under the influence of the working conditions shall be suitably and effectively protected so that such deterioration or corrosion is a minimum over the life of the plant.

9.0 LUBRICATION

9.1 Provision shall be made for suitable efficient lubrication where necessary to ensure smooth operation free from undue wear.

9.2 Non ferrous capillary tubing shall be used throughout.

9.3 Gear boxes and oil baths shall be provided with filling and drain plugs, both of adequate size. An approved means of oil indication including level switches and temperature indication shall be provided.

9.4 All high speed gears shall be oil bath lubricated. Low speed gears shall be lubricated by means of soft grease. Removable and accessible drip pans shall be provided to collect lubricant which may drop from operating parts.

9.5 All lubrication points shall be conveniently situated for maintenance purposes. It must be possible to carry out lubrication from a gangway or landing and without the removal of guarding or having to insert the hand into it. Where accessibility to a bearing for oiling purposes would be difficult a method of remote lubrication shall be fitted.

9.6 The Contractor shall supply grease gun equipment suitable to service each type of nipple fitted.

10.0 LUBRICANTS AND CONTROL FLUIDS

10.1 The Contractor shall provide a detailed and comprehensive specification for all lubricating oils, greases and control fluids required for the entire plant. A sufficient supply of these shall be provided by the Contractor for initial commissioning, first fill and till COD of unit.

10.2 The Contractor shall supply a detailed schedule giving the lubricant testing, cleaning and replacement procedures. All equipment and facilities necessary for the testing, cleaning and changing of lubricants and control fluids shall be provided. The Contractor shall endeavor to reduce the varieties and grades of required lubricants and control fluids to a minimum, matching them where possible to those already in use in the generating station in order to simplify procurement and minimise storage requirements. All lubricants and control fluids shall be of internationally recognized standards and shall be easily obtainable from a large number of Indian suppliers. Bidder shall also indicate the equivalent Indian Standard for the above for easy procurement in future.

10.3 No lubricant or control fluid shall have toxic or other harmful effects on personnel or on the environment.

11.0 OPERATION AND MAINTENANCE

11.1 The plant shall be designed and constructed so that operation and maintenance manpower requirements are minimized.

The design and layout shall facilitate inspection, cleaning, maintenance and repair. The importance of continuity of operation is second only to that of safety.

11.2 Spare parts for equipment shall be interchangeable with the original components and, so far as possible, be of common design and manufacture.

11.3 All similar standard components/parts of similar standard equipment provided shall be interchangeable with one another. Further, identical equipments shall be provided for similar duties so that the same are interchangeable with one another in totality and component wise.

11.4 All heavy parts (500 Kg and above) must be provided with a convenient arrangement for slinging and handling during erection and overhaul. Any item of plant normally stripped or lifted during periods of maintenance and weighing one tonne or above, shall be clearly marked with its weight.

11.5 On completion of commissioning, a complete set of tools for the maintenance of the entire plant shall be provided by the Contractor. This shall include all necessary spanners, special wrenches, extraction equipment and any special tools reasonably required by the Engineer. Tools used during erection and commissioning shall not be accepted except with the specific approval of the Engineer.

11.6 All equipment and major valves should be provided with adequate maintenance approach and facility.

12.0 PLANT LIFE AND MODE OF OPERATION

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 critical components of the major equipments like Steam Generator, Turbine-Generator and Auxiliary equipment, the life of which is limited by time and temperature dependent mechanisms such as thermal stress, creep and low cycle fatigue, are to be designed considering expected (hot, warm and cold) start-up, shut-down and cyclic load variations.

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.

The expected start-ups should be considered as minimum
(Based on HPT metal temperature)

(a)	Cold start-up (>50 hrs. shutdown)	:	20 per year
(b)	Warm start-up (between 10 to 50 hrs. of shutdown)	:	40 per year
(c)	Hot start-up (Less than 10 hrs. shutdown)	:	180 per year

The allowable stresses shall be so selected so that life expectancy to minimum 2,00,000 hours of operation can be achieved. The Bidder shall

discuss this aspect in his technical proposal.

13.0 PACKAGING & MARKING

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials, the limitations from the point of view of availability of railway wagon sizes in India shall be taken into account. Bidder shall consider the details of various wagons normally available with Indian Railways for transportation of heavy equipment. The Contractor shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.

As per the information available, the dimensions of OD consignment for transportation of the equipment by rail (if any equipment to be handled through rail transportation) are as below:

(a)	Width of the Package (from centre-line of rails-1.6 metres on both sides)	:	3.2 Meters
(b)	Height of the package from rail top	:	4.47 Meters

The above indicates the dimensions, which can be normally transported on the wagons without infringement of the "moving gauge". This is however not indicative of the consignment which can be carried out with infringement of "moving gauge" duly authorised and approved by the Indian Railways. There may be difference between the "moving gauge" and the "fixed structure gauge" and consignments infringing the "moving gauge" can be moved after investigation regarding possible infringement with the fixed structures. As the critical fixed structures in each route are different, consignments infringing moving dimensions have to be individually investigated to select a route and also determine the restrictions under which such movement is to be carried out. Such routes selected or other mode of transport envisaged is to be clearly brought out in the proposal wherever transport of over dimensional equipment is involved.

Bidder shall consider unloading of material delivered through rail transportation, at near by railway station/ site unloading siding. The subsequent transportation up to project work place shall be considered by

road only. All unloading and handling equipment both at railway station siding and at project site shall be arranged by the Bidder. Necessary arrangement to be organized with the railway authority for such purpose shall also be under the scope of services of the Bidder. Bidder may consider entire material delivered up to site through rail transportation only.

The identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of the packages. In addition, the Contractor shall include in the marking gross and net weight, outer dimension and cubic measurement. Each package shall be accompanied by a packing note (in weather proof paper) quoting specifically the name of the Contractor, the number and date of contract and names of the office placing the contract, nomenclature of contents and Bill of Material.

For imported equipment and material, suitable port facilities may be used in which case material may be transported from the port by tractor-trailer. Bidder may consider this aspect.

Specification of Packaging and Marking has been described in detail in Volume I: General Condition of Contract of the Specification.

14.0 PROTECTION

Equipment having antifriction or sleeve bearings shall be protected by weather-tight enclosures. Coated surfaces shall be protected against impact, abrasion, discoloration and other damages. Surfaces that are damaged shall be repainted.

Electrical equipment controls and insulations shall be protected against moisture and water damages. All external gasket surfaces and flange faces, couplings, rotating equipment shafts, bearings and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection. All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors.

All piping, tubing and conduit connections on equipment and other equipment openings shall be closed with rough usage covers or plugs. Female threaded

openings shall be closed with forged steel plugs. The closures shall be taped to seal the interior of the equipment. Open ends of piping, tubing and conduit shall be sealed and taped.

Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense.

15.0 PAINTING

15.1 GENERAL

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. Surfaces not easily accessible after shop assembly shall be treated before-hand and protected for life of the equipment. Surfaces to be finish painted after installation shall be shop painted with at least two (2) coats of primer. Steel surfaces, which are not to be painted, shall be coated with suitable rust preventive compound subject to the approval of the Owner.

All paints shall be used in accordance with the manufacturer's instructions. No thinners or other substance 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.

All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

All primers shall be well marked into the surface, particularly in areas where pitting is evident, and the first priming coat shall be applied as soon as possible after cleaning, within four hours maximum. The paint shall be applied by brush, roller or airless spray, according to the manufacturer's instructions. Spray painting shall be carried out by operators trained and thoroughly experienced in the use of the equipment. If the drying interval between successive coats, which should not exceed one week, has been so long as to endanger the adhesion of the following coat, the paint already applied shall be lightly rubbed down with fine abrasive paper before putting on the next coat.

Paint spraying on large surfaces shall not normally be done indoors, except with the approval of the Engineer. Spray guns shall not be used outdoors in

windy weather or near unprotected surfaces of a contrasting colour and under no circumstances shall spray guns be used where spray may be carried into or onto exposed electrical equipment.

Paint containers shall not be opened until required and the paint shall be mechanically mixed thoroughly before use, and agitated occasionally during use.

Electrical equipment shall be shop finished with one or more coats of primer and two coats of high-grade oil resistant enamel. The interior of all panels' cabinets and enclosures shall be finished with gloss white enamel.

The Contractor shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory surfaces of each item of equipment. The touch-up paint shall be of the same type and colour as the factory applied paint and shall be carefully packed to avoid damage during shipment. Complete painting instructions shall be furnished.

The Contractor shall select shop primer for steel and iron surfaces, which will have a continuous operating temperature below 35°C, in accordance to the relevant standard. Special high temperature primer shall be used on surface exposed to operating temperature above 35°C.

The Owner/Engineer shall submit the colour scheme during execution of contract for approval.

15.2 PREPARATION

Oil and grease shall be removed from the surface by washing with a suitable detergent, rinsing with clean water, and drying.

Surfaces to be shot blasted shall be cleaned to Swedish Standard SA 2.5 or equivalent, and all dust remaining after cleaning shall be removed.

The priming coat shall be applied without delay.

15.3 DAMAGED PAINTWORK

Any damaged paintwork shall be made good as follows:

15.3.1 The damaged area, together with an area extending 25 mm around its boundary, shall be cleaned down to bare metal.

15.3.2 A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50 mm around the perimeter of the original damage.

15.3.3 The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming

15.4 PAINTING SYSTEMS

The requirements for the Dry Film Thickness (DFT) of paint and the materials to be used shall be as stated below, unless otherwise specified elsewhere in this specification.

15.4.1 Surfaces subject to Weathering

All surfaces shall have a minimum of four coats of paint made up as follows:

(a)	Primer coat	:	35 micron DFT
(b)	Tie coat	:	35 micron DFT
(c)	Finishing coat (Two Nos.)	:	35 micron DFT per coat
(d)	The total minimum DFT	:	140 micron

15.4.2 Surfaces Inside Buildings

All surfaces shall have a minimum of three coats of paint made up as follows:

(a)	Primer coat	:	35 micron DFT
(b)	Tie coat	:	35 micron DFT
(c)	Finishing coat (Two Nos.)	:	25 micron DFT per coat
(d)	The total minimum DFT	:	120 micron

The Contractor shall select the type and colour of primer & finish coat after approval by the Owner.

For detail painting on building & structural steel elements, please refer **Volume VI / A & B** of this specification.

16.0 COLOUR CO-ORDINATION & FINISH

16.1 Exterior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and with the surrounding landscape.

16.2 Interior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and which will be conducive to; the comfort, well-being and high productivity of the operators. Operating plant and services provided shall be colour coded for ease of identification.

16.3 All finishes shall be durable and as far as possible maintenance free. Finishes shall be easily cleaned.

16.4 Final colours and finishes shall be to the Approval of the Engineer.

17.0 ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT

17.1 ENVIRONMENT PROTECTION

The plant shall be designed for installation and operation in harmony with the surrounding environment and all measures of pollution control shall be ensured by the Bidder to restrict pollution from the liquid effluent and Stack emission within the limits as given below with due consideration of Environment (Protection) Rules 1986 as amended till date.

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.

17.1.1 For Liquid Effluent

(a) Provision laid down in schedule-I for Thermal Power Plants and also in Schedule-VI: General Standards for discharge of Environmental pollutants Part-A: Effects of Environmental (Protection) Rules 1986, as amended till date.

(b) Any specific requirement of State Pollution Authorities over and above the above stipulation

17.1.2 For Air Emission

(a) Suspended Particulate Matter i.e. dust burden at Chimney outlet - Maximum 50 mg/Nm^3 (with worst coal and one field out).

(b) NOx : 365 ppm (maximum) or 750 mg/Nm^3 (Equivalent NO_2).

(c) SO_2 : As per prevailing Indian/ World Bank standards

The Bidder shall include in his scope all necessary equipment and measuring instruments to comply with above requirements. Location and accessibility of the instruments shall be properly coordinated.

17.2 NOISE LEVEL REQUIREMENT

The plant shall be designed, constructed and provided with suitable acoustic measures to ensure the noise level criteria as per the following stipulations.

17.2.1 Maximum noise level shall not exceed 85 dB (A) when measured at 1.0 M away from the noise emission source.

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.

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.

18.0 INSPECTION AND TESTING

18.1 GENERAL:

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/ systems shall be furnished as part of the bid.

18.2 INSPECTION AND TESTS DURING MANUFACTURE

18.2.1 The method and techniques to be used by the Contractor for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner prior to the Award of Contract.

18.2.2 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this Specification.

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.

18.2.4 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.

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.

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.

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.

18.2.7 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Owner. The certificates shall include tests for mechanical properties and chemical analysis of representative material.

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.

18.2.9 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.

18.2.10 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR, as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination, magnuflux and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major butt welding joints shall be radiographed.

18.2.11 Statutory payments in respect of IBR approvals including inspection for design and manufacturer of equipment shall be made by the Bidder. All payment for erection and testing at site (i.e. under IBR Maharashtra Jurisdiction) shall also be made by the Bidder. In such case, Contractor's scope shall also be extended to preparation of all necessary documents, co-ordination and follow-up with IBR authorities for above approval.

18.3 PERFORMANCE TESTS AT SITE

18.3.1 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected system shall be tested by the Contractor on site under normal operating conditions. The Contractor shall also ensure the correct performance of the system under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks etc.

18.3.2 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.

18.3.3 The Contractor shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection,

pre-commissioning to tests on completion and commissioning of the complete system/equipment.

18.4 For details of specific tests required on individual equipment, refer to respective section of this specification.

19.0 TRAINING OF OWNER'S PERSONNEL

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.

Number of man-days of training as mentioned below shall be included in Tender.

19.1 TRAINING AT CONTRACTOR'S PREMISES

The Contractor shall conduct training of Thirty (30) engineers of the Owner on engineering, operation and maintenance of the Plant at the Contractor's or Associates or Sub-contractor's premises where adequate training facilities are available during the design and manufacturing stage of the Contract.

The total man-months for training of engineers shall be maximum Thirty (30), having following indicative break-up:

	Discipline	**Number of Engineers**	**Number of Man-month**
(a)	Operation	10 heads	10
(b)	Maintenance (Boiler & Turbine)	10 heads	10
(c)	Electrical Maintenance	4 heads	4
(d)	Control & Instrumentation	4 heads	4
(e)	Maintenance Planning	2 heads	2
		30 heads	30

However, the details of the training programme will be discussed and finalised with the successful Bidder.

The training may also be arranged by the Contractor in any Plant where the equipment manufactured by the Contractor or his Associates is under installation, operation or testing to enable the trainees to become familiar with the equipment being furnished by the Contractor. All expenses inherently related to the training shall be borne by the Contractor and shall include but not limited to travel expenses (international and inland fares), lodging and per diem charges as well as medical insurance, instructors fee, programme and miscellaneous cost to be incurred during the training.

The training programme shall be adequate for the trainees to acquire the necessary expertise and competence in the area of engineering, operation and maintenance and as trainers for in-house technology transfer programme of the Owner.

The Contractor shall be responsible for the development of the Training Module and Programme Schedule, which shall be submitted to the Owner for approval.

The components of the training modules shall include but not be limited to the training procedures/methodology, instructional materials such as audio visual materials, CDs and slides and manuals for each trainee.

Three (3) sets of the materials included in the training modules shall be handed over to the Owner upon completion of the training. An evaluation shall be jointly undertaken by the Contractor and the Owner's representative on the adequacy, appropriateness and relevance of the training and the programme effectiveness after the training. The training material shall be in English language only.

The content of the training programme shall include but not be limited to:

(a) Coal fired thermal plant principles in management and practice for operators, technicians and maintenance personnel.

(b) Plant operation and systems training for operators including simulator training as applicable.

(c) Maintenance training programme covering electrical, mechanical and instrumentation and control.

Said training programme shall be submitted to the Owner for approval.

The timing of the training should be such that the participants will be conversant with sufficient know-how to participate in the pre-commissioning and commissioning tests of the Plant.

The Contractor shall provide qualified English speaking instructors and training coordinator (s) during the tenure of the training programme.

19.2 OPERATION AND MAINTENANCE TRAINING AT SITE

The Contractor shall provide a comprehensive training programme related to design application, plant management, operation and maintenance, including trouble shooting of the Contractor's supplied system and equipment at the Site starting from Start of Commissioning and thereafter up to the Final Acceptance of the Unit.

The following instructors shall be at the Site continuously during the training:

(a) One (1) for Steam Generator and Auxiliaries ;

(b) One (1) for Turbine Generator and Auxiliaries ;

(c) One (1) for Electrical Works ;

(d) One (1) for Instrumentation and Control (Boiler and Auxiliaries) ;

(e) One (1) for Instrumentation and Control (Turbine and Auxiliaries).

Instructors shall also be available for Coal handling Plant, Ash Handling Plant, Water Treatment Plant and other specific areas as per requirement.

19.3 ON-THE-JOB TRAINING

During the period of pre-commissioning, commissioning and trial operation, the Owner shall provide operation and maintenance personnel to assist the Contractor in the operation and maintenance of his supply and work under the direction of the Contractor for the purpose of on-the-job training.

The Owner shall have the right to send to the Site his employees later intended to operate and maintain the equipment supplied under this Contract. The Contractor shall, without additional cost, use his site staff to instruct these employees on the operation and maintenance of the equipment. All instructions shall be in the English language.

LIST OF STANDARDS FOR REFERENCE

ANNEXURE – A

1.0 International Standards Organisation (ISO)

2.0 International Electro-technical Commission (IEC)

3.0 American Society of Mechanical Engineers (ASME)

4.0 American National Standards Institute (ANSI)

5.0 American Society for Testing and Materials (ASTM)

6.0 American Institute of Steel Construction (AISC)

7.0 American Welding Society (AWS)

8.0 Architecture Institute of Japan (AIJ)

9.0 National Fire Protection Association (NFPA)

10.0 National Electrical Manufacturer's Association (NEMA)

11.0 Japanese Electro-technical Committee (JEC)

12.0 Institute of Electrical and Electronics Engineers (IEEE)

13.0 Federal Occupational Safety and Health Regulations (OSHA)

14.0 Instrument Society of America (ISA)

15.0 National Electric Code (NEC)

16.0 Heat Exchanger Institute (HEI)

17.0 Tubular Exchanger Manufacturer's Association (TEMA)

18.0	Hydraulic Institute (HIS)
19.0	International Electro-Technical Commission (IEC) Publications
20.0	Power Test Code for Steam Turbines (PTC)
21.0	Applicable German Standards (DIN)
22.0	Applicable British Standards (BS)
23.0	Applicable Japanese Standards (JIS)
24.0	Electric Power Research Institute (EPRI)
25.0	Standards of Manufacturer's Standardization Society (MSS)
26.0	Bureau of Indian Standards (BIS)
27.0	Indian Electricity Rules
28.0	Indian Boiler Regulations (IBR)
29.0	Indian Explosives Act
30.0	Indian Factories Act
31.0	Tariff Advisory Committee (TAC) rules
32.0	Emission regulation of Central Pollution Control Board (CPCB)
33.0	Pollution Control regulations of Dept. of Environment, Govt. of India
34.0	Central Board of Irrigation and Power (CBIP) Publications
35.0	The Air Prevention and Control of Pollution Act
36.0	The Environmental Protection Act
37.0	The Public Liability Insurance Act

38.0 The Forest Conservation Act

39.0 The Wildlife protection Act

40.0 The EIA Notification, 1994

41.0 IS: 14665-Specification for Electric Traction Lift

42.0 Any other statutory Codes/Standards/Regulation

CONSULTANT : PROCON ENGINEERS

CRITERIA FOR LAYOUT

ANNEXURE – B

SR. NO.	ITEM	SPECIFICATION REQUIREMENT
1.0	**SITE CONDITIONS TO BE CONSIDERED**	
1.1	Prevalent wind direction during summer (for deciding cooling tower orientation)	See wind-rose in plot plan.
1.2	Prevalent wind direction (s) during dry seasons (for deciding the location of coal stock pile and ash dump/ unloading areas, minimising the pollution effect due to dust)	See wind-rose in plot plan.
1.3	Location of	
1.3.1	Raw Water intake point	As shown in Plot Plan
1.3.2	Plant drainage outfall point (s)	In Existing Drainage/Effluent treatment Plant
1.3.3	Railway entries & exits	As shown in Plot Plan
1.3.4	Road entries & exits	As shown in Plot Plan
1.3.5	Electrical power transmission grid system	As shown in Plot Plan
1.3.6	Preferred / selected ash dump area	Velhala nearly 10 Km from the site
1.3.7	Nearest residential area	Existing Colony

SR. NO.	ITEM	SPECIFICATION REQUIREMENT
2.0	**LAYOUT REQUIREMENTS**	
2.1	MAXIMUM PERMISSIBLE SLOPE IN	
2.1.1	Rail track	1 in 400
2.1.2	Road	1 in 30
2.1.3	Sides of unpaved embankment	1 in 2
2.2	REQUIRED ROAD WIDTH	
2.2.1	Main roads	14.00 Metres with 1.0 m wide shoulders on either side for outer roads on western and eastern side and 7 meters with 1.5 m wide shoulders for other two sides of power block.
2.2.2	Auxiliary interconnections	Minimum 4 Metres without shoulders on either side and shall vary upto 7 m subject to availability of space. For carriage way, 5 Metre wide with 0.5 Metre shoulders and 7.0 Mtre wide with 1.5 Metre shoulders.
2.2.3	Road to the power house unloading bay	
(a)	Only for entry to the unloading bay	Yes
(b)	To pass through the unloading bay	No

SR. NO.	ITEM	SPECIFICATION REQUIREMENT
2.3	Required minimum horizontal distance between the nearest points of	
2.3.1	Plant boundary and the boundary of residential area	(Local municipality/factory rule)
2.3.2	Electrical transformer and any other	As per the Tariff Advisory Committee Rules
2.3.3	Fire water supply installation and any building / facility subject to fire risk.	As per the Tariff Advisory Committee Rules
2.3.4	Inflammable liquid (fuel oil, etc.) storage & handling installation and their fencing and other buildings/facilities	Rules of the Indian Explosive (Indian Explosives Act) and Indian Petroleum Code
2.4	Required minimum vertical clearance	
2.4.1	Under pipes/cable racks at road crossings	8.0 Metres
2.4.2	Soil coverage over underground pipes	1.0 Metre (minimum)
2.4.3	Pipe/Cable trench	Not Acceptable
2.5	Railway Wagon clearance	Rules of the Indian Railways
2.6	Minimum Clearance between any road edge and building/ structure / any fixed installation	3 Metres
2.7	Required level, above the local developed grade level, of	

SR. NO.	ITEM	SPECIFICATION REQUIREMENT
2.7.1	Top of all roads	150 mm
2.7.2	All outdoor paved areas	150 mm
2.8	Temporary storage areas, workshops, offices, residence etc. required at the time of erection work.	Yes
2.9	Green belt around power plant area	As per environmental guidelines of MOEF, Govt. of India.

CONSULTANT : PROCON ENGINEERS

BUILDING/ EQUIPMENT LAYOUT REQUIREMENTS

ANNEXURE – C

SR. NO.	ITEM	SPECIFICATION REQUIREMENT
1.0	Minimum clear space required at all working and walking areas for operating & maintenance personnel	
1.1	HORIZONTAL, IN ALL DIRECTIONS	
1.1.1	Adjacent to any electrical equipment, electrical cables, running (rotating / reciprocating) equipment, safety valve or vent / drain pipe outlet, pipe / equipment of surface temperature exceeding 60°C.	1200 mm
1.1.2	Adjacent to any other plant facilities (including walls / structures)	1000 mm
1.2	VERTICAL (head-room clearance)	
1.2.1	Under any pipe / equipment surface of temperature exceeding 60°C and any electrical cables or other electrical items.	2.0 Metre
1.2.2	Under any other plant facilities (including structures, pipes etc.)	2.0 Metre

CONSULTANT : PROCON ENGINEERS

SR. NO.	ITEM	SPECIFICATION REQUIREMENT
1.3	For all areas where any equipment (including trucks, trolleys and other material handling equipment) move or manoeuvre.	Minimum 500 mm clear in all direction from the outer edges of the equipment
1.4	Minimum clear hand space required for	
1.4.1	The application of thermal insulation	100 mm
1.4.2	Welding work	150 mm
1.4.3	Bolt tightening	150 mm
2.0	**FLOORS, PLATFORMS, STAIRCASE, LADDERS, WALLS, DOORS & WINDOWS**	
2.1	Statutory Requirement	As per the regulations of Tariff Advisory Committee, Indian National Building Code, Indian Factories Act, Local Municipal Rules, etc.
2.2	OPERATION & MAINTENANCE REQUIREMENT	
2.2.1	Adequate floor space shall be kept to permit dismantling, temporary storing and in-situ Maintenance of plant & equipment parts, satisfying the clear space requirements stated above. A separate unloading bay for such purpose is required.	Yes

SR. NO.	ITEM	SPECIFICATION REQUIREMENT
2.2.2	Floors or fixed/portable platforms with stairs/ ladders shall be provided for easy approach to any plant item, including valves, instruments, etc. to be operated, observed and/or to be frequently (more than once a month) maintained.	Yes
2.3	Minimum access opening required (with rolling shutter) transportation,	3.5 M wide x 4 M high or wherever entry of truck, for material depending upon the envisaged equipment size to be handled.
2.4	Plinth level of all buildings, above the local developed for power house building.	300 mm
3.0	**OTHER MAINTENANCE REQUIREMENT**	
3.1	Generator stator handling 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.	Yes

SR. NO.	ITEM	SPECIFICATION REQUIREMENT
3.2	Maintenance of the internals / impellers of all important equipment, like Boiler Feed Pumps, Feed Water Heaters, Surface Condenser, fans of the boiler draft plant, Intake and circulating water pumps, Cooling Water Pumps, Coal Mills, Air Compressors, Blowers, Heat Exchangers, Fuel Oil Pumps, Filters etc.	Shall be possible without disconnecting or dismantling any piping/ducting.
3.3	Overhauling and handling of the casings for the above items	Shall be possible without disturbing / dismantling any piping / ducting not directly connected to them.
3.4	Crane Approach Wherever required, the unobstructed approach of the crane hook / other hoisting equipment hook to various plant & equipment shall be possible.	Yes
4.0	**CENTRAL CONTROL ROOM** All electronic equipment other than those directly associated with control, operation or presentation of displays shall be mounted external to the control room in air conditioned control equipment room.	Yes

SR. NO.	ITEM	SPECIFICATION REQUIREMENT
5.0	The bidder shall describe in his bid the proposed layout philosophy of the Central Control Room and Control Equipment Room and the arrangement of equipment best suited for the system offered by him and as per good ergonomically consideration.	
5.1	However, as a guide line, following features are given:	
5.1.1	False ceiling and false flooring shall be provided.	
5.1.2	Uniform height, colouring schemes for cabinets etc. shall be available.	
5.1.3	The total area of floor space covered by Control Consoles/Panels in the Control Room shall not exceed 15% of floor area.	
5.1.4	No opening shall be provided from Boiler side.	
5.1.5	Two double leaf doors, suitably located for entering the Control room shall be provided with opening towards the turbine floor.	
5.1.6	Cable entry for the panels/consoles shall be from bottom and suitable openings shall be provided.	

SR. NO.	ITEM	SPECIFICATION REQUIREMENT
5.1.7	The Control Room lighting shall be designed to provide a glare free uniform illumination. The level of illumination shall be minimum 400 LUX.	
5.1.8	Necessary Air Conditioning shall be provided for Central Control room, Control Equipment Room and SWAS room etc.	
5.1.9	Basic amenities like toilet, Tiffin rooms, wash basins, rest rooms etc. shall be provided near the Control Room.	
6.0	Toilet and drinking water facility	Required in all buildings and on all floors wherever operating personnel are to be deployed.

SPECIFIC LAYOUT CONSIDERATIONS

ANNEXURE-D

While developing the layouts, the following major layout parameters shall be ensured, as a minimum:

SR.NO.	PARAMETER	REQUIREMENTS
1.0	AB bay, BC & CD bay widths	36.0 M, 12.0 M & 12.0M
2.0	Arrangement of TG set	Longitudinal
3.0	Floor levels in AB bay	0.0 M, 9.0 M, 17.0 M
4.0	Floor levels in B-C bay	0.0 M, 9.0 M, 17.0 M 24.0M, 28.0 M 32.8 M, 38.0 M
5.0	Level of operating floor	17.0 M
6.0	Level of mezzanine floor	9.0 M
7.0	HT/LT Switchgear and MCC location	HT Switchgear at 3.5 M and LT Switchgear & MCC at 12.0 M in AB bay
8.0	Area of unloading bays	750 sq. M
9.0	Lay down Area (Minimum on operating floor) with EOT Crane approach	750 sq. M.
10.0	Minimum clear working space around the equipment	1200 mm
11.0	Location of Deaerator	In BC bay at EL. 38.0 M

CONSULTANT : PROCON ENGINEERS

SR.NO.	PARAMETER	REQUIREMENTS
12.0	Location of Heaters	HP Heaters/LP Heaters at Operating Floor/ Mezzanine Floor respectively in B-C Bay.
13.0	Location of BFP	TDBFP at Operating Floor and MDBFP at Ground Floor in AB Bay.
14.0	Location of Boiler MCC	At 28.0 M in BC bay
15.0	Clear Head room within Main plant Building for pipes, structures & cable trays, ducts etc.	2.5 M
16.0	Number of Fire Escape staircases in the main plant with fire doors at each landing	Minimum Four (4)
17.0	Minimum width of all staircases landings	1500 mm
18.0	Passenger Elevators	One (min)
19.0	Clear approach width in front and rear of ESP	10 M (Height = 8 M)
20.0	Head Room for pipe/cables trestles at rail, road crossing	8.0 M
21.0	Minimum straight length in Flue gas duct at ESP outlet for Opacity meters.	As required for accurate dust measurement within the battery limits.
22.0	Elevation of ID Ducts entering Chimney	12.75 M (Min.) (Bottom of steel)

CONSULTANT : PROCON ENGINEERS

VOLUME III-F

SECTION-2

LOW PRESSURE PIPING, VALVES AND SPECIALITIES

CONSULTANT : PROCON ENGINEERS

CONSULTANT : PROCON ENGINEERS

CONTENTS

CONSULTANT : PROCON ENGINEERS

1.0 GENERAL INFORMATION

This section covers all the low-pressure piping up to 400 NB size, associated valves and specialties that include as a minimum:

1.1 The Raw Water Piping supplying raw water to raw water reservoir (from proposed raw water gravity line from Ozerkheda reservoir to existing 2 x 500 MW units.)

1.2 Raw water piping from discharge of raw water pumps up to Cascade Aerator in Pre treatment plant.

1.3 Service Air System

1.4 Instrument Air System

1.5 Demineralised Water Supply system

1.6 Plant Potable Water System - (filtered & Ozonised water)

1.7 Service Water System

1.8 Air heater washing system

1.9 Clear water supply line for Coal handling plant dust suppression/dust extraction from discharge of CHP DS/DE supply pumps located at Clear water pump house in ETP area.

1.10 Fuel oil system piping supply and Fuel Oil return from boiler and Steam tracing to HFO tank.

1.11 Any other low pressure piping as found necessary during detail engineering shall also be included.

2.0 CODES AND STANDARDS

2.1 In addition to the requirements spelt out in Volume II, the design, manufacture, inspection and testing of the piping, fittings, valves and

specialties covered under this specification shall conform, in general, to the standards and codes mentioned below:

2.1.1	IS-1239 [Part-I & II]	:	Mild steel tubes, tubular and other wrought steel fittings.
2.1.2	IS-3589	:	Electrically welded steel pipes for water, gas and sewage (200 to 2000 NB)
2.1.3	IS-554	:	Dimensions for pipe threads where pressure tight joints are required on the threads.
2.1.4	IS-1363 [Part-I & II]	:	Hexagonal head bolts, screws and nuts (size range M5 to M36)
2.1.5	IS-1364	:	Precision and Semi-precision hexagon bolts, screws, nuts and lock nuts (diameter range 6 to 39 mm)
2.1.6	IS-3138	:	Hexagon bolts & nuts (M42 to M150)
2.1.7	IS-4736	:	Hot dip zinc coating on mild steel tubes.
2.1.8	IS 14846	:	Sluice Valves for water works purposes.
2.1.9	IS-2685	:	Code of practice for selection, installation and maintenance of sluice valve.
2.1.10	IS-5312	:	Swing check type reflux (non-return) valves.
2.1.11	IS-2379	:	Colour code for the identification of pipelines.
2.1.12	IS-2016	:	Plain washers
2.1.13	IS-2712	:	Compressed asbestos fibre jointing
2.1.14	ANSI B-16.5	:	Steel pipe flanges and flanged fittings
2.1.15	ANSI B-16.9	:	Wrought steel Butt welding flanged
2.1.16	ANSI B-16.11	:	Forged steel fittings, Socket-welding and Threaded.

2.1.17	ANSI B-36.10	:	Steel pipes thickness
2.1.18	API-600	:	Steel gate valves
2.1.19	BS-2633	:	Class I Arc welding of ferrite steel pipe work for carrying fluids.
2.1.20	BS-534	:	Specification for steel pipes and specials for water and sewage.
2.1.21	BS-5351	:	Specification for Ball valves.
2.1.22	BS EN ISO 17292 : 2004	:	Specification for Ball valves.
2.1.23	AWWA-C-504	:	Specification for Butterfly valves.
2.1.24	AWWA-C-208	:	Dimension for fabricated steel water pipe fittings.

2.2 Other international codes and standards may also be offered by bidder. However, same may be subject to acceptance by the Owner.

3.0 SCOPE OF WORK

3.1 The equipment and materials to be supplied shall include as a minimum, the following :

(a) Supply of all low pressure piping including bends, elbows, tees, branches, laterals, crosses, reducing union, couplings, caps, saddles, shoes, flanges, blank flanges, Y-pieces etc as required for the piping system.

(b) Matching pipes, matching pieces like reducers/expanders etc, counter flanges with bolts, nuts, washers, temporary and permanent gaskets, threaded union etc.

(c) Supply and machining work of flanges, pipe spools and matching pipes to connect flow measuring orifices/nozzles with the main pipe work.

(d) All isolating and regulating valves, non-return valves, steam/air traps, relief/safety valves (wherever applicable), strainers, pressure reducing orifices etc complete with the counter flanges and matching connecting pieces as required for entire low pressure piping system.

(e) Anchors, hangers and supports etc as required. Any platform necessary for maintenance and operation of valve and equipment located 1.5 m above any permanent floor or platform including access ladders, supporting structures etc.

(f) All secondary structural steel members required for pipe supports from building steel structures and from embedded steel wherever provided including pipe supports in trenches. However, trench piping shall be avoided to the extent possible.

(g) Funnels, tundishes for drips and drains including all miscellaneous drain piping and drain piping from tundish outlet up to drain points. All drain and vent lines shall be conveniently terminated to floor drain points/permanent drain trenches of the Power Station.

(h) Pipe rack required between WTP, Oil storage area to TG Hall and boiler area is under bidders cost of design and construction including the civil foundation for pipe rack and any other piping support foundations wherever required.

(i) Flanges, counter flanges, blank flanges, bolts, nuts, washers, temporary and permanent gaskets, fasteners caps etc as required for interconnecting piping, valves & fittings.

(j) Cleaning and Painting of all piping, valves & specialties at manufacturer's shop.

3.2 Following general requirements shall however be provided

(a) Instrument connections including instruments, root valves, sensing lines etc.

(b) Pipe stubs and blanking plates etc required for chemical cleaning and hydro testing.

For conducting acceptance test, the required pressure, temperature, flow measurement points shall be provided.

3.3 The Flow Diagrams forming a part of the specification are mainly intended to give general guidelines to the Bidder regarding extent of piping, valves, and specialties to be supplied under this section.

4.0 GENERAL DESIGN AND CONSTRUCTION

4.1 GENERAL CONSIDERATIONS

4.1.1 Line Sizing

Sizes of piping shall be selected such that the velocity of fluid in pipes does not exceed the following limits under conditions of maximum possible volumetric flow.

(a)	Water				
	(i)	Condenser CW	Below 1000 NB	1000-2000 NB	Above 2000 NB
		a. Pump suction	1.0	1.3	1.5
		b. Pump discharge / distribution	2.4	2.8	3.0
	(ii)	Water- General	Below 200 NB	200-400 NB	400-700 NB
		a. Pump suction	1.0		
		b. Pump discharge / distribution	1.8	2.2	2.5
(b)	Fuel oil				
		Heavy oil (Heated)			
		a. Pump suction	1.0		

		b. Pump discharge / distribution	1.5-2.0
(c)	Gases		
		a. Compressed air	15-25

4.1.2 The piping systems included in this section shall be designed to operate continuously without replacement during the plant service life of 30 years.

4.1.3 The piping system shall be complete in every detail and in accordance with the highest standard of workmanship. Against any doubt, Owner shall be referred for clarification.

4.1.4 All design and fabrication shall be in accordance with codes/standards specified.

4.1.5 No pipe work shall run in trenches carrying electrical cables.

4.1.6 Pipe size above 50 NB shall be shop fabricated and of size 50 NB and below shall be field run.

4.1.7 All piping shall be identified by means of colour strips, by adequate lettering, conveniently spaced and located. Identification colours and lettering shall be as approved.

4.1.8 Air release and drain branches shall be provided, wherever necessary, depending upon the layout and arrangement so that the drains and air release valves are located for easy operation.

4.1.9 Unless otherwise specified, all pipe work shall be suitable for a minimum pressure of 10.0 kg/cm² (g) at 80°C or as required by the design of the different piping system, if higher.

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.

4.1.11 Specification of pipes used in different services included in the L.P. piping section has been detailed in Annexure-I.

4.1.12 Following types of valves shall be used for the system/ service marked as y

	Types of Valves				
	Butterfly	**Gate**	**Globe**	**Check**	**Ball**
(a) Water	y	y	y	y	y
(b) Drains & Vent		y	y	y	
(c) Fuel oil		y	y	y	y
(d) Air		y	y	y	y

4.1.13 HFO oil line shall be traced by steam tracers.

4.2 MATERIAL SPECIFICATION

4.2.1 Materials for pipes and fittings shall be as stipulated in Annexure-I. In case bidder wants to offer alternative piping material, same may be accepted by the Owner depending on the merits of alternative material.

4.2.2 Pipe attachments for supports, anchors and restraints, which are coming in direct contact with pipes, shall have similar materials as the piping concerned. All other materials of supports, anchors and restraints shall be of tested quality and as per manufacturer's standards.

4.3 FABRICATION

For Detailed Fabrication requirement of LP piping, Refer clause no- 6.5 of Section –I of this specification.

4.4 HANGERS, SUPPORTS, ANCHORS

Normally pipe supports and anchors shall be selected at those points in the buildings where provision has been made for the loads imposed. The cutting of floor/roof beams or the reinforcement in slabs will not be permitted. Piping attached to a plant item, shall be supported in such a way that the plant item does not take the weight of the piping.

4.4.1 Support spacing shall be as per good engineering practice. However, in no case it shall be less than support spacing stipulated in ANSI B31.1.

4.4.2 Accurate weight balance calculations shall be made to determine the required supporting force at each hanger location and the pipe weight load at each equipment connection.

4.4.3 All large pipes and all long pipes shall have at least two supports each arranged so that any length of pipe or valve may be removed without any additional supports being required.

4.4.4 Support steel shall be of structural quality. Perforated strap, wire or chain shall not be used. Support components shall be connected to support steel by welding, by bolting or by beam clamps. Boltholes shall be drilled, not burned. Support components may be bolted to concrete using approved concrete anchors.

4.5 VALVES AND ACCESSORIES

4.5.1 Valves

(a) All valves shall be of approved make and type and shall have cast/ forged bodies with covers and glands of approved construction and materials as specified in Annexure-II & III.

(b) Valves and specialties to be supplied under this specification will be used for various air and water services and will be located indoor/ outdoor and on horizontal/vertical runs of the pipelines. However, mounting of valves in vertical pipe runs shall be avoided as far as possible.

(c) All valves shall, unless otherwise stated, have the internal diameter same as the internal diameter of the pipes to be joined.

(d) All valves shall receive tests at manufacturer's or contractor's works in accordance with the specific requirements of the approved Codes of Practice. Valves shall be rising stem or otherwise as approved by the Owner.

(e) All valves shall function smoothly without sticking, rubbing or vibration on opening or closing and shall be suitable for most stringent service conditions i.e. flow, temperature and pressure under which they may be required to operate.

(f) Where valves are of similar size and type they shall be interchangeable with one another. Valves shall have welded or flanged connections subject to the Owner's approval.

(g) Gate, Globe and Ball valves shall be provided with the following accessories in addition to other standard items:

(i) Hand wheel with embossed open and shut directions.

(ii) Local position indicator.

(iii) Motorised operation as specified by Engineer.

(h) Gate valves, in addition shall be provided with following extra features

(i) Bypass valve for larger valves

(ii) Draining arrangement

(iii) Enclosed Gear operators for valves 300 NB and above for ease in operation.

(iv) Motorised operation as specified by Engineer.

(i) All gate and globe valves shall be rising stem type.

(j) All valves shall be provided with hand-wheels, chain, operator, extended spindle and floor stand wherever required so that they can be operated manually by a single operator from the nearest operating floor either at a lower or higher elevation as the case may be. If such a valve is provided with integral bypass then similar arrangement shall be done for the bypass valve also.

(k) All valves and specialties shall be provided with brass Tag Discs indicating Tag numbers and nomenclature of the valve including duty or service intended and the function of the valves specialties.

(l) Stems shall preferably be arranged vertically with gland at the top, however, in no circumstances must the stem be inclined downward from horizontal or gland be at the bottom. Globe valves shall be installed with the pressure under the disc. Valves shall not be fitted in inverted position.

(m) Where necessary, for accessibility, grease nipples shall be fitted at the end of extension piping and where possible these shall be grouped together and mounted on a common panel situated at a convenient position. A separate nipple shall be provided to lubricate each point. The Bidder shall supply the first fill of oil or grease for these parts. The Bidder shall supply a suitable manually operated grease gun for the standard type of nipple provided.

(n) The spindles for all valves for use outside the building shall have weatherproof protection covers of approved construction.

(o) All valves shall be fitted with indicators so that it may be readily seen whether the valves are open or shut. In the case of those valves fitted with extended spindles, indicators shall be fitted both to the extended spindles and to the valve spindles.

(p) Plastic or bakelite valve hand wheels will not be accepted.

(q) All valves shall be closed by rotating the hand wheel in a clockwise direction when looking at the faces of the hand wheel. The face of each hand wheel shall be clearly marked with the words 'Open' and 'Shut' with arrows adjacent to indicate the direction of rotation to which each refers.

(r) Wherever practicable, heavy valves of total weight including actuator, drive motor, integral by-pass etc., equal to or greater than 500kg shall be provided with suitable lugs to permit direct suspension by hanger rod or direct resting on bottom support, as applicable.

(s) Special attention shall be given to the operating mechanism for large size valves in order that quick and easy operation is obtained and maintenance is kept to a minimum.

(t) Eyebolts shall be provided where necessary to facilitate handling heavy valves or parts of valves.

(u) The Bidder shall supply with his bid and in addition during the course of the Contract, comprehensive drawings showing the design of valves, test pressure and working pressure/temperatures. They should include a parts list referring to the various materials used in the valve construction.

(v) All sampling and root valves shall be of integral body bonnet type.

(w) Gate and globe valves used for fuel oil system shall be of such design as to permit re-packing while in service.

For Design Requirements for different valves, refer Annexure-II & III.

4.5.2 Strainer for fuel oil system

(a) There shall be Duplex strainers on the Fuel Oil Line.

(b) The strainer shall have basket type straining elements permitting easy removal and replacement.

(c) The open area ratio (i.e. straining area to the inlet area ratio) shall be at least 6:1.

(d) The strainer shall have screen of stainless steel (AISI-316) construction with wire diameter of about 0.01 inch and open area of about 50%.

(e) Strainer body shall be made of Mild steel. No Cast Iron component shall be used in F.O. system.

(f) All strainers shall also be provided with oil drip plates beneath them for collection of oil.

(g) Bolts and nuts shall be as per IS-1363. Gaskets shall be minimum 3 mm thick and made of compressed asbestos fibre as per IS-2712.

4.5.3 Steam Traps

(a) The steam traps shall be inverted bucket or thermodynamic type complete with integral or separate strainers.

(b) Traps shall have carbon steel body with stainless steel internals to AISI 316.

(c) Y-type strainers whether integral with steam traps or otherwise shall have body of Cast Steel Class 150 material and perforated metal screen of type AISI-316 stainless steel with about 0.8 mm perforation. The strainer shall have screwed blow off connections fitted with removable plug. The free hole area shall be at least three (3) times the internal pipe area.

(d) Numbers and location of steam traps shall be selected by the Bidder.

4.6 SAFETY/RELIEF VALVES

4.6.1 Safety/Relief valves shall be of direct spring loaded type and shall have a tight, positive and precision closing.

4.6.2 All safety valves shall be provided with manual lifting lever.

4.6.3 Valves used for air and any other compressive fluid shall be of pop type.

4.6.4 Safety/Relief valves shall be constructed and adjusted to permit the fluid to escape without increasing the pressure beyond 10% above the set blow off pressure. Valve shall reset at a pressure not less than 2.5% and more than 5% of the set pressure.

4.6.5 Releasing capacity of the safety/relief valves shall be as per the applicable codes and standards and shall be subject to the approval of the Engineer.

4.6.6 The seat and disk of safety valves shall be of suitable material to resist erosion. The seat of valve shall be fastened to the body of the valve in such a way that there is no possibility of the seat lifting.

4.7 HOSE PIPE AND ACCESSORIES

4.7.1 Hose valves for service water system shall be Gate valves and service air system shall be Globe valves.

4.7.2 Hose pipes with fittings for Service Water System:

(a) The water hose shall be as per IS-444 (Type-3).

(b) Length of each hose shall be 15 metres.

(c) For each hose, one end shall be fitted with M.S. female coupling with swivelling nuts and soft seating ring suitable for connection to male end of hose valve and other end shall be made threaded for joining with the swivelling nut of a second hose whereby two hose lengths may be joined.

4.7.3 Hose pipes with fittings for Compressed air System

(a) The compressed air hose shall be as per IS-911 (Type 2).

(b) The length and type of each end shall be similar to as specified in above clause no. 4.7.2 (b) (c) above.

5.0 BROAD GUIDELINES FOR ERECTION AND INSTALLATION OF LP PIPING

5.1 All fittings like "T" pieces, flanges, reducers etc shall be suitably matched with pipes for welding. The valves shall be checked, cleaned or overhauled in full or in part before erection, after chemical cleaning and during commissioning.

5.2 Adjustments like removal of oval ties in pipes and opening or closing the fabricated bends of high pressure piping to suit the layout shall be considered part of work and such work shall be carried out as per instructions, which shall include specified heat-treatment procedures etc also, wherever required.

5.3 Certain adjustments in length may be necessary while erecting low pressure pipelines and the extra lengths shall be removed to suit the final layout after preparing edges afresh and adopting specified heat treatment procedures.

5.4 Suspension for piping, pressure parts etc shall be supplied in running lengths, which shall be cut to suitable sizes and adjusted as required.

5.5 All the valves, lifting equipments, actuators, power cylinders etc shall be serviced and lubricated to the satisfaction of Engineer before erecting the same and during pre-commissioning. Even after commissioning, the equipments, if there are problems in the operation, shall be attended to by the Bidder during the tenure of the contract. Welding or jointing of extension spindle for valves to suit the site conditions and operational facility shall be part of erection work.

5.6 All tubes and pipes shall be cleaned and blown with compressed air and shown to the engineer before lifting. Bigger size pipes should be cleaned with flexible wire brush, wherever necessary. After cleaning is over, the end caps shall be put back in tube openings till such time they are welded to other tubes.

5.7 Fine fittings, drain piping, oil systems & other small bore piping have to be routed according to site conditions and hence shall be done only in position. As such, layout of small-bore piping shall be done as per site requirement. There is a possibility of slight change in routing the above pipelines even

after completion of erection, which shall be carried out by the Bidder without any extra cost to the Owner. Work shall also include fabrication of small bends at site from straight lengths to suit the site conditions.

5.8 No temporary supports shall be welded on the pressure parts. Welding of temporary supports, cleats etc on the building columns shall also be avoided. In case of absolute necessity, prior approval from Engineer shall be taken. Further, any cutting or alteration of member of the structure or platform or other equipments shall not be done without specific prior approval of Engineer.

5.9 Wherever piping is connected to other piping or equipment, the joint at the connecting point shall be considered under this specification.

(a) All piping shall be grouped wherever practicable and shall be routed to present a neat appearance.

(b) The piping shall be arranged to provide clearance for the removal of equipment for maintenance and for easy access to valves, instruments and other piping accessories required for operational maintenance.

(c) Piping shall be routed above ground unless otherwise specifically indicated/approved by the Engineer. In such special case, the piping may be arranged in trenches or buried and properly protected as per AWWA Standards.

(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.

(e) Drains shall be provided at all low points and vents at high points as per actual layout regardless of whether some have been shown in respective drawings or not. The pipelines shall be sloped towards the drain points.

(f) All drips and drains for piping and equipment whether shown in the drawings or not shall terminate on the ground floor up to station drain unless otherwise specified.

5.10 Painting

(a) All uninsulated piping systems, hangers and supports shall have two coats of red oxide Zinc Chromate primer (conforming to IS 2074) with minimum dry film thickness (DFT) of 25 microns per coat and two coats of finish paints using enamel paint to give a minimum total DFT of 100 microns (after two coats of primer and two coats of finish paint). Shades shall be as per IS 5 or as indicated by Owner/ Engineer. Service of the pipe/line designations shall be painted on all pipes at visible locations.

(b) Before application of paint, Contractor shall clean the pipes of all mill scale, dirt dust, soot, grease, rust etc.

(c) All pipe lines, piping components shall be adequately protected against corrosion during manufacture, fabrication, shipment and storage by appropriate protective paint.

6.0 DRAWINGS, DATA, INFORMATION & MANUALS

6.1 For Drawing, Data and Information required along with BID refer, **Volume VIII.**

ANNEXURE – I

(SPECIFICATION OF PIPES FOR DIFFERENT SERVICES)

	A	B	C	D
1.0 Services	(a) Raw Water Piping (b) Clarified Water piping, (c) Filtered Water to DM Plant	Drinking (Potable) Water Supply piping (filtered water, ozonised)	Demineralised Water, Service and Instrument air piping less than and equal to 40 NB	Demineralised Water, Service and Instrument air piping for sizes equal to or greater than 50 NB
2.0 Material of Pipe	Carbon Steel IS-1239 Part I Heavy Grade upto 150 NB and IS-3589 for sizes above 150 NB with minimum pipe thickness of 6 mm.	Carbon Steel as per IS-1239 Part I Heavy Grade upto 150 NB and IS-3589 for sizes above 150 NB. The pipes shall be galvanized as per IS-4736.	Stainless Steel as per ASTM A-312 Gr 304. Thickness schedule 40S as per ANSI-B 36.19	Stainless steel as per ASTM A-312 Gr 304. Size up to 250 NB as per schedule 10S, ANSI B 36.19
3.0 Construction	ERW/Seamless	ERW/Seamless	Seamless	ERW/Seamless
4.0 End connections	Flange and butt weld for size 50 NB and above and Socket weld joint for size 40 NB and below.	Screwed flange for sizes 50 NB and above and screwed socket for size 40 NB and below.	Socket welded for DM water lines. Screwed end connection for airlines.	SORF and butt weld joint for DM application. Screwed end connection for air

	A		B		C	D
						lines upto 80 NB. Beyond 80 NB, it shall be butt-welded.
5.0 Fittings	Pipe size ≥ 50 NB	Pipe Size ≤ 40 NB	Pipe size ≥ 50 NB	Pipe Size ≤ 40 NB		
5.1 Materials	A 234 Gr WPB/ IS 3589	A105 or As compatible with IS-1239	A 234 Gr WPB /IS 3589	A105 or as compatible with IS -1239	A 182 F304	A 351 CF8
5.2 Construction	Welded/ Seamless	Forged	Welded/ Seamless	Forged	Forged	Welded/Seamless
5.3 Standard	ANSI-B16.9 / fabricated fitting as per AWWA-C-208 is also acceptable	ANSI-B 16.11/ IS-1239 (Part-II) cold Bends from pipes having bend radius R=3D is also acceptable	ANSI B16.9	ANSI B16.11/IS-1239 (Part- II)	ANSI-B16.11	ANSI B16.9
5.4 End Details	Butt welded As per ANSI B16.25	Socket welded as per ANSI-B-16.11	Screwed/ Flanged	Screwed/ Socket as per ANSI B16.11/or IS-1239	Socket Welded	Butt welded for pipe & fittings and flanged for

	A	B	C	D
		(Part-II)		valves/equipment
		All fittings shall be galvanized		
6.0 Flanges	150 class as per ANSI B16.5 complete with nuts, bolts and gaskets. FF flanges for CI valves.	As per ANSI B16.5 pressure class 150 - galvanised- complete with nuts, bolts and gaskets. FF flanges for CI valves.	As per ANSI B16.5 pressure class 150 complete with nuts, bolts and gaskets. Use slip on flanges here.	150 class, flat face, as per ANSI-B-16.5 complete with nuts, bolts and gaskets. Use Lap Joint flanges here.

1.0	Services	Fuel Oil System
2.0	Material of Pipe	API 5L Gr B or ASTM 106 Gr B
3.0	Construction	Seamless
4.0	End connections	≤ 40NB SW, ≥ 50NB – BW
4.1	Fittings	ASTM A234 Gr WPB/A 105
5.0	Valve end	Flanged end is preferred
6.0	connection	

NOTE:

1. Refer Annexure –III for Valve material specification.
2. Pipes which fall under IS: 1239 shall be hydrostatically tested according to the said code, for others refer Section-V, Volume II.

ANNEXURE – II

SERVICES OF VARIOUS CATEGORIES OF VALVES

SR. NO.	VALVE CLASSIFICATION	SERVICE	
1.0	Cast iron body Gate/ Globe/Check Valve	(a) Service Water (Clarified)	For sizes 50 NB and above
		(b) Filtered Water	
		(c) Drinking Water	
		(d) Inhibited Demineralised Water	
2.0	Stainless steel & Bronze body Gate / Globe / Check / Ball Valve	(a) For Demineralised water	For all sizes
		(b) Drinking Water	For sizes less than and equal to 40 NB
		(c) Service and Instrument Air	For all sizes. Ball valves to be used in air line.
3.0	Steel Body valves	(a) Clarified Water	For sizes less than and equal to 40 NB
		(b) Inhibited Demineralised Water for DMCW system	
		(c) Fuel oil system	For all sizes
4.0	Cast Iron body butterfly valve & Check valve	(a) For Demineralised Water	For sizes 50 NB and above. Rubber lining shall be provided for DM water application.
		(b) Raw water	
		(c) Clarified Water	
		(d) Filtered Water	
		(e) Inhibited Demineralised Water for DMCW system	

ANNEXURE-III

SPECIFICATION OF VALVES

	(A) Cast Iron Body Gate/ Globe/Check Valve	(B) Stainless Steel Body Gate/ Globe /Check/Ball Valve	(C) Steel Body Gate / Globe / Check Valves
1.0 BASIC DESIGN CODE			
(a) Gate	(a)	(a)	(a)
	(i) IS-780 for 50 – 300 NB	(i) API 600 for 50 NB and above /ANSI-B-16.34	(i) API 600 for 50 NB and above/ ANSI-B-16.34
	(ii) IS-2906 for 350 NB & above or as per MSS-SP-70	(ii) API 602 for size below 50 NB /ANSI-B-16.34	(ii) API 602 for size below 50 NB/ANSI-B-16.34
(b) Globe	(b) MSS-SP-85	(b) BS 1873/ANSI-B-16.34	(b) BS 1873/ANSI-B-16.34
(c) Check	(c) IS-5312/MSS-SP-71	(c) BS 1868/ANSI-B-16.34	(c) BS 1868/ANSI-B-16.34
(d) Ball		(d) BS 5351	(d) BS 5351
2.0 PRESSURE CLASS	To be suitably chosen considering the pressure requirement.		
3.0 CONSTRUCTION	Cast body and bonnet/ cover	Forged body up to 50 NB and Cast body above that size	Same as Group B
4.0 MATERIAL			

	(A) **Cast Iron Body Gate/ Globe/Check Valve**	(B) **Stainless Steel Body Gate/ Globe /Check/Ball Valve**	(C) **Steel Body Gate / Globe / Check Valves**
4.1 Body & Bonnet Cover	IS 210 Gr. FG 260	A 351 CF8 for cast Body and A 182 F304 for forged Body	A 216 Gr. WCB for Cast Body and A 105 for Forged body
4.2 Trim/Disc	IS 210 Gr. FG 260	A 182 F304 for 13% Cr. Steel as per Gate, Globe, Check valves and A 351 CF8 for Ball Valves	A 182 Gr.F6 heat treated and hardened (min. 250 BHN) for cast body and A 105 Hard faced with Stellited (min. 350 HB) for forged body.
4.3 Seating surface	13% Cr. Steel as per IS-1570	For Ball valves PTFE seats and seals	13% Cr. Steel as per A 182 Gr. F6.
5.0 END PREPARATION	Socket welded for size equal to and below 40 NB and flanged with counter flanges for 50 NB and above.		
6.0 TESTING			
(a) Gate	(i) IS-780 for 50 – 300 NB	ANSI B-16.34/API-598/MSS-SP-61/ EN 12266-1	ANSI B-16.34/API-598/MSS-SP-61/ EN 12266-1
	(ii) IS-2906 for sizes equal to and above 350 NB		
(b) Globe	MSS-SP-85		
(c) Check	IS 5312/MSS-SP-71		
(d) Ball			

1X660 MW BHUSAWAL TPP UNIT 6

COMPRESSED AIR SYSTEM

SECTION IA

(FUNCTIONAL / PERFORMANCE / DEMONSTRATION REQUIREMENT)

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
NOIDA-INDIA

1.0.0 GENERAL REQUIREMENTS

1.1.0 After satisfactory completion of the trial operation, the performance test shall be conducted at site by the Contractor. Any preparations required for this test shall be carried out by the Contractor. The duration of the Performance Guarantee Test of the Plant at the rated capacity shall be mutually agreed. However, a stability period of 2 hours before commencement of test and 2 hours test period followed by another 2 hours stable period shall be maintained. The PG test procedure should be submitted to the owner well in advance and got approved before the commencement of PG test. Performance Guarantee Test shall be conducted within 30 days of intimation from the Contractor about his readiness for conducting Performance Guarantee Test. These tests shall be binding on both the Owner and the Contractor to determine performance of the equipment/system with the performance guarantee data.

1.2.0 The tests shall be conducted at the specified load conditions or as near the specified conditions as practicable. The Owner/Contractor will apply agreed factors to compensate for deviation from the designed parameters. The suitable correction curves mutually agreed by the Owner and the Contractor shall be used.

1.3.0 All test instrumentation as required for the Performance Guarantee Test shall be arranged by the Contractor free of cost. Precision instruments required for Performance Guarantee Test shall, however, be arranged by the contractor. Calibration before and after test and installation of the test instrumentation for the test shall be the Contractor's responsibility. All test instrumentation shall be in accordance with the applicable code. All test instruments and calibration procedures shall be duly approved by the Owner. Batch calibration shall not be accepted. The test shall be commenced only after clearance of owner on the above vital issues.

1.4.0 Any special equipment, tools and tackles required for the successful completion of the performance tests shall be provided by the Contractor free of cost.

1.5.0 The performance guarantee figures of the equipment shall be proved by the Contractor during the Performance Guarantee Test.

1.6.0 Should the results of these tests show any decrease from guaranteed values, the Contractor shall modify the equipment within 90 days from the date of intimation by the owner as required to bring it to meet the guarantees. In such cases, the performance tests shall be repeated within one month from the date on which the equipment is made ready again for tests subject to grid requirements at that time. All costs of modifications including labour, material and the cost of additional testing to prove that equipment meets the guarantee shall be borne by the Contractor.

1.7.0 The provisions outlined in the ASME performance test code or other International and Indian approved equivalents shall generally be used as a guide for all the above test procedures unless specified otherwise in the specification. The details of all measuring/recording meters, test instrumentation such as class of accuracy, make etc. shall be covered in the trial operation/ performance test reports. All the list of equipment, accuracy class and test certificates to be submitted and got approved by the owner before the commencement of trail operation.

1.8.0 PG test to be witnessed by the consultant and the owner

2.0 PERFORMANCE GUARANTEES, PENALTIES & CAPABILITY TESTS:

2.1 The Contractor shall meet the Performance Guarantees as have been indicated in the Specifications.

2.2 The penalty for not meeting the performance guarantees during the Performance Guarantee Test shall be assessed and recovered from the Contractor. Such penalty shall be levied without limitations, in accordance with stipulations made in Technical Specification and shall be without prejudice to all the other conditions of the contract.

2.3 If the guarantees specified are not achieved by the Contractor within 90 days of notification by the Owner, he may at his discretion reject the equipment or accept it after levying and recovering suitable penalties.

2.4 In case there is shortfall in capability of equipment while demonstrating capability tests, the Contractor shall forth-with rectify his equipment within 90 days and re-perform the capability tests to Owner's satisfaction.

2.5 Performance parameters for compressed air system to be demonstrated are:

a) Demonstration of Auxiliary power consumption for the system.
b) Free air delivery at site conditions per each compressor (Nm^3/min).
c) Power consumption at site rated parameters per each compressor (kW).
d) Max. Capacity of each air dryer at min working pressure and max. Temp at after cooler outlet (Nm^3/min).
e) Parallel operation of air compressors to be demonstrated at site.
f) Pressure drop across Air Drying Plant, Capacity and outlet dew point of each air drying plant shall be demonstrated at site.
g) Vibration level and noise level of each air compressor, blowers and any other rotating equipment of each air drying plant shall be demonstrated at site.
h) Instrument air quality

3.0 PENALTY FOR POOR PERFORMANCE:

3.1 Category I Guarantees: Performance guarantees penalties.
Auxiliary power consumption - Summation of power consumption of working drives at their rated capacities for compressed air system. Base auxiliary power consumption for CAS and penalties shall be as per Section III F. Bidder to furnish its guaranteed auxiliary power consumption with its technical offer (Not in sealed price).

3.2 Category III Guarantees: If the demonstrated parameters continued to be beyond the stipulated acceptable limits even after the modifications / replacements, the employer will have the right to

(i) Reject the equipment/system/plant and recover from the contractor the payments already made.

OR

(ii) Accept the equipment/system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by the employer. Such damages shall, however be limited to the cost of replacement of the deficiency so as to achieve the guarantee performance.

The following items are under Category III Guarantees:
a) Capacity and discharge pressure of each air compressor. (Shall be demonstrated at shop).
b) Parallel operation of air compressors to be demonstrated at site.
c) Dew point of air at the outlet of air drying plants of instrument air compressors to be demonstrated at site.
d) Pressure drop across Air Drying Plant of air compressors to be demonstrated at site.
e) Vibration level and noise level of each air compressor, blowers and any other rotating equipment of each air drying plant shall be demonstrated at site.

1X660 MW BHUSAWAL TPP UNIT 6

COMPRESSED AIR SYSTEM

SECTION IA

(QUALITY ASSURANCE AND INSPECTION REQUIREMENTS)

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
NOIDA-INDIA

VOLUME II

SECTION – 7

QUALITY ASSURANCE REQUIREMENTS

CONSULTANT : PROCON ENGINEERS

CONSULTANT : PROCON ENGINEERS

CONTENT

CONSULTANT : PROCON ENGINEERS

1.0 QUALITY ASSURANCE PROGRAMME

1.1 To ensure that the equipment and services under the scope of Contract whether manufactured or performed within the Contractor's works or at his Sub-contractor's premises or at the Owner's site or at any other place or work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Owner/Authorised representative after discussions before the award of contract. A quality assurance programme of the Contractor shall generally cover the following:

1.1.1 His organisation structure for the management and implementation of the proposed quality assurance programme.

1.1.2 Documentation control system.

1.1.3 Qualification data for Bidder's key personnel.

1.1.4 The procedure for purchase of materials, parts, components and selection of Sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.

1.1.5 System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.

1.1.6 Control of non-conforming items and system for corrective actions.

1.1.7 Inspection and test procedure both for manufacture and all site related works.

1.1.8 Control of calibration and testing of measuring and testing equipments.

1.1.9 System for quality audit.

1.1.10 System for indication and appraisal of inspection status.

1.1.11 System for authorising of release of manufactured product to the Owner.

1.1.12 System for handling storage and delivery.

1.1.13 System for maintenance of records.

1.1.14 Furnishing of quality plans for manufacturing and field activities, detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component.

2.0 GENERAL REQUIREMENTS - QUALITY ASSURANCE

2.1 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection /tests to be carried out by the Contractor for some of the major items is given in the respective technical specification. This is however, not intended to form a comprehensive programme as it is the Contractor's responsibility to draw up and implement such programme duly approved by the Owner/Consultant. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder, separately in the format attached at Annexures and shall be submitted to Owner/ Authorised representative for approval. Schedule of finalisation of such quality plans will be finalised before award.

2.2 Manufacturing Quality Plan shall detail out for all the components and equipment, various tests/inspection to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's Quality 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.

2.3 Field Quality Plans shall detail out for all the equipment, the quality practices and procedures etc to be followed by the Contractor's site Quality Control organisation, during various stages of site activities from receipt of materials/equipment at site.

2.4 The Bidder shall also furnish copies of the reference documents / plant standards / acceptance norms/tests and inspection procedure etc as referred