

TENDER NO: PSER:SCT:BAR-C1971:19

VOLUME -IF

TECHNICAL CONDITIONS OF CONTRACT
(TCC)

FOR

LEVELLING GRADING, PILING WORK INCLUDING TESTING OF PILES AND OTHER ASSOCIATED WORKS ETC. OF FGD SYSTEM FOR BARH STAGE-I (3X660 MW) & STAGE-II (2X660 MW), STPP, BIHAR.

BHARAT HEAVY ELECTRICALS LIMITED

(A GOVT. OF INDIA UNDERTAKING)

POWER SECTOR – EASTERN REGION

PLOT NO. – 9 / 1, DJ – BLOCK,

SECTOR – II, KARUNAMOYEE,

SALT LAKE CITY,

KOLKATA – 700091.

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This volume shall be construed as part of tender document and shall be read along-with others volumes of tender. Unless otherwise specified, in case of any conflict or inconsistency between the general and technical conditions, the same shall be brought out by the bidder in writing to BHEL for clarification during pre-bid discussions, **if applicable**; failing which most stringent interpretation/ clause in favour of BHEL shall be adopted and the same shall be binding to the bidder. Unless otherwise specified, all terms & conditions shall be applicable for entire scope and for each package of the tender.

CLAUSE NO	DESCRIPTION
1.0	PROJECT SYNOPSIS AND GENERAL INFORMATION
1.1	<p>Project name: BARH SUPER THERMAL POWER PROJECT, STAGE-I No. of Units x capacity: 3 X 660 MW Project setting up by: National thermal Power Corporation Project Location : (i) Place: BARH : (ii) District: PATNA : (iii) State: BIHAR</p> <p>Nearest Railway station: BARH Distance of project location from the Railway station: 5.0 KM (Approx.) Nearest town: BARH Distance of the town from the Project site: 5.0 KM Nearest Commercial Airport: PATNA Distance of airport from the project site : 70 KM.</p>
2.0	SITE VISIT
	The contractor should visit project site and acquire full knowledge and information about conditions prevailing at site and in & around the plant premises, together with all the statutory, obligatory, mandatory requirements of various authorities before submission of the bid.
3.0	NAME OF WORK
	Levelling Grading, Piling Work Including Testing of Piles and Other Associated Works etc. of FGD System for Barh Stage-I (3x660 Mw) & Stage-II (2x660 MW), STPP, Bihar.
4.0	SCOPE OF WORK
4.1	<p>The scope broadly covers providing labour, supervision, materials (except those which will be supplied by BHEL free of cost), T&Ps, consumables etc as per technical specification and terms & conditions of tender taking into account all clarifications, confirmations and agreements till date for the following jobs:</p> <p>Installation and Testing of BORED CAST IN-SITU Pile for</p> <ul style="list-style-type: none"> ● Absorber Tower ● FGD Control Room ● Ball Mill Building & Lime Stone Building ● Gypsum Dewatering Building ● RC Pump & Oxidation Blower Foundation ● Misc. Tank Foundation ● Misc. Pump & Equipment Foundations ● Duct Foundation ● Pipe Rack ● Limestone Storage Silo ● Wet Ball Mill Foundation ● Booster Fan Foundation ● SO₂ Analyser Room ● CW Treatment Building ● ECW Pump House
4.2	<p>Ready mix concrete shall be given by BHEL Free of Cost at Batching Plant inside the plant premises. Bidder has to transport the concrete from batching plant to the location of work. Bidder to submit a receipt of concrete at batching plant based on the print out of batching. Reconciliation of quantity of concrete shall be done based on actual use of concrete at site.</p>

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4.3	The scope shall include other related works although they may not be specifically mentioned in the subsequent clauses and all such incidental items not mentioned, but are necessary for completion of the work as a whole. The scope also includes testing of all materials at site laboratory or approved laboratory outside, submitting test reports, arranging supervision etc. and execution of the contract with major areas of work mentioned above.
4.4	Any buried pipe / cable coming in the working fronts are to be removed safely by the contractor at no extra cost to BHEL.
4.5	The work to be performed under this specification consists of providing all labour, materials, consumables, equipment, temporary works, temporary storage sheds for contractors own use, temporary colony for labour and staff, temporary site offices, constructional plant's transportation / handling and all incidental items not shown or specified but reasonably implied or necessary for the completion of subject scope, all in strict accordance with the specifications including revisions and amendments thereto as may be required during the execution of work.
4.6	The scope shall also include setting up by the bidder a testing room with compressive test of concrete machine and other site test instruments for conducting day to day testing of concrete cubes & piing work. Qualified quality engineer to be deployed as necessary.
4.7	All quality standards, tolerances, welding standards & other technical requirements shall be strictly adhered to. The bidder shall fully apprise himself of the prevailing conditions at the proposed site, climatic conditions including monsoon pattern, soil conditions, local conditions and site specific parameters and shall include for all such conditions and contingent measures in the bid, including those which may not have been specifically brought out in the specifications.
5.0	DEVIATIONS The bidder is required to submit with his offer in the relevant schedule / format without any ambiguity. Any assumptions, presumptions, deviations etc. indicated or implied anywhere by the bidder except those indicated in the deviation schedule / format will not be recognized and will not form a part of consideration / offer. In the absence of such filled-up schedule / format it will be understood and agreed that the bidder's offer is based on strict conformance to the specification and no negotiation would be allowed in this regard. BHEL reserve the right not to recognize any / all deviations submitted after opening of the bid.
6.0	DEWATERING Contractor shall ensure at all times that his work area & approach / access roads are free from accumulation of water, so that the materials are safe and the erection / progress schedule are not affected. No separate claim in this regard shall be admitted by BHEL. No separate payments for dewatering of subsoil, surface water or catchments water, if required, at any time during execution of the work including monsoon period shall be considered by BHEL.
7.0	GENERAL TECHNICAL REQUIREMENTS (CODES AND STANDARDS)
7.1	Except where otherwise specified, the plant / equipment shall comply with appropriate Indian Standard or an agreed internationally accepted Standard Specification as mentioned elsewhere in tender, each incorporating the latest revisions at the time of tendering. Where no internationally accepted standard is applicable, the bidder shall give all particulars and details as necessary; to enable BHEL to identify all of the plant/ equipment in the same detail as would be possible had there been a standard specification.
7.2	Where the bidder proposes alternative codes or standards he shall include in his tender one copy (in English) of each standard specification to which materials offered shall comply. In such case, the adopted alternative standard shall be equivalent or superior to the standards mentioned in the specification.
7.3	In the event of any conflict between the codes & standards referred above and requirements of this specification, the requirements which are more stringent shall govern.
7.4	Tools used during erection and commissioning shall not be accepted except with the specific approval of the engineer.
7.5	Wherever specified or required the plant / equipment shall conform to various statutory regulations such as Indian Boiler Regulation, Indian Electricity Rules, Indian Explosive Act, Factories Act etc, wherever required, obtaining approval for plant / equipment supplied under the specification from statutory authorities shall be the responsibility of the contractor.
8.0	GENERAL SERVICES TO BE RENDERED BY THE BIDDER
8.1	Deployment of all tools & tackle, construction machinery, transportation vehicles and all other implements in adequate number and size, appropriate for the construction work to be handled under scope of this specification except otherwise specified.

8.2	Providing support services for the contractor's erection staff e.g. construction of site offices, temporary stores, residential accommodation and transport to work site for erection personnel, watch and ward for security and safety of the materials under the Contractor's custody etc. as required.
8.3	Maintaining proper documentation of all site activities undertaken by the contractor as per the proforma mutually agreed with BHEL, submitting monthly progress reports as also any such document as and when desired by BHEL / owner, taking approval of all statutory authorities e.g., Factory Inspector, Provident Fund authority etc. for respective portions of work under the jurisdiction of such statutes of laws.
8.4	As part of overall project management activity, the contractor shall be responsible for proper co-ordination of construction activities during various phases of execution of the contract. The contractor shall identify a person designated as construction manager, with whom BHEL shall interact on matters related to execution of the contract. The construction manager shall be the single point contact person on behalf of the contractor. BHEL shall interact with the construction manager only on all matters on co-ordination between BHEL and the contractor. For timely completion of work, the contractor may have to work in one or more shifts. He will not be eligible for any extra charge on this account.
8.5	The contractor shall confine all his field operations to those works which can be reformed without subjecting the equipment and materials to adverse effects, during inclement weather conditions, like monsoon, storms etc and during other unfavourable construction conditions. No field activities shall be performed by the contractor under conditions which might adversely affect the quality and efficiency thereof, unless special precautions or measures are taken by the contractor in proper and satisfactory manner in the performance of such works and with the concurrence of the engineer. Such unfavourable construction conditions in no way relieve the contractor of his responsibility to perform the works as per the schedule.
8.6	The contractor shall supply all skilled, semi-skilled and unskilled workmen required for all works of handling and transportation from site store to erection site, erection, testing and commissioning contemplated under this specification. Only fully trained and competent men with previous experience on the job shall be employed. They shall hold valid certificates wherever necessary. BHEL reserve the right to decide on the suitability of the workers and the other personnel who will be employed by the contractor. BHEL reserves the right to insist on removal of any employee of the contractor at any time, if they find him unsuitable and the contractor shall forthwith remove him.
8.7	The supervisory staff employed by the contractor shall be technically qualified and experienced in the area of work. They shall ensure proper out turn of work and discipline on the part of labour put on the job by the contractor and in general see that the works are carried out in a safe and proper manner and in coordination with other labour and staff employed directly by BHEL or other contractors of BHEL and BHEL's client.
8.8	The contractor shall also furnish daily manpower report showing by classification the number of employees engaged in various categories of work a progress report of work as required by BHEL engineer.
8.9	The work shall be executed under the usual conditions affecting major power plant construction and in conjunction with numerous other operations at site. The contractor and his personnel shall co-operate with other personnel, and other contractors, co-ordinating his work with others and proceed in a manner that shall not delay or hinder the progress of work as a whole.
8.10	The contractor's supervisory staff shall execute the work in the most substantial and workman like manner in the stipulated time. Accuracy of work and aesthetic finish are essential part of this contract. The contractor shall be responsible to ensure that assembly and workmanship conform to the dimensions and tolerance given in the drawing / instruction given by BHEL Engineer from time to time.
8.11	It is the responsibility of the contractor to engage his workman in shifts or on overtime basis for achieving the target set by BHEL during erection, commissioning and testing period. Contractor's quoted rate shall include all these contingencies.
8.12	Any other service, although not specifically called for but required for a contract of the size and nature indicated in the specification.
9.0	PROTECTION
9.1	Equipment having anti-friction or sleeve bearings shall be protected by weather tight enclosures. Coated surfaces shall be protected against impact, abrasion, discoloration and other damages. Surfaces which are damaged shall be repainted.
9.2	Electrical equipments, controls and instrumentations 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 and protected with

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	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
9.3	All piping, tubing and conduit connections on equipment and equipment openings shall be closed with rough usage covers or plugs. Female threaded openings shall be closed with rough usage covers or plugs or 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.
9.4	All other consumables to be supplied by the contractor within the quoted rate.
10.0	GENERAL GUIDELINES FOR FIELD ACTIVITIES
10.1	The contractor shall execute the works in a professional manner so as to achieve the target schedule without any sacrifice on quality and maintaining highest standards of safety and cleanliness.
10.2	The contractor shall co-operate with owner / BHEL and other contractors working in site and arrange to perform his work in a manner so as to minimise interference with other contractor's works. BHEL's engineer shall be notified promptly of any defect in other contractors' works that could affect the contractor's work. If rescheduling of contractor's work is requested by the owner's / BHEL's engineer in the interest of overall site activities, the same shall be complied with by the contractor. In all cases of controversy, the decision of BHEL shall be final and binding on the contractor without any commercial implication.
10.3	The engineer shall hold weekly meeting of all the contractors working at site at a time and a place to be designated by the engineer. The contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the engineer and shall strictly adhere to those decisions in performing this work. In addition to the above weekly meeting, engineer may call for other meetings either with individual contractors or with selected number of contractors and in such a case the contractor, if called will also attend such meetings.
10.4	Time is the essence of the contract and the contractor shall be responsible for performance of his work in accordance with the specified construction schedule. If at any time the contractor is falling behind the schedule, he shall take necessary action to make good of such delays by increasing his work to comply with the schedule and shall communicate such action in writing to the engineer, satisfying that his action will compensate for the delay. The contractor shall not be allowed any extra compensation for such action.
10.5	The engineer shall however not be responsible for provision of additional labour and or materials or supply of any other services to the contractor except for the co-ordination work between various contractors as set out earlier.
10.6	The works under execution shall be open to inspection & supervision by BHEL's / Owner's engineer at all times. The contractor shall give reasonable notice to BHEL before covering up or otherwise placing beyond the reach of inspection any work, in order that same may be verified, if so desired by owner/ BHEL.
10.7	Every effort shall be made to maintain the highest quality of workmanship by stringent supervision and inspection at every stage of execution. Manufacturer's instruction manual and guidelines on sequence of erection and precautions shall be strictly followed. Should any error or ambiguity be discovered in such documents the same shall be brought to the notice of BHEL's engineer. Manufacturer's interpretation in such cases shall be binding on the contractor.
10.8	The contractor shall comply with all the rules and regulations of the local authorities, all statutory laws including Minimum Wages, Workmen Compensation etc. All registration and statutory inspection fees, if any, in respect of the work executed by the contractor shall be to his account.
10.9	Equipment and material, in case wrongly installed, shall be removed and reinstalled to comply with the design requirement at the contractor expense, to the satisfaction of BHEL / owner.
11.0	QUALITY CONTROL & QUALITY ASSURANCE
11.1	INSPECTION & FIELD QUALITY ASSURANCE
11.1.1	Contractor shall carry out all activities conforming to the approved Field Quality Plan (FQP) & technical instructions as revised from time to time. 'Total Quality' shall be the watchword of the work and contractor shall strive to achieve the quality standards, procedures laid down by BHEL. He shall follow all the instructions as per BHEL drawings and quality standards. Contractor shall provide the services of quality assurance engineer as per the relevant clauses.
11.1.2	Preparation of quality assurance log sheets and protocols with customer / consultants / statutory authority, welding logs, NDE records, testing & calibration records and other quality control and quality assurance documentation as per BHEL engineer's instructions, is within the scope of work / specification. These records shall be submitted to BHEL / customer for approval from time to time.

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11.1.3	<p>The protocols between contractor and customer / BHEL shall be made for correctness of foundations, materials, procedures, at each stage of installation, generally as per the requirement of customer / BHEL. This is necessary to ensure elimination of errors and to avoid accumulation and multiplication of errors.</p>
11.1.4	<p>A daily log book (with proper indexing) should be maintained by every supervisor / engineer of contractor, for respective area of work, on the job for detailing and incorporating alignment/ clearance / centering / levelling readings and inspection details of various equipment, etc. This log book shall be always accessible to BHEL engineers.</p> <p>High pressure welding (as applicable under the scope of this contract) details like serial number of weld joints, welders name, date of welding, details of repair, heat treatment etc. will be documented in welding log as per BHEL Engineer's instructions.</p> <p>Record of radiography (as applicable under the scope of this contract) containing details like serial number of weld joints, date of radiography, repairs, if any, re-shots etc shall also be maintained as per BHEL Engineer's instructions.</p> <p>Record of heat treatments (as applicable under the scope of this contract) performed shall be maintained as prescribed by BHEL.</p>
11.1.5	<p>The performance of welders (as applicable under the scope of this contract) will be reviewed from time to time as per the BHEL standards. Welders' performance record shall be furnished periodically for scrutiny of BHEL's Engineer. Corrective action as informed by BHEL shall be taken in respect of those welders not conforming to these standards. This may include removal/ discontinuance of concerned welder(s). Contractor shall arrange for the alternate welders immediately.</p>
11.1.6	<p>Only welders duly authorized by BHEL / customer / consultant after welder qualification test as per ASME Sec-Ix / AWS D1.1 (as applicable) shall be engaged on the work. All the welders shall carry identity cards as per the proforma prescribed by BHEL / Customer / Consultant.</p>
11.1.7	<p>Any re-laying or re-termination of cables / re-erection of instruments / recalibration of instruments etc. required due to contractor's mistake and found at any stage inspection shall be carried out by the contractor at no extra cost. Repair / rectification procedure to be adopted to make any job acceptable shall be subject to the approval of BHEL.</p>
11.1.8	<p>Weekly Quality Review Meeting at site shall be organised by BHEL to discuss quality issues and next weeks inspection plans. Site in-charge of the contractor along with QAEs of the contractor must be present in the meeting with closure report of the issues raised by BHEL in the previous meetings.</p>
11.2	REQUIREMENT OF ISO 9001
11.2.1	<p>BHEL: PSER is accredited with ISO 9001 certification and as such this work is subject to various audits to meet ISO 9001 requirements.</p>
11.2.2	<p>The basic philosophy of the Quality Management System under ISO 9001 is to define the organizational responsibility, work as per documented procedures, verify the output with respect to acceptance norms, identify the non-conforming product / procedure and take corrective action for removal of non-conformance specifying the steps for avoiding recurrence of such non-conformities, & maintain the relevant quality records. The non-conformities are to be identified through the conduct of periodical audit of implementation of quality systems at various locations/stages of work. Suppliers / vendors of various products / services contributing in the work are also considered as part of the quality management system. As such the contractor is expected not only to conform to the quality management system of BHEL but also it is desirable that they themselves are accredited under any quality management system standard.</p>
11.2.3	<p>BHEL reserves the right to carry out quarterly quality audits and quality surveillance of the systems and procedures of contractor's quality management. Contractor shall provide all necessary assistance to enable BHEL to carry out such audit & surveillance.</p>
11.2.4	<p>Quality audits / approval of the results of test & inspection will not prejudice the right of BHEL to reject an equipment service not giving desired performance and shall not in no way limit the liabilities and responsibilities of the contractor in earning satisfactory performances of equipment / service as per specification.</p>
11.3	MMEs / MMRs
11.3.1	<p>Contractor shall ensure deployment of reliable and calibrated MMEs (Measuring and Monitoring Equipment). The MMEs shall have test / calibration certificates from authorised / Government approved / Accredited agencies traceable to National / International Standards. Re-testing / re-calibration shall also be arranged at regular intervals during the period of use as advised by BHEL Engineer within the contract price. The contractor will also have alternate arrangements for such MMEs so that work does not suffer when the particular equipment / instrument is sent for calibration. Also if any MMEs not found fit for use, BHEL shall have the right to stop the use of such item and instruct the contractor to deploy proper item</p>

	and recall i.e. repeat the readings taken by that instrument, failing which BHEL may deploy MME and retake the readings at Contractor's cost.			
11.3.2	Contractor shall provide all the Measuring Monitoring Equipment (MMEs) required for completion of the work satisfactorily. These MMEs shall be of brand, quality and accuracy specified by BHEL Engineer and should have necessary calibration and other certificates as per the requirement of BHEL Engineer. Decision of BHEL Engineer regarding acceptance or otherwise of the measuring instruments / gauges / tools for the work under this specification, is final and binding on the contractor. BHEL shall give an indicative list of MMEs required for this work else where in this contract and to be made available by the contractor. The list will be reviewed by BHEL site as per the requirement of approved FQPs and the contractor shall meet any augmentation needed wherever required.			
11.3.3	It is the responsibility of the contractor to prove the accuracy of the testing / measuring / calibrating equipment brought by him based on the periodicity of calibration as called for in the BHEL's quality assurance standards/BHEL Engineer's instructions.			
11.3.4	Re-work necessitated on account of use of invalid MMEs shall be entirely to the contractor's account. He shall be responsible to take all corrective actions, including resource augmentation if any, as specified by BHEL to make-up for the loss of time.			
11.3.5	In the courses of erection, it may become necessary to carry repeated checks of the work with instruments recently calibrated, re-calibrated. BHEL may counter / finally check the measurements with their own MMEs. Contractor shall render all assistance in conduct of such counter / final measurements.			
11.4	INSPECTION BY TS / FES / QA ENGINEERS OF BHEL UNITS / ENGINEERING CENTRES			
11.4.1	Apart from day-to-day inspection by BHEL Engineers stationed at Site and Customer's Engineers, stage inspection of equipment under erection and commissioning at various stages may also be conducted by teams of Engineers from Field Engineering Services of BHEL's Manufacturing Units, Quality Assurance teams from Field Quality Assurance, Unit/Factory Quality Assurance and Commissioning Engineers from Technical Services etc. Contractor shall arrange all labour, tools and tackles etc along with proper access for such stage inspections free of cost.			
11.4.2	Any modifications suggested by BHEL FES and QA Engineers' team shall be carried out. Claims of contractor, if any, shall be dealt as per applicable clause of the contract, and provided such modifications have not arisen for reasons attributable to the contractor.			
11.5	PENALTIES ON VENDORS / SUB-CONTRACTORS AGAINST NON-COMPLIANCE OF QUALITY NORMS			
Sl. No.	Nature of Non-compliance	Penalty for Domestic Project	Penalty for Export Project	Remarks
GENERAL				
11.5.1	Unavailability of QAE deployment schedule (duly approved by BHEL Site) matching with manpower requirement of approved L2 schedule	0.10%	0.10%	Against each RA bill
11.5.2	Unavailability of required number of QAE with proper experience & NDT certification as per the requirement of the Contract	Rs. 1,000.00	\$16.00	Per person per day
11.5.3	Not attending quality meeting of BHEL by nominated member of vendor / sub-contractor	Rs. 2,000.00	\$32.00	Per meeting
CALIBRATION				
11.5.4	Use of MMEs without valid calibration certificate	Rs. 1,000.00	\$16.00	Per equipment per instance
11.5.5	Use of NDT equipment, welding equipment without having valid calibration certificate / condition not as per requirement	Rs. 1,000.00	\$16.00	Per equipment per instance
WELDING & NDT				

11.5.6	Unqualified welders carrying out welding / tack welding	Rs. 1,000.00	\$16.00	Per welder per instance. (Gatepass of the person shall be withheld)
11.5.7	Not using portable oven for welding consumables	Rs. 500.00	\$8.00	Per welder per instance. (The consumables in the oven shall be confiscated)
11.5.8	Not using electrodes pre-baked in baking oven	Rs. 500.00	\$8.00	Per instance. (The subject consumables shall be confiscated)
11.5.9	Not using welding consumables of approved make & not using correct type of electrode as per approved EWS / Drawing / WPS	Rs. 1,000.00	\$16.00	Per instance. (The subject consumables shall be confiscated)
11.5.10	Non-removal of welding slag and spatters after welding	Rs. 500.00	\$8.00	Per joint
11.5.11	Not using NDT equipment as prescribed in the manual / FQP / guidelines / Contract	Rs. 1,000.00	\$16.00	Per equipment per instance
11.5.12	Welder doing welding without valid job card	Rs. 500.00	\$8.00	Per instance
11.5.13	Discrepancy observed in the weld joints identified by BHEL / Customer for RT vs RT film offered	Rs. 2,000.00	\$32.00	per joint
MATERIAL MANAGEMENT				
11.5.14	Non-maintenance of grid pillar marking	Rs. 200.00	\$3.00	Per location week
11.5.15	Mismatch of location of material in store area w.r.t. location mentioned in stock register	Rs. 500.00	\$8.00	Per instance
11.5.16	Non-compliance of Preservation of material as per storage & preservation manuals	Rs. 1,000.00	\$16.00	Per equipment
11.5.17	Not offering received material for verification within stipulated time as per contract	Rs. 500.00	\$8.00	Per instance
PAINTING & ALLIED WORKS				
11.5.18	Not using primer / paints of approved make and as per Specifications	Rs. 1,000.00	\$16.00	Per instance
11.5.19	Painting without proper surface preparation as per approved schedule / drawing / FQP	Rs. 500.00	\$8.00	Per instance
PROTOCOLS & LOG SHEETS				
11.5.20	Delay in preparation of Protocols / Logsheets as per approved FQP within 3 days of completion of checks	Rs. 200.00	\$3.00	Per protocol per day delay
INSPECTION OF BOUGHT-OUT ITEMS / CONSUMABLES				
11.5.21	Delay in offering inspection of Bought-out Items / Consumables / Aggregates (for items which need site inspection as per approved QP) within 3 days of receipt of material at site	1% of the item value of the LOT	1% of the item value of the LOT	per item per day delay after receipt of material

11.5.22	Delay in submission of required documents (viz. Invoice, Inspection Release Note, COC, MDCC, MTC as the case may be) of Bought-out Items (shop inspection items / consumables) with in 3 days of receipt of material at site.	1% of the item value of the LOT	1% of the item value of the LOT	per item per day delay after receipt of material
NOTE: Any non-conformity requiring dismantling / rework, attributable to vendor / sub-contractor, shall be penalised at a rate mentioned above or cost to BHEL, which ever is higher.				
12.0	HEALTH, SAFETY & ENVIRONMENT			
12.1	General			
12.1.1	The contractor shall comply with all the requirements of "The Building and Other Construction Workers (Regulation of Employment, Conditions of Service) Act," 1996 and its Central Rule 1998 / State Rules and any other statutory requirements as applicable.			
12.1.2	The Contractor shall follow NTPC Safety Rules as issued from time to time with respect to safety in construction & erection.			
12.1.3	The contractor shall have the approved Safety, Health and Environment (SHE) Policy in respect of Safety and health of Building Workers and it shall be circulated widely and displayed at conspicuous place in Hindi and local language understood by the majority of the workers. A copy of the safety policy should be submitted to Engineer in charge.			
12.1.4	The contractor shall submit the safety plan comprising of methods to implement the Safety Policy/ Rules, Risk assessment and ensuring Safety at work areas, Safety audits, inspections and its compliance, Supervision and Responsibility to ensure Safety at various levels, Safety training to employees, review of Safety and accident analysis, ensure Health and Safety Procedures to prevent accidents to Engineer I/c for approval as per the format of Safety plan as annexed at Annexure - I.			
12.1.5	The Contractors shall ensure proper safety of all the workmen, materials, plant and equipment belonging to him or to the Employer or to others, working at the Site.			
12.1.6	All equipments used in construction and erection by the contractor shall meet BIS I International Standards and where such standards do not exist, the Contractor shall ensure these to be absolutely safe. All equipments shall be strictly operated and maintained by the contractor in accordance with manufacturer's operation manual. The contractor should also follow Guidelines/Rules of the Employer in this regard.			
12.1.7	The Contractors shall provide suitable latest Personal Protective Equipments of prescribed standard to all their employees and workmen according to the need. The Engineer I/c shall have the right to examine these safety equipments to determine their suitability, reliability, acceptability and adaptability. The contractor should also ensure these before their use at worksite.			
12.1.8	The Contractor shall provide safe working conditions to all workmen and employees at his workplace including safe means of access, railings, stairs, and ladders, scaffolding, work platforms, toe boards etc. The scaffoldings shall be erected under the control and supervision of an experienced and competent person. For erection of scaffolds, access, work platforms etc. shall be good and the contractor shall use standard quality of material.			
12.1.9	The Contractor shall follow and comply with all the Safety Rules, standards, code of practices of NTPC and relevant provisions of applicable laws pertaining to the safety of workmen, employees, plant and equipment as may be prescribed from time to time without any protest or contest or reservation. In case of any unconformity between statutory requirement and the Safety Rules of the Employer referred above, the latter shall be binding on the Contractor unless the statutory provisions are more stringent. As and when required he can refer / obtain copy of NTPC safety documents as stated above.			
12.1.10	The contractor shall have his own arrangements with nearby hospitals for shifting and treatment of sick and injured. The medical examination of the workers employed in hazardous areas shall be conducted as per Rule 223 Of The Building and Other Construction Worker (Regulation of Employment and Condition of Service) Central Rule 1998 Their health records shall be maintained accordingly and to be submitted to Engineer 1/c when asked for. If any worker found suffering from occupational health hazard, the worker should be shifted to suitable place of working and properly treated under intimation to Engineer I/c. The medical fitness certificate to be submitted to Engineer (I/c).			
12.1.11	First Aid boxes equipped with requisite articles as specified in the Rule 231 of TheBuilding and Other Construction Worker (Regulation of Employment and Condition of Service) Central Rule 1998 shall be provided at construction sites for the use of workers. Training has to be provided on first aid to workmen & office bearers working at site.			
Emergency Action Plan				

12.2	The contractor shall prepare an emergency action plan approved by his competent authority to handle any emergency occurred during construction work. Regular mock drills shall be organized to practice this emergency plan. The Emergency Action Plan should be widely circulated to all the employees and suitable infrastructure shall be provided to handle the emergencies.
12.3	Scaffolding The contractor shall take all precautions to prevent any accidental collapse of scaffolding or fall of persons from scaffolding. The contractor should ensure that scaffolding are designed by a competent person and its erection and repairs should be done under the expert supervision. The scaffolding shall meet the required strength and other requirements for the purpose for which the scaffold is erected. The material used for scaffold should conform to the BIS / International standards.
12.4	Opening The contractor shall ensure that there is no opening in any working platform/any floor of the building, which may cause fall of workers or material. Whenever an opening on a platform/any floor of the building is unavoidable, the opening should be suitably fenced and necessary measures for protection against falling objects or building workers from such platform are taken by providing suitable safety nets, safety belts or other similar means.
12.5	Explosives The contractor shall take all precautions while handling, using, storing or transporting of all explosives. Before usage of any explosive necessary warning / danger signals be erected at conspicuous places to warn the workers and general public. The contractor should strictly ensure that all measures and precautions required to be complied for use, handling, storing or transportation of explosives under the rules framed under the Explosives Act, 1884.
12.6	Fencing of Machinery The contractor shall provide suitable fencing or guard to all dangerous and moving parts of machinery. The contractor shall not allow any of the employees to clean, lubricate, repair, adjust or examine during machinery in motion, which may cause injury to the person.
12.7	Carrying of Excessive Weight by a Worker The worker shall not be allowed to lift by hand or carry over his head, back or shoulder more than the maximum limit set by the prescribed rules for the construction Workers.
12.8	Dangerous and Harmful Gases / Equipment The contractor shall ensure that the workers are not exposed to any harmful gases during any construction activity including excavation, tunneling, confined spaces etc. The contractor should not allow any worker to go into the confined space unless it is certified by Engineer (I/c) to be safe and fit for the entry to such work place. Proper record and work permits should be followed to carry out such works.
12.9	Dangerous and Harmful Gases / Equipment The contractor shall ensure that the workers are not exposed to any harmful gases during any construction activity including excavation, tunneling, confined spaces etc. The contractor should not allow any worker to go into the confined space unless it is certified by Engineer (I/c) to be safe and fit for the entry to such work place. Proper record and work permits should be followed to carry out such works.
12.10	Overhead Protection The contractor shall ensure that any area exposed to risk of falling materials, articles or objects is roped off or cordoned off or otherwise suitably guarded from inadvertent entry of any person. Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards.
12.11	Working at Heights All working platforms, ways and other places of construction work shall be free from accumulations of debris or any other material causing obstructions and tripping. Wherever workers are exposed to the hazard of falling into water, the contractor shall provide adequate equipment for saving the employees from drowning and rescuing from such hazards. The contractor shall provide boat or launch equipped with sufficient number of life buoys, life jackets etc. manned with trained personnel at the site of such work. Every opening at elevation from ground level through which a building worker, vehicle, material equipment etc. may fall at a construction work shall be covered and/or guarded suitably by the contractor to prevent such falls. Wherever the workers are exposed to the hazards of falling from height, the contractor shall provide full harness safety belts fitted with fall arresting systems to all the employees working at higher elevations and life line of 8 mm diameter wire rope with turn buckles for anchoring the safety belts while working or moving at higher elevations. Safety nets shall also be provided for saving them from fall from heights and such equipment should be in accordance with BIS standards. Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards.

	<p>The contractor shall provide standard prefabricated ladders on the columns where the workers are required to use them as an access for higher elevations till permanent staircase is provided. The workers shall be provided with safety belts permanent staircase is provided. The workers shall be provided with safety belts fitted with suitable fall arresting system (Fall arrestors) for climbing/getting down through ladders to prevent fall from height.</p>
12.12	<p>Handling of Hazardous Chemicals</p> <p>The Contractor will notify well in advance to the Engineer I/c of his intention to bring to the Site any container filled with liquid or gaseous fuel or explosive or petroleum substance or such chemicals which may involve hazards. NTPC shall have the right to prescribe the conditions, under which such container is to be stored, handled and used during the performance of the works and the Contract shall strictly adhere to and comply with such instructions. The Engineer I/c shall have the right at his sole discretion to inspect any such container or such construction plant / equipment for which material in the container is required to be used and if in his opinion, its use is not safe, he may forbid its use. No claim due to such prohibition shall be entertained by NTPC and NTPC shall not entertain any claim of the Contractor towards additional safety provisions / conditions to be provided for / constructed.</p> <p>Further, any such decision of the Engineer I/c shall not, in any way, absolve the Contractor of his responsibilities and in case, use of such a container or entry thereof into the Site area is forbidden by NTPC, the Contractor shall use alternative methods with the approval of the NTPC without any cost implication to the NTPC or extension of work schedule.</p> <p>Where it is necessary to provide and / or store petroleum products or petroleum mixtures and explosives, the Contractor shall be responsible for carrying-out such provision and / or storage in accordance with the rules and regulations laid down in Petroleum Act 1934, Explosives Act 1948, and Petroleum and Carbide of Calcium Manual published by the Chief Inspector of Explosives of India. All such storage shall have prior approval of the Engineer I/c. In case any approvals are necessary from the Chief Inspector (Explosives) or any statutory authorities, the Contractor shall be responsible for obtaining the same.</p> <p>The Contractor shall be fully responsible for the safe storage of his and his Sub- contractor's radio-active sources in accordance with BARC/DAE (Bhabha Atomic Research Centre/ Department of Atomic Energy, Govt. of India) Rules and other applicable provisions. All precautionary measures stipulated by BARC/DAE in connection with use, the contractor would take storage and handling of such material.</p> <p>The contractor shall provide suitable personal protective equipments to the workers who are handling the hazardous and corrosive substances including alkalis and acids.</p> <p>As a precautionary measure the contractor should keep the bottles filled with distilled water in cupboard / Boxes near work place for emergency eye wash by worker exposed to such hazardous chemicals.</p>
12.13	<p>Eye Protection</p> <p>The contractor shall provide suitable personal protective equipment to his workmen depending upon the nature of hazards and ensure their usage by the workers engaged in operations like welding, cutting, chipping, grinding or similar operations which may cause injuries to his eyes.</p>
12.14	<p>Excavation</p> <p>The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding material or article from any bank or side of such excavation which is more than one and a half meter above his footing by providing adequate piling, shoring, bracing etc. against such bank or sides. Adequate and suitable warning signs shall be put up at conspicuous places at the excavation work to prevent any persons or vehicles falling into the excavation trench. No worker should be allowed to work where he may be stuck or endangered by excavation machinery or collapse of excavations or trenches.</p>
12.15	<p>Electrical Hazards</p> <p>The contractor should ensure that all electrical installations at the construction work comply with the requirements of latest electricity acts / rules.</p> <p>The contractor shall take all adequate measures to prevent any worker from coming into physical contact with any electrical equipment or apparatus, machines or live electrical circuits which may cause electrical hazards during the construction work. The contractor shall provide the sufficient ELCBs / RCCBs for all the portable equipments, electrical switchboards, distribution panels etc. to prevent electrical shocks.</p> <p>The contractor should ensure use of single I double insulated hand tools or low voltage i.e., 110 volts hand tools.</p> <p>The contractor should also ensure that all temporary electrical installations at the construction works are provided with earth leakage circuit breakers.</p>
12.16	<p>Vehicular Traffic</p> <p>The contractor should employ vehicle drivers who hold a valid driving license under the Motor Vehicles Act, 1988.</p>
	Lifting Appliances, Tools & Tackles, Lifting Gear And Pressure Plant & Equipment etc.

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12.17	<p>The contractor shall ensure all the lifting appliances, tools & tackles including cranes etc., lifting gear including fixed or movable and any plant or gear, hoists, Pressure Plant and equipment etc. are in good condition and shall be examined by competent person and only certified shall be used at sites. Periodical Examination and the tests for all lifting / hoisting equipment & tackles shall be carried out. A register of such examinations and tests shall be properly maintained by the Contractor and will be promptly produced as and when desired by the Engineer I/c or by the person authorized by him.</p>
12.18	<p>Excessive Noise, Vibration</p> <p>The contractor shall take adequate measures to protect the workers against the harmful effect of excessive noise or vibration. The noise should not exceed the limits prescribed under the concerned rules, Noise Pollution (Regulation and Control) Rules, 2000.</p>
12.19	<p>Electrical Installations</p> <p>The Contractor shall not interfere or disturb electric fuses, wiring and other electrical equipment belonging to the Employer or other contractors under any circumstances, whatsoever, unless expressly permitted in writing by the Engineer I/c to handle such fuses, wiring or electrical equipment. Before the Contractor connects any electrical appliances to any plug or socket belonging to the other contractor or the NTPC, he shall</p> <ul style="list-style-type: none"> i) Satisfy the Engineer I/C that the appliance is in good working condition; ii) Inform the Engineer I/C of the maximum current rating, voltage and phases of the appliances; iii) Obtain permission of the Engineer I/C detailing the sockets to which the appliances may be connected. <p>The Engineer I/C will not grant permission to connect until he is satisfied that:</p> <p>The appliance is in good condition and is fitted with suitable plug; having earth connection with the body.</p> <p>Wherever armored / metallic sheathed multi core cable is used, the same armored / sheathed should be connected to earth.</p> <ul style="list-style-type: none"> iv) No repair work shall be carried out on any live equipment. The Engineer I/c must declare the equipment safe and a permit to work shall be issued by the NTPC / contractor as the case may be to carry out any repair / maintenance work. While working on electric lines / equipments whether live or dead, suitable type and sufficient quantity of tools will have to be provided by the contractor to electricians / workmen / Officers. v) The contractor shall employ necessary number of qualified, full time Electricians / Electrical Supervisors to maintain his temporary electrical installation. <p>The installations are provided with suitable ELCBs and RCCBs wherever required</p>
12.20	<p>Safety Organisation</p>
12.20.1	<p>The contractor employing more than 250 workmen whether temporary, casual, probationary, regular or permanent shall employ at least one full time safety officer exclusively to supervise safety aspects of the equipments and workmen, who will coordinate with the NTPC Safety Officer. Further requirement of safety officers, if any, shall be guided by Rule 209 of The Building and Other Construction Worker (Regulation of Employment and Conditions of Service) Central Rule 1998. In case the work is being carried out through subcontractor, the employees / workmen of the sub contractor shall also be considered as the contractor's employees/workmen for the above purpose. In case of contractor deploying less than 250 workmen he should designate one of his Engr / supervisor or the contractor himself (if he is directly supervising the work) as safety officer in addition to his existing responsibilities. The Engr./ supervisor should get atleast 2 days safety training from any reputed organization or from NTPC before resuming the work. If already trained in past the declaration along with trg. certificate to be furnished to NTPC safety officer.</p>
12.20.2	<p>The name and address of such Safety Officer of the Contractor will be promptly informed in writing to the EIC with a copy to the Project Safety Officer before he starts work or immediately after any change of the incumbent is made during currency of the Contract.</p>

12.21	<p>Reporting of Accident and Investigation</p> <p>In case any accident occurs during the construction / erection or other associated activities undertaken by the Contractor thereby causing any near miss, minor or major or fatal injury to his employees due to any reason, whatsoever, it shall be the responsibility of the Contractor to promptly inform the same to the Engineer I/C, NTPC Safety Officer with a copy to NTPC Head of Project in the prescribed form and also to all the authorities envisaged under the applicable laws.</p>
12.22	<p>Right to stop Work</p>
12.22.1	<p>The Engineer VC shall have the right at his sole discretion to stop the work, if in his opinion the work is being carried out in such a way that it may cause accidents and endanger the safety of the persons and / or property, and / or equipments. In such cases, the contractor shall be informed in writing about the nature of hazards and possible injury / accident and he shall comply to remove shortcomings promptly. The Contractor after stopping the specific work can, if felt necessary appeal against the order of stoppage of work to the Project Manager within 3 days of such stoppage of work and decision of the Project Manager in this respect shall be conclusive and binding on the Contractor.</p>
12.22.2	<p>The Contractor shall not be entitled for any damages / compensation for stoppage of work, due to safety reasons and the period of such stoppage of work shall not be taken as an extension of time for Completion of the Facilities and will not be the ground for waiver of levy of liquidated damages.</p>
12.23	<p>Fire Protection</p> <p>The contractor shall provide sufficient fire extinguishers at place /s of work. The fire extinguishers shall be properly maintained as per relevant BIS Standards. The employees shall be trained to operate the fire extinguishers / equipment.</p>
12.24	<p>Penalties</p> <p>I. If the Contractor fails in providing safe working environment as per the Safety Rules of NTPC or continues the work even after being instructed to stop the work by the Engineer I/C as provided in, the Contractor shall be penalized at the rate of Rs. 25,000/- per day or part thereof till the instructions are complied with and so certified by the Engineer I/C. However, in case of accident, the provisions contained in relevant sub clause shall also apply in addition to the penalties mentioned in this sub-clause.</p> <p>II. If the Contractor does not take all safety precautions and / or fails to comply with the Safety Rules as prescribed by the Employer or under the applicable law for the safety of the plant and equipment and for the safety of personnel and the contractor does not prevent hazardous conditions which cause injury to this own employees or employees of other contractors, or NTPC's employees or any other person who are at the Site or adjacent thereto, the Contractor shall be responsible for payment of penalty to NTPC as per the following schedule:-</p> <p>a) Fatal injury or accident causing death: Penalty @10% of contract value or Rs. 5,00,000/- per person, which ever is less.</p> <p>b) Major injuries or accident causing 25% or more permanent disablement to workmen or employees: Penalty @2.5% of contract value or Rs. 1,00,000/- per person which ever is less Permanent disablement shall have the same meaning as indicated in The Workmen's Compensation Act' 1923. The penalty mentioned above shall be in addition to the compensation payable to the workmen / employees under the relevant provisions of the Workmen's Compensation Act' 1923 and rules framed there under or any other applicable laws as applicable from time to time.</p> <p>III. If any contractor worker found working without using the safety equipment like safety helmet, safety shoes, safety belts, etc. or without anchoring the safety belts while working at height the Engineer 1/c / Safety Officer of NTPC shall have the right to penalize the contractor for Rs. 200/- per person per day and such worker shall be sent out of the workplace immediately and shall not be allowed to work on that day. Engineer 1/c / Safety Officer of NTPC will also issue a notice in this regard to the contractor.</p> <p>IV. If two or more fatal accidents occur at same NTPC site under the control of contractor during the period of contract and he has</p> <p>(1) not complied with keeping adequate PPEs in stock or</p>

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	<p>(2) defaulted in providing PPEs to his workmen</p> <p>(3) not followed statutory requirements / NTPC safety rules</p> <p>(4) been issued warning notice/s by NTPC head of the project on non observance of safety norms</p> <p>(5) not provided safety training to all his workmen, the contractor can be debarred from getting tender documents in NTPC for two years from the date of last accident.</p> <p>The safety performance will also be one of the overriding criteria for evaluation of overall performance of the contractors by NTPC. The contractor shall submit the accident data including fatal / non-fatal accidents for the last 3 years where he has undertaken the construction activities Projects-wise along with the tender documents. This will also be considered for evolution of tender documents. If the information given by the contractor found incorrect, his contract will be liable to be terminated.</p>
12.25	The Contractor will make available minimum quantity of all safety equipments and safety personal protection equipments (PPEs) of required specifications as per suggestive list included bidding documents as a part of "List of minimum T & P". Further Contractor will ensure availability of additional requirement for individual worker and safety equipment as per site requirement during execution of the contract till its completion.
12.26	Award If the Contractor's performance on safety front is found satisfactory i.e. without any fatal/reportable accident in the year of consideration; he may be considered for suitable award "ACCIDENT FREE SAFETY MERITORIOUS AWARD" as per scheme of the employer.
12.27	The Contractor shall abide by the following during Construction and Erection activities I. Chain pulley block shall not be used for loads more than 2 (Two) tonne. II. Hydra shall not be used for material transport. III. Cage shall necessarily be provided to Monkey ladders of height more than 4 m. IV. Fencing shall be provided to all Electrical Distribution boards and transformers etc.
12.28	Further details of applicable HSE norms shall be as per HSE clause of Tender SCC.
13.0	LAND
13.1	Availability of land within plant boundary is very limited and the contractor has to plan & use the existing land considering the use of land by other contractors and the storage of plant machineries and materials. The existing land shall be shared by all erections agencies. The same will be reviewed by BHEL and allotted to the extent available/ considered necessary free of cost. Contractor shall develop these areas for their site office, their own stores etc. Bidder must visit site to assess site condition, prior to quoting.
13.2	Levelled area for storage area for BHEL's material shall be provided as per availability free of cost.
13.3	Land for labour colony shall be arranged by successful bidder at their own. The contractor shall construct labour colony / hutment as per his requirements after obtaining approval of formalities from statutory body. Further, contractor must ensure minimum HSE norms and hygienic sanitary conditions in his labour colony.
13.4	The contractor will be responsible for handing back all lands, as handed over to him by BHEL/NTPC.
14.0	WATER
14.1	BHEL will provide single point supply for construction & drinking water inside the project premises for office free of cost.
14.2	Further necessary network for construction & drinking water system shall be done by the bidder at his own cost.
14.3	Contractor should arrange for water for labour colony of their own.
14.4	BHEL shall not be responsible for any inconvenience or delay caused due to any interruption of water supply and the contractor shall claim no compensation for delay in work for such interruption. Contractor may make standby arrangement for water at their own cost.
14.5	Contractor will have to arrange for storage of water to meet the day-to-day requirement.
14.6	The availability of water (construction as well as drinking) may be limited. Contractor shall ensure that no water is wasted. In this regard the contractor shall take all necessary measure towards preservation of water.

15.0	ELECTRICITY
15.1	BHEL shall provide construction power free of charge at 415V level at one point. Contractor has to make their own distribution arrangement to draw electricity. Overall area illumination will be provided by BHEL. However, for night working contractor should arrange illumination as and when required by them.
15.2	The bidder shall have to provide earth leakage circuit breaker at each point wherever human operated electrical drives/ T&Ps are deployed.
15.3	The power supply will be from the available grid. BHEL shall not be responsible for any inconvenience or delay caused due to any interruption of power supply/ variation in voltage level and no compensation for delay in work can be claimed by the contractor due to such non-supply on the grounds of idle labour, machinery or any other grounds.
15.4	Bidder will have to arrange sufficient illumination at their own work areas.
15.5	The contractor should ensure that the work in critical areas is not held up in the event of power breakdown. In the event of breakdown in the electric supply, if the progress of work is hampered, it will be the responsibility of the contractor to step up the progress of work after restoration of electric supply so that overall progress of work is not affected.
15.6	The contractor shall have to make arrangement at their own cost for illumination that will be required in the working area for execution of the work & safety of workmen.
15.7	Contractor shall make arrangement of electricity of their own for labour colony.
16.0	CONSUMABLE
16.1	All consumables, like gas, electrodes, chemicals, lubricants etc. required for the scope of work, shall be arranged by the contractor at his cost unless otherwise specifically mentioned in the contract.
16.2	All consumables to be used for the job shall have to be approved by NTPC / BHEL prior to use.
16.3	In the event of failure of contractor to bring necessary and sufficient consumables, BHEL may arrange for the same at the risk and cost of the contractor. The entire cost towards this along-with overhead shall be paid by the contractor or deducted from the contractor's bills.
17.0	TEST CERTIFICATES
	Necessary test certificates of all materials supplied by contractor are to be produced to BHEL prior to use of those materials.
18.0	PROJECT MANAGEMENT/ CONSTRUCTION MANAGEMENT
	To meet the need of construction management at site, contractor shall provide the following services within quoted / accepted rates.
18.1	PLANNING & MONITORING
18.1.1	The bidder shall prepare detail construction schedule (L-3) as per completion dates given in this document. This schedule must include all milestone and key activities for each sub-systems / components in the areas of engineering (wherever applicable), procurement, manufacture (wherever applicable), ecogniz, excavation/ construction/ erection. This network must conform to the overall project schedule. The bidder should also ensure monitoring of these activities at least weekly basis to start with and on daily basis whenever required by BHEL.
18.1.2	The bidder shall also prepare progress report indicating progress on key activities, management summary for critical activities, list of actions requiring attention of BHEL. This schedule is to be preferably made in PRIMAVERA/ MS PROJECTS, so that the same is compatible with BHEL's project management software.
18.2	PROGRESS REPORTING
18.2.1	The bidder shall submit daily, weekly and monthly progress reports for work force, materials reports, consumables (gases/electrodes) report and other reports as per pro-forma considered necessary by the BHEL. In case of any failure on contractor's part to comply with this, BHEL may at its discretion, consider to withhold part payment against their RA bills.
18.2.2	The progress report shall indicate the progress achieved against planned with reasons indicating delays, if any, and shall give the remedial actions which the contractor intends to take to make good the slippage or lost time, so that further works again proceed as per the original program and the slippages do not accumulate and effect the overall program.
18.2.3	The daily work force reports shall clearly indicate the work force deployed, category-wise specifying also the activities in which they are engaged.
18.2.4	Weekly progress review meetings will be held at site during which actual progress during the week vis-à-vis scheduled program shall be discussed or actions to be taken for achieving targets. For discussions,

	the contractor shall present program of subsequent week. The contractor shall constantly update/revise his work program to meet the overall requirement.	
18.2.5	Periodic progress reviews on the entire activities of execution in respect of supply and works in scope of bidder will be held once in a month at Kolkata / Site. These meetings will be attended by reasonably higher officials of the contractor and will be used as a forum for discussing all areas where progress needs to be speeded up. The contractor shall be further responsible for ensuring that suitable steps are taken to meet various targets decided upon such meetings.	
18.2.6	During construction, contractor shall take an average forty colour digital photograph / slides (indicating date) each month (not less than five per week) of the works during progress. In case of failure in providing such photograph in each month, an amount of Rs. 20,000/- per month shall be deducted from contractor's RA bill.	
18.2.7	Successful bidder has to provide for electronic/ computerized storing and re-production/ printing/ plotting of various data, log sheets, protocols, measurements etc. These may be stored in CD (as per requirement) and handed over to BHEL as per requirement.	
18.3	SITE ORGANIZATION	
18.3.1	The contractor shall maintain a site organization of adequate strength in respect of manpower, construction machinery and other implements at all time for smooth execution of the contract headed by a competent construction manager for site operations with sufficient level of authority to take site decisions. The vendor will submit organization chart (showing the name of Site-in-charge) with individual bio-data indicating various levels of experts to be posted for supervision in the fields of supervision and execution, quality, material management, planning, safety, etc. The organization shall be reinforced from time to time, as required to make up slippage (if any) from the schedule without any commercial implication to BHEL. The organization chart is to be submitted within 10 days from the date of LOI.	
18.3.2	Following (minimum) engineering manpower with power plant construction background to be deployed at site by the successful vendor for their day to day supervision etc.	
18.3.2.1	Qualified safety officers with assistants (exclusive for safety supervision for project jobs).	Officer – One no. Assistant - Two nos.
18.3.2.2	Site supervising engineer and supervisors for piling work etc.	Two Engineers (day & night working). Four Supervisors (day & night working).
18.3.2.3	Engineer & Supervisors for quality inspection.	One Engineer & Two supervisor (Assitant).
18.3.3	Deputation of above man-power shall be jointly decided at site in line with construction schedule.	
18.3.4	Engineer/ supervisor for other functions like store & purchase, material management, planning, finance, administration etc are to be provided as per site requirement and not considered above.	
18.3.5	In the event of non deputation of engineer/ supervisor by the bidder as per above agreed schedule, BHEL shall reserve the right to deduct Rs 70,000 per man-month for engineer, Rs 50,000 per man-month for the supervisor/ safety officer and Rs. 35000 per man-month for safety supervisor from RA bills. Further induction of manpower regarding site supervisor & site engineer will be decided at site as per requirement without any financial implication.	
18.3.6	BHEL reserves the right to reject or approve the list of personnel proposed by the contractor. The persons whose bio-data have been approved by BHEL will have to be posted at site and deviation in this regard will not be permitted unless specific & reasonable justification is made.	
18.3.7	In addition to above, a well experienced qualified engineer to be designated, as 'Project Manager', shall be deployed by the contractor. Such engineer shall have adequate exposure on the job and shall remain fully involved in all planning activities, guidance etc to contractor's own team during the complete execution period of contract.	
18.3.8	The contractor should also submit to BHEL for approval a list of T&Ps along with their fitness certificates. The tools & tackles shall not be removed from site without written permission of BHEL.	
18.3.9	The contractor should also submit network programs for the erection of various items. These networks shall show the customer / BHEL hold points (CHP), which have to be cleared by customer/ BHEL, or their authorized representatives before further erection can take place. These programs for the erection would clearly identify responsibilities of the contractor and customer/ BHEL. It is the responsibility of the contractor to get the networks approved by BHEL within four weeks of the date of finalization of award of work/ placement of LOI.	
18.4	CONSTRUCTION MANAGEMENT	

18.4.1	Based on the approved program, the contractor shall submit a program of construction/ erection/ commissioning for the implementation. These programs would be amplified showing start of erection and subsequent activities and shall form the basis for site execution and detail monitoring. The three monthly rolling program with the first month's program being tentative based on the site condition would be prepared based on these programs. The contractor shall also be involved along with NTPC / BHEL to tie up detailed resources mobilization plan over the period of the contract matching with the performance targets.	
18.4.2	The program would be jointly finalized by the site in-charge of the contractor with BHEL/ NTPC's project coordinator as well as the site-planning representative. The erection program will also identify sequential events matching financial turnover.	
18.4.3	The contractor is liable to furnish all documentary evidences towards payment of Works Contract Tax as and when required by BHEL.	
18.4.4	Piling shall be done by using rotary hydraulic rig. Three stages flushing of pile bore shall be ensured by air lift technique or any other internationally accepted technique duly approved by NTPC / BHEL. The construction methodology to be adopted shall be suitable to ensure proper termination of pile in the starta as specified.	
19.0	TOOLS & PLANTS (TO BE PROVIDED BY CONTRACTOR)	
19.1	Tentative list of T&P to be deployed by contractor for successful completion of work is detailed below.	
19.2	It may be noted that the list is not exhaustive and is only for general guidance. The contractor is required to provide all necessary T&P (other than those specified to be provided by BHEL, if any) measuring (calibrated) instruments & handing equipments for timely completion of total work as per contract. In case of project requirement, some activities may have to pre-pone. In such cases the contractor may have to deploy additional T&P. Quoted rate shall be inclusive of such requirements. However, contractor shall submit deployment plan of all T&P along with tender bid.	
19.3	In the event of any failure on the part of the contractor, BHEL may at his discretion also terminate the contract on this ground and take out any or whole amount of the contract from the scope of the contractor. In the event of failure of contractor to deploy necessary and sufficient T&P/ IMTEs, BHEL will be at liberty to arrange the same at the risk & cost of contractor including transportation cost of same from any of BHEL site/ other agency & charges as applicable shall be deducted from contractor's RA bill. Decision of BHEL in this regard will be final & binding on contractor.	
19.4	Following major T&Ps to be arranged by contractor within the time as indicated against each T&P	
	Major T&P items	Mobilisation time (from the date of written intimation by BHEL to start the work)
19.4.1	2 no 10/12/14/18 MT Nextgen pick & carry type tyre mounted mobile crane.(like Escorts F15 Pick and Carry Eqpt.)	Within 20 days
19.4.2	1 no Trailor – 15T.	As per site requirement
19.4.3	2 no Jack Hammer	As per site requirement
19.4.4	2 no Hydraulic Excavator/ Poclairn.	Within 20 days
19.4.5	1 no JCB.	As per site requirement
19.4.6	10 nos Hydraulic Rotary Piling Rigs to achieve at least 750 nos piles per month alongwith required capacity of crane, compressor with all accessories for flushing of piles bore for air lift technique and water cleaning method, flushing pipe, tremie pipe, bentonite re-circulation pump, bentonite feed pump, hose pipe for bentonite re-circulation.	5 rigs within 30 days. Balance rigs to be deployed progressively within 50 days
19.4.7	2 sets - Kentledge arrangement (preferably concrete blocks with structural arrangement) with high capacity hydraulic jack, dial gauges for vertical load test of pile.	Within 60 days
19.4.8	6 nos Transit Mixer (5 / 6 cum capacity), peak period 4 nos. transit mixer.	3 Nos. within 30 days. Balance as per site requirement.
19.4.9	3 no Self Priming Dewatering Pump 5 HP (diesel / electric).	Within 20 days.
19.4.10	2 nos 10 HP Submersible Mono-Block Electric Pump (KOS-1040+ of Kirloskar or equivalent).	Within 60 days.
19.4.11	4 nos Self Priming Dewatering Pump 2 HP (diesel/ electric).	Within 30 days.
19.4.12	1 no Dozer.	Within 25 days.

19.4.13	6 nos Dumper.	3 nos within 25 days. Balance within 60 days
19.4.14	1 no. Reinforcement Bending Machine.	As per site requirement
19.4.15	1 no Reinforcement Cutting Machine.	Within 30 days.
19.4.16	1 no Compression Testing Machine (200 T cap).	Within 40 days.
19.4.17	2 no Total Station with adequate arrangement for surveyors..	1 st Within 15 days. 2 nd Within 45 days
19.4.18	4 nos Auto Level & Staff.	2 Nos.Within 15 days. Balance as per site requirement.
19.4.19	90 nos. Concrete Cube Moulds.	Within 45 days.
19.4.20	1 no of Small Trucks 5T for movement within site.	As per requirement.
19.4.21	Two nos Drinking Water Tank – 1000 lit.	Within 30 days.
19.4.22	1 no Truck Mounted Water Tank (minimum 3000 lit) capacity with sprinkler arrangement.	Within 30 days.
19.4.23	Portable Fire Extinguishers as below Soda Acid – 4 sets. Dry Chemical Powder – 4 sets CO2 – 5 sets. Water & Sand Bucket (2 buckets in one stand) – 3 sets. Fire Hose with Nozzle (50 M length) – 3 sets.	Within 40 days
19.5	T&P shown in the above mentioned list are minimum requirement. Mobilisation schedule as mutually agreed at site for major T&Ps, have to be adhered to and no change will be permitted. Further requirement will be reviewed time to time at site and contractor will provide additional T&P/ equipments to ensure completion of entire work within schedule/target date of completion without any financial implication to BHEL. Vendor will give advance intimation & certification regarding capacity etc prior to dispatch of heavy equipments.	
19.6	All T&P and all IMTEs, which are required for successful and timely execution of the work covered within the scope of this tender, shall be arranged and provided by the contractor at his own cost in working condition.	
19.7	In the event of non mobilisation of any T&P by the successful bidder and as a result progress of work suffered, BHEL reserves the right to deduct suitable amount from the dues of the bidder, with assigning reasons thereof at the following rates	
	Major T&P items	Recovery rates
19.7.1	10/12/14/18 MT Nextgen pick & carry type tyre mounted mobile crane.(like Escorts F15 Pick and Carry Eqpt.)	Rs. 15000/- per week or part thereof
19.7.2	Trailor – 15T	Rs. 10000/- per week or part thereof
19.7.3	Jack hammers	Rs. 1000/- per week or part thereof
19.7.4	hydraulic excavator / Poclain	Rs. 50000/- per week or part thereof
19.7.5	JCB / Pay Loader	Rs. 25000/- per week or part thereof
19.7.6	Crawler Mounted Hydraulic rotary piling rigs alongwith required capacity of crane, compressor with all accessories for flushing of piles bore for air lift technique and water cleaning method, flushing pipe, tremie pipe, bentonite re-circulation pump, bentonite feed pump, hose pipe for bentonite re-circulation.	Rs. 50000/- per week or part thereof
19.7.7	Kentledge arrangement (preferably concrete blocks with structural arrangement) with high capacity hydraulic jack, dial gauges for vertical load test of pile.	Rs. 10000/- per week or part thereof
19.7.8	Transit Mixer (5/6 M3 capacity),	Rs. 20000/- per week or part thereof
19.7.9	Self Priming Dewatering Pump 5 HP (diesel/ electric)	Rs. 1000/- per week or part thereof
19.7.10	10 HP Submersible Mono-Block Electric Pump (KOS-1040+ of Kirloskar or equivalent),	Rs. 2000/- per week or part thereof
19.7.11	Self Priming Dewatering Pump 2 HP (diesel/ electric)	Rs. 1000/- per week or part thereof
19.7.12	Dozer	Rs. 40000/- per week or part thereof
19.7.13	Dumper	Rs. 10000/- per week or part thereof
19.7.14	Reinforcement Bending Machine	Rs. 5000/- per week or part thereof

19.7.15	Reinforcement Cutting Machine	Rs. 5000/- per week or part thereof
19.7.16	Compression Testing Machine (200 T Cap)	Rs. 4000/- per week or part thereof
19.7.17	Total station with adequate arrangement for Surveyors.	Rs. 5000/- per week or part thereof
19.7.18	Auto level & staff	Rs. 5000/- per week or part thereof
19.7.19	Drinking water tank – 1000 lit.	Rs. 1000/- per week or part thereof
19.7.20	Truck mounted water tank (minimum 3000 lit) capacity with sprinkler arrangement.	Rs. 5000/- per week or part thereof
19.7.21	Portable Fire Extinguishers as below Soda Acid. Dry Chemical Powder CO2. Water & Sand Bucket (2 buckets in one stand) Fire Hose with Nozzle (50 M length)	Rs. 1000/- per week or part thereof for any item
19.7.22	Any other instrument	As per discretion of the engineer
20.0	INSURANCE	
20.1	BHEL shall arrange comprehensive MCE (marine cum erection) Insurance Policy for total project supply & services including balance of plant package covering transit risks & loss, destruction or damage during handling at Site, Storage, civil works ,erection, testing and commissioning up to trial operation completion of unit including theft, sabotage, fire, lightning and other natural calamities.	
20.2	Contractor shall report to BHEL in writing any damages to equipment/components on receipt, storing, and during withdrawal of the materials from stores, in transit to site and unloading at place of work and during erection and commissioning till trial operation completion including handing over. The above report shall be as prescribed by BHEL site management. Any consequential loss arising out of non-compliance of this stipulation will be borne by contractor.	
20.3	The contractor will take necessary precautions/ due care to protect the material at Project site, while in his custody from any damage/ loss till the same is handed over to BHEL/ customer at Project site. For lodging/ processing of insurance claim the contractor will submit necessary documents. BHEL will reserve the right to recover the loss from the contractor as detailed below in case the damage/loss is due to negligence/ carelessness on the part of the contractor. In case of theft of material under contractor's custody, the same shall be reported to police by the contractor immediately and copy of FIR and subsequently police investigation report shall be submitted to BHEL/ customer for taking up with insurance. However, this will not relieve the contractor of his contractual obligation for the materials in his custody.	
20.4	In case the damage/loss/theft of materials are attributable to negligence/failure in discharging the duties and obligations of the contractor, the expenses incurred for repair/replacement of such components in excess of the amount realized from the underwriters, limited to Normal Excess (Deductible Franchise) shall be recovered from the contractor.	
20.5	Other conditions of Insurance shall be as per relevant clause of GCC/SCC.	
21.0	MATERIAL HANDLING (BHEL ISSUED MATERIAL)	
21.1	Reinforcement and Ready Mix Concrete will be issued free of cost by BHEL for use in the work covered in this contract.	
21.2	All other materials required for proper completion of job shall be provided by contractor and quoted rates shall be inclusive of this. Consignment of steel will be directly issued to the contractor as received by BHEL, on weighment basis from its supplier, as per delivery challan of supplier.	
21.3	It would be the responsibility of the contractor to keep in constant contact with BHEL / site to find out the delivery status, arrival of the consignments and arrange for escort to accompany the truck / trailer for transportation of above materials by BHEL'S supplier, as necessary. The lorry, truck way bill for the consignment as shall be received by BHEL would be handed over to the contractor immediately for unloading of materials including all arrangement for necessary gate passes etc. All arrangement for necessary gate passes etc shall be the responsibility of contractor.	
21.4	Payment of all demurrages that may result due to contractor's fault / delay would be the responsibility of the contractor. If BHEL have to make payment of demurrage together with freight, the amount so paid as demurrages for the reasons stated above, shall be recovered from the bills of the contractor. The decision of BHEL's engineer in this regard will be final and binding on the contractor. However the contractor has to clear all such charges, if any in this regard and complete the job without waiting for BHEL's decision	

21.5	It would be the responsibility of the contractor to sign on the delivery book acknowledgement slip of supplier / transport authorities etc. & to submit computerized account of all such consignments of materials received by them, daily to BHEL.
21.6	Consignments coming on Sundays and holidays are also required to be handled/ unloaded by the contractor. Since the offices and stores will probably remain closed on such days, it will be the responsibility of the contractor to contact BHEL engineers at their residence and obtain instructions.
21.7	Since the consignments are expected to arrive during any time of the day or night, contractor shall have, his workmen round the clock at site as well as other places as required to unload the materials immediately on arrival.
21.8	BHEL reserve the right to recover from the contractor any loss arising out of damage/ theft or any other causes of the materials issued to him at any point.
21.9	Alternately Steel will be issued to the contractor from BHEL / customer's store within the plant premises, on weight basis. Receipt from BHEL / customer's stores, handling/ transportation to work site, unloading etc will be under the scope of work within his quoted rate.
21.10	Open land (free from encumbrance) shall be provided by BHEL on free of cost basis. Contractor shall maintain one centralized fenced store cum bar bending yard (Area approx 70mx70m). Hard surfacing of this yard and all round drain shall be carried out by the contractor at his own cost within the quoted rate.
21.11	The contractor shall in no case be entitled for any compensation or damages on account of any delay in supply or non-supply thereof for all or any such material.
21.12	No material shall be issued to the contractor except as those indicated above i.e. Reinforcement steel & Ready Mix Concrete unless otherwise expressly provided for in the contract. Contractor will have to make his own arrangement at his own cost for procurement of any other material as required for the works and of such quality as acceptable to BHEL.
21.13	The contractor shall maintain proper store account for all the BHEL issued materials and shall give three copies of once in two months computerised reconciliation statement of such account to the BHEL.
21.14	The contractor shall solely be responsible for the safety & quality of material after it is handed over and issued to contractor by BHEL.
21.15	BHEL issued materials shall not under any circumstances taken out of the project site unless otherwise permitted by BHEL.
22.0	ISSUE OF MATERIALS
22.1	ISSUE OF STEEL
22.1.1	The steel as received from the manufacturer / supplier shall be issued directly to the contractor free of cost on the following basis.
22.1.2	Reinforcement steel (TMT), earthing MS Rod – Weight basis (unit – MT).
22.1.3	All the steel (reinforcement (TMT), earthing MS Rod issued by the BHEL shall be properly accounted for. The total quantity of steel required for the work will be calculated from the approved Bar Bending schedule, fabrication drawings. The measurement for payment as well as for accounting shall be based on the sectional weights as indicated in the following/applicable latest IS specifications. Reinforcement Fe-500 conforming to IS: 1786. or grade-1 of IS:432 (part-I)
22.1.4	In case any such sectional weights are not available in the above documents, the manufacturer recommendation shall be binding.
22.1.5	The steel issued to the contractor shall be mainly in standard length and sections as received from the supplier. However, the contractor shall be bound to accept the steel in length as available in the project stores no claims for extra payment because of issue of non-standard length will be entertained.
22.1.6	The contractor shall satisfy himself of the quality and quantity of the materials at the time of taking delivery from BHEL / NTPC stores. No claims whatsoever will be entertained by BHEL because of quality or quantity after the materials are taken by the contractor from BHEL/ NTPC stores.
22.1.7	The contractor shall submit to the engineer, a statement indicating estimated quantity of Ready Mix Concrete and steel required at least two months in advance. In addition, the contractor shall also furnish the estimated requirement of Ready Mix Concrete and steel during next month by the third week of the current month. Failing which BHEL will not responsible to ensure supply of Ready Mix Concrete and steel. Delay in completion if any for the same shall be in bidders account.
22.1.8	Bidder to note that all fasteners like MS/HT/HSFG bolts/nuts, lock nuts, washers etc shall be supplied by the bidder as per applicable item of BOQ-cum Rate schedule.
22.1.9	Bidder to note that cement and steel required for his enabling job like store/site office etc shall be arranged at his own cost. All TG staging material shall be arranged by contractor at his own cost. Bidder shall do

	the design for its structure just immediately after receipt of TG deck drawing and obtain approval from BHEL.		
22.2	ISSUE OF READY MIX CONCRETE		
22.2.1	Bidder has to give a receipt of quantity of Ready Mix Concrete at the time of taking of concrete at batching plant. For ensuring quantity, bidder may check the print out of concrete from batching plant.		
23.0	RETURN OF MATERIALS		
23.1	RETURN OF STEEL INCLUDING SCRAP		
23.1.1	All surplus steel and all wastage materials will be taken back on weighment basis.		
23.1.2	Surplus, unused and un-tampered steel shall be sorted section-wise and returned separately for a place directed by BHEL - Engineer within the project area; Return of such materials will not be entitled to any handling and incidental charges.		
23.1.3	All wastage / scrap (including wastage, unusable scrap) shall be returned to the stores on weighment basis and a receipt obtained for material accounting purposes. Return of such material will not be entitled to any additional cost due handling and transportation and incidental charge.		
23.1.4	Scrap for reinforcement steel and structural steel shall be returned separately.		
23.2	RETURN OF READY MIX CONCRETE		
23.2.1	Under any circumstances Ready Mix Concrete will not be taken back. Bidder to plan accordingly for proper use of Ready Mix Concrete.		
24.0	CEMENT & STEEL CONSUMPTION AND WASTAGE		
24.1	REINFORCEMENT STEEL CONSUMPTION		
24.1.1	The theoretical consumption of various diameter of reinforcement shall be based on approved construction drawing and bar bending schedule. Weight shall be calculated considering the sectional weights as per Indian standards. No extra cost shall be payable to the contractor for any deviation in weights for the different procedures adopted for issue and calculation of the theoretical consumption including rolling tolerances.		
24.1.2	Actual consumption = Issue – Surplus.		
24.1.3	Surplus = Un-tampered and unused quantity of steel returned by the contractor to BHEL store along-with relevant documents.		
24.1.4	Wastage = Actual consumption – Theoretical consumption.		
24.2	READY MIX CONCRETE CONSUMPTION		
24.2.1	The theoretical consumption of various grade of based on approved construction drawing. Quantity shall be calculated considering the volume of concrete as per approved drawing. No extra cost shall be payable to the contractor for any deviation in quantity of Ready Mix Concrete received from the Batching Plant and actual use at site.		
24.3	REINFORCEMENT STEEL WASTAGE		
24.3.1	Allowable wastage: (+4%) of the theoretical consumption shall be considered as allowable wastage.		
24.3.2	Wastage and scrap shall be as per actual weighment basis.		
24.3.3	Sl no	Reinforcement steel	Basis of issue & penal recovery
	R-1	Theoretical consumption (without considering wastage and scrap or loss)	Free
	R-2a	Wastage limited to plus three percent (+3%) of aforesaid theoretical consumption (R-1) towards allowable wastage and return to BHEL Store.	Free
	R-2b	Wastage limited to plus three percent (+3%) of aforesaid theoretical consumption (R-1) towards allowable wastage but not returned to BHEL Store.	Penal rate
	R-3	Wastage beyond four percent (+4%) of the theoretical consumption above (R-1).	Penal rate
24.4	READY MIX CONCRETE WASTAGE		
24.4.1	Allowable wastage: +1.5% of the theoretical consumption shall be considered as allowable wastage.		
25.0	RECONCILIATION OF BHEL ISSUED MATERIALS		
25.1	The contractor shall submit a reconciliation statement of steel issued to him, once in a months. The same may be submitted alongwith RA Bill.		
25.2	The contractor shall properly account for the material issued to him as specified herein to the satisfaction of BHEL certifying that the balance material are available with contractor's custody at site.		

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25.3	If it is noticed by BHEL that the wastage is high and calls recovery at the penal rate, then BHEL will proceed for recovery for the excess wastage as per penal recovery rates as specified from RA bill.	
25.4	The approved drawings/ bar bending schedules are to be considered for the purpose of reconciliation of materials.	
26.0	RECOVERY OF MATERIAL	
26.1	If wastage exceeds the specified limit, the recovery of excess wastage shall be made from monthly RA bill at the penal rate stipulated below.	
26.2	PENAL RATE OF MATERIALS	
	Item	Penal rate (Rs)
26.2.1	Reinforcement steel	75,000 per MT.
26.2.2	Ready Mix Concrete	
	M - 7.5	6,500 per Cum
	M - 10	7,000 per Cum
	M - 15	7,850 per Cum
	M - 20	8,600 per Cum
	M - 25	8,700 per Cum
	M – 30	8,900 per Cum
	M - 35	12,300 per Cum
	M - 40	12,600 per Cum
27.0	CONSTRUCTION OF TEMPORARY OFFICE, STORES ETC	
	The contractor shall arrange at his own cost cleaning of area allotted, construction of his temporary office, stores, cement godown etc. and also the watch and ward of all the above. Materials required for the same shall be provided by contractor at his own cost.	
28.0	CIVIL LABORATORY AT SITE	
	Contractor shall establish and maintain civil laboratory with necessary equipment (as per Annexure-A) for conducting relevant site tests, as required.	
29.0	CONSTRUCTION SCHEDULE	
29.1	Entire work shall be carried out in accordance with the construction schedule given below, within the stipulated completion period. Within 30 days of LOI, the contractor shall discuss with BHEL site engineer & furnish the (L-3) construction schedule indicating all milestones on the basis of major activities and get it approved from BHEL Engineer.	
29.2	Schedule for major construction activities covered under the scope of work is as below.	
	Major activity description	
29.2.1	Piling Works for Absorber	06 months
29.2.2	Piling works for Wet Limestone Ball Mill	07 months
29.2.3	Piling works for Ball mill Building/Limestone grinding house	08 months
29.2.4	Piling works for FGD Control Room Building	10 months
29.2.5	Piling works for Lime Stone Storage Silo	12 months
29.2.6	Piling works all balace area	15 months
29.3	The contractor shall plan his work in such a manner so as to meet the overall project schedule, in consultation with BHEL/ customer engineer.	
29.4	Contractor shall submit daily work program based on above construction schedule.	
30.0	COMPLETION PERIOD	
30.1	The entire work under this scope shall be successfully completed in all respect within 15 (Fifteen) months from the date of start of work as certified by Construction Manager, BHEL.	
30.2	Contractor shall mobilise resources to start the work within 15 days from date of intimation of BHEL.	
30.3	However, actual date of start of work shall be reckoned based on certification of Construction manager,	
31.0	LIQUIDATED DAMAGE/ PENALTY	
31.1	Intermediate Milestones	
31.1.1	In case delay in achieving the Milestone as mentioned in Clause 29.2.1 above, is solely attributable to the contractor, 0.5% per week of executable contact value, limited to maximum 2% of executable contact value, will be withheld.	
31.1.2	In case delay in achieving the Milestone as mentioned in Clause 29.2.4 above, is solely attributable to the contractor, 0.5% per week of executable contact value, limited to maximum 3% of executable contact value, will be withheld.	

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31.1.3	Amount already withheld, if any against slippage of clause 29.2.1, 29.2.4 above, shall be released only if there is no delay attributable to contractor in achievement of Milestone as mentioned in clause 29.2.6 above.
31.1.4	Amount to be withheld on account of slippage of identified intermediate milestone(s) shall be withheld out of respective milestone payment and balance amount (if any) shall be withheld @10% of RA Bill amount from subsequent RA bills.
31.1.5	Final deduction towards LD (if applicable), on account of delay attributable to contractor shall be based on final delay analysis on completion / closure of contract. Withheld amount, if any due to slippage of identified intermediate milestone(s) shall be adjusted against LD or released as the case may be.
31.1.6	In case of termination of contract due to any reason attributable to contractor before completion of work, the amount already withheld against slippage of intermediate milestones shall not be released and be converted into recovery.
31.2	Overall Completion
31.2.1	If the completion of work is delayed beyond the completion period referred above due to reasons attributable to the contractor, they shall pay to BHEL as penalty a sum @ 0.5% of contract prices per week of delay or part thereof subject to a maximum of 10% of the total contract value.
31.2.2	All other terms shall be as per the provision of GCC in this regard.
31.3	In case of LD recovery, the applicable GST shall also be recovered from the contractor.
32.0	CERTIFICATE TOWARDS COMPLETION
	The work under the scope of the contractor shall be deemed to have been completed in all respects only when so certified by BHEL/ customer. Decision of BHEL in this regard shall be final and binding on the contractor.
33.0	GUARANTEE
33.1	Even though the work will be carried out under supervision of BHEL, the contractor will be responsible for the quality of workmanship, quality of materials/ items and design for which the contractor is responsible.
33.2	The contractor shall guarantee the work executed under the scope of the contract for a period of 12 (twelve) months from the date of start of guarantee period as certified by the engineer (ie on completion of total work under scope and taking over by BHEL) and shall rectify free of cost all defects due to faulty supply or work done. In case the contractor fails to repair/ replace the defective works within the time specified by the engineer, BHEL may proceed to undertake the repairs/ replace such defective works at contractor's risk and cost without prejudice to any other rights and recover the same from security deposit/ other dues.
34.0	INTEREST BEARING RECOVERABLE ADVANCE/ MOBILISATION ADVANCE
	Not applicable for this tender.
35.0	OVER RUN CHARGES
	Not applicable for this tender.
36.0	REVISION ON ACCEPTED CONTRACT RATE
	Not applicable in this tender.
37.0	PRICE VARIATION CLAUSE
	Not applicable in this tender.
38.0	EXTRA/ ADDITIONAL ITEMS OF WORK
	It shall be as per GCC.
39.0	SECURITY DEPOSIT, PERFORMANCE BOND & FINAL BILL
39.1	Security deposit shall be applicable as per relevant clause of GCC (Volume-IB).
39.2	Performance bond is not applicable for the tender.
39.3	RELEASE OF SD BANK GUARANTEE (BG) AND FINAL BILL
	In addition to other provisions of tender regarding release of SD and final bill, following provisions shall also be governing to this tender.
39.3.1	For SD BG- further extension beyond date of acceptance of final bill will not be enforced if the following is fulfilled.
39.3.1.1	Contractor discharges their responsibility in r/o of submission of final bill alongwith absolute 'No Demand Certificate' and other documents as detailed below to the satisfaction of BHEL
39.3.1.2	Joint protocol of set of documents as submitted as detailed in below is certified by site & contractor's representative.

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39.3.1.3	There is no negative value of the final bill (after release of SD BG) - site to certify the same before release of SD BG.
39.3.1.4	Contractor has returned the property belonging to BHEL - site to certify the same before release of SD BG.
39.3.1.5	Contractor has submitted joint protocol against 'Delay analysis', if applicable for delayed execution of job.
39.3.2	List of documents to be submitted & jointly protocolled indicating acceptance of final bill by BHEL.
39.3.2.1	Final bill.
39.3.2.2	Measurement for final bill signed, jointly signed by BHEL & contractor's representative.
39.3.2.3	Statement having cumulative joint measurement for the contract, jointly signed by BHEL & contractor's representative.
39.3.2.4	Claim by contractor for refund of security deposit.
39.3.2.5	Jointly signed material reconciliation statement.
39.3.2.6	Statement of payment received from BHEL – Bill wise (Including RA/ PVC/ ORC/ rate revision/ extra work).
39.3.2.7	No claim certificate by contractor.
39.3.2.8	Clearance certificates wherever applicable, viz clearance certificates from customer, various statutory authorities, like Labour Department, PF Authorities, Commercial Department, etc.
39.3.2.9	Notarized Indemnity Bond as per prescribed format.
40.0	TAXES, DUTIES ETC
40.1	All taxes excluding GST & BOCW Cess (as specified elsewhere in the tender) but including, Charges, Royalties, any State or Central Levy and other taxes for materials if any obtained for the work and for execution of the contract shall be borne by successful bidder and shall not be payable extra by BHEL. Any increase of above at any stage during execution of contract, including extension of the contract, shall have to be borne by successful bidder contractor. Bidder's quoted/ accepted rates/ price shall be inclusive of all such requirements.
40.2	GST along with Cess (as applicable) legally leviable & payable by successful bidder as per GST Law shall be paid by BHEL, extra. Hence, bidder shall not include GST along with Cess (as applicable) in their quoted rates/ price.
40.3	Successful bidder shall furnish proof of GST registration with GSTN Portal covering the services under this contract. Registration should also bear endorsement for the premises from where the billing shall be done by successful bidder on BHEL for this project / work.
40.4	Since GST on output will be paid by BHEL separately as enumerated above, bidder's your quoted rates / price should be after considering the Input Credit under GST law at bidder's end.
40.5	TDS under Income Tax shall be deducted at prevailing rates on gross invoice value from the running bills (RA bills) unless exemption certificate from the appropriate authority / authorities is furnished.
40.6	TDS under GST shall be deducted at applicable rates on gross invoice value from the running bills (RA bills).
40.7	Bidder shall note that GST Tax Invoice complying with GST Invoice Rules (Section 31 of GST Act & Rules referred thereunder) wherein the 'Bill To' details shall encompass following. BHEL GSTN – Refer attached GSTN code table of BHEL. Name - BHARAT HEAVY ELECTRICALS LIMITED Address - Shall be intimated later. Specific details of BHEL GSTN, Name and Address as stated above, have been specified elsewhere in the tender.
40.8	Successful bidder to intimate immediately on the day of removal of goods (in case of any supply of goods) to BHEL along with all relevant details and send a scanned copy of Tax Invoice to BHEL through following communication mode for enabling BHEL to meet its GST related compliances. Portal address. and Email address – Shall be intimated later. Specific details of above shall be intimated to successful bidder by BHEL at appropriate juncture.
40.9	In case of delay in submission of above mentioned documents on the date of despatch, BHEL may incur penalty / interest for not adhering to Invoicing Rules under GST Law. The same will be liable to be recovered from successful bidder, in case such delay is not attributable to BHEL.
40.10	In case of raising any Supplementary Tax Invoice (Debit / Credit Note), successful bidder shall issue the same containing all the details as referred to in Section 34 read with Section 31 of GST Act & Rules referred there under.

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40.11	Successful bidder shall comply with the Time Limit prescribed under the GST Law and rules thereof for raising of the Tax Invoice. If any supply of goods is applicable, successful bidder shall also ensure prompt delivery of goods after despatch.
40.12	Bidder shall note that in case GST credit is delayed / denied to BHEL due to delayed / non receipt of goods and / or Tax Invoice or expiry of the timeline prescribed in GST Law for availing such ITC, or any other reasons, not attributable to BHEL, GST amount shall be recoverable from successful bidder along with interest levied/ leviable on BHEL, as the case may be.
40.13	Successful bidder shall upload the invoices raised on BHEL in GSTR-1 within the prescribed time as given in the GST Act. Bidder shall note that in case of delay in declaring such invoice in your return and GST credit availed by BHEL is denied or reversed subsequently as per GST Law, GST amount paid by BHEL towards such ITC reversal as per GST law shall be recoverable from the successful bidder along with interest levied / leviable on BHEL.
40.14	Way Bill: Successful bidder to arrange for way bill / e-waybill for any transfer of goods for the execution of the contract. Successful bidder has to make their own arrangement at their cost for completing the formalities, if required, with Issuing Authorities, for bringing materials, plants & machinery at site for execution of the works under this contract, Road Permit / Way Bill, if required, shall be arranged by successful bidder and BHEL will not supply any Road Permit/ Way Bill for this purpose.
40.15	Any new taxes & duties, if imposed subsequent to due date of offer submission as per NIT & TCN, by statutory authority during contract period (including extension, if the same is not attributable to you), shall be reimbursed by BHEL on production of relevant supporting document to the satisfaction of BHEL. However, you shall obtain prior approval from BHEL before depositing new taxes and duties.
40.16	Benefits and / or abolition of all existing taxes must be passed on to BHEL against new taxes, if any, proposed to be introduced at a later date.
41.0	INTERIM PAYMENTS
41.1	For all items of work as per Volume-III, Price Schedule, interim payment shall be limited to 95 % of the gross value of interim bill on item rate basis. The balance 5 % shall be payable on completion of guarantee period and subject to confirmation of full GST. However, this 5 %, retained from each RA bill, may be released against submission of a separate bank guarantee as per Performance Bank Guarantee format, to be kept valid till final bill & guarantee period, subject to (i) Receipt of certificate that all works are completed in all respects; (ii) Reconciliation of materials / T&P / IMTE; (iii) Completion of final bill formalities (iv) handing over to BHEL / customer and (v) subject to confirmation of full GST. Any Interest if levied thereon for reasons elaborated in Tax & duties clause of the contract and attributable to you shall be recovered for the Final Payment/ Retention amount.
41.2	All admissible recovery / adjustments etc. shall be made from the interim payable amount.
41.3	Out of this 95 %, 1.5 % of gross bill amount shall be paid in the following manner on certification by BHEL engineer after compliance of each of following activity in each month. In case of non-fulfilment of respective activity by vendor in each month, no payment shall be made by BHEL against corresponding activity and no claim of bidder at a later date, whatsoever, in this regard shall be entertained by BHEL.
41.3.1	0.7 % shall be paid on compliance of house keeping of vendor's working area and store/ office areas.
41.3.2	0.3 % shall be paid on compliance of general illumination of vendor's working area and stores, office area.
41.3.3	0.2 % shall be paid on compliance of applicable OHSAS requirement as per guidelines of BHEL/ PSER and as specified in the tender.
41.3.4	0.3 % shall be paid on compliance of applicable safety requirement as per guidelines of BHEL/ PSER and as specified in the tender.
41.4	BHEL site at its discretion may further split up the above percentages of break up and effect payment to suit the site condition, cash flow requirement, according to the progress of work.
41.5	The contractor shall submit his running bill, once in a month at the end of each month. The RA bill complete in all respect, accompanied by BHEL engineers certified measurement sheets, jointly signed, will be paid after 30 days of submission of bill, subject to completeness and correctness. Income Tax at the prevailing rates on gross value of work done & applicable surcharge shall be deducted from contractor's bill, unless exempted by Income Tax Authority.
41.6	Applicable GST, which can be claimed at any point, shall be released to you upon compliance of following:
41.7	You declaring such Invoice in your GSTR-1
41.8	Receipt of Goods / services and Tax Invoice by BHEL

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41.9	Confirmation of payment of GST thereon by you on GSTN Portal
41.10	Above is subject to receipt of goods / service and tax invoice thereof along with you declaring invoice in your return and paying GST within timeline prescribed for availing ITC by BHEL.
42.0	CONTRACT PRICE
42.1	The bidder shall quote their price/rates strictly in accordance with prescribed price/rate schedule -Volume-III (SCH-1).
42.2	The quantities of the various items mentioned in the respective Price schedules, Volume-III are approximate, based on very preliminary information and may vary to any extent or to be deleted altogether. The quoted rates of each item will remain firm throughout the period of execution including extension, for reasons whatsoever, as long as variation in the total value of the work executed under any part of this contract including extra items, if any, but excluding any price variation, remains within +/- 30 % (plus/minus thirty percent) of the awarded price (as per LOI / WO).
42.3	The quoted rates shall remain firm irrespective of any variations in the individual quantities. No compensation becomes payable in case the variation of the final executed contract value is within the limits of Plus (+) or Minus (-) 30% of awarded contract value.
42.4	Compensation due to variation of final executed value in excess of the limits defined in clause above, shall be as follows:
42.4.1	In case the finally executed contract value reduces below the lower limit of Contract Value due to quantity variation specified above, the contractor will be eligible for compensation @ 15% of the difference between the lower limit of the contract value and the actual executed value.
42.4.2	In case the finally executed contract value increases above the upper limit of Contract Value due to quantity variation specified above, there will be no revision in the rates within the contract period.
43.0	METHOD OF MEASUREMENT
	Mode of measurement shall be as per relevant clauses of technical specification of this tender. In case the same is not available the relevant IS 1200 in conjunction of IS code 3385 shall be adopted. In case the same is also not available, the standard procedure adopted in CPWD shall be adopted. In case the same is also not available in CPWD, the measurement of the work done will be based on the mutual agreement between BHEL and contractor. In all the above cases, the interpretation of BHEL will be final and binding to the contractor.
44.0	OTHER TERMS
44.1	While bidder's scope includes deployment of all resources, like T&P, materials, consumables, manpower including supervision etc for proper completion of the subject job and no sub-contracting for execution of the job is allowed by BHEL, depending on project's requirement and on prior acceptance of BHEL, bidder may associate agencies for deployment of skilled/ unskilled manpower only for site execution. Bidder should arrange all resources, like T&P, materials, consumables, supervision etc directly for the subject job.
44.2	All other term & conditions of this specification, not mentioned above shall be governed by the pertinent provisions of GCC, Volume-IB.

ANNEXURE - A
LIST OF EQUIPMENTS FOR CIVIL SITE LABORATORY

SL NO	NAME OF TEST	NAME OF EQUIPMENT	SIZE OF EQUIPMENT	REF
CONCRETE TESTING EQUIPMENT				
1	Concrete Cube casting	Concrete Cube Mould	150x150x150mm, minimum 10 sets	IS 10086
2	Workability of concrete	Slump cone	Standard, at least 02 nos	IS 456
3	Concrete Compressive test	Compressive Testing Machine with 2000 KN capacity.	2000KN capacity	IS 2505
PROCESS CONTROL ACCESSORIES				
SL. NO.	EQUIPMENT	SPECIFICATION / QTY.	REMARKS	
1	Hot air oven	Temperature range 50° C to 300° C	600x600x600mm (min.size)	
2	Physical balance	20 kg capacity	Weights 20g to 10 kg	
3	Thermometer	2Nos. Temperature range 0° C to 100° C	Digital / Analogue	
4	Digital pH meter	02 nos	0.01 mm least count,	
5	Mud Balance	02 nos	Range of 0.8 to 2.5	
6	Dial gauge	08 Nos.	0.01 mm least count,	
7	Hydraulic Jack with Calibrated Pressure Gauge	04 Nos.	2 Nos. 800 MT Capacity & 2 Nos. 600 MT Capacity	
8	Slurry Sampler	02 sets		
9	Marsh Funnel and Cup	02 sets		

ANNEXURE-I

SAFETY PLAN

01. Safety Policy of the Contractor to be enclosed:
02. When was the Safety Policy last reviewed:
03. Details of implementation procedure / methods to implement Safety Policy / Safety Rules:
04. Name, Qualification, experience of Safety Officer
05. Review of Accidents Analysis Method, Methods to ensure Safety and Health:
06. Unit executive responsible to ensure Safety at various levels in work area:
07. List of employees trained in safety employed before execution of the job. Give the details of training:
08. Safety Training Targets, Schedules, methods Adopting to providing safety training to all employees:
09. Details of checklist for different jobs / work and responsible person to ensure compliance (copy of checklist to be enclosed):
10. Regular Safety Inspection Methods and Periodicity and list of members to be enclosed:
11. Risk Assessment, Safety Audit by Professional Agencies, Periodicity:
12. Implementation of Recommendations of Audit / Inspections. Procedures for implementation and follow up:
13. Provision for treatment of injured persons at work site:
14. Review of overall safety by top Management and Periodicity:
15. System for Implementation of Statutory legislations:
16. Issue of PPEs to employees, Periodicity / stock on hand etc:

NTPC Limited

(A Government of India Enterprise)



LOT 1A PROJECTS

**PART – B
(DETAILED TECHNICAL SPECIFICATION)**

**SUB-SECTION-IV-D
(CIVIL WORKS)**

SECTION – VI

**TECHNICAL SPECIFICATION
FOR
FLUE GAS DESULPHURISATION (FGD)
SYSTEM PACKAGE**



PART – B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION-IV-D (CIVIL WORKS)

LOT-IA PROJECTS
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI
BID DOCUMENT NO.: CS-0011-109(1A)-2



SUB-SECTION-IV-D

CIVIL WORKS

**LOT-IA PROJECTS
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI
BID DOCUMENT NO.: CS-0011-109(1A)-2**

CLAUSE NO.	TECHNICAL REQUIREMENTS		
1.00.00	GENERAL		
1.01.00	<p>This section of the bidding document deals mainly with the technical specification for the design and preparation of detailed drawings, getting the design and drawings approved by the Employer, fabrication, erection and construction of the necessary civil, structural and architectural works associated with the FGD package for Lot-1A. The work shall have to be carried out both below and above ground level and shall be involving, basements, equipment foundations, slabs, beams, columns, footings, rafts, walls, steel frames, brick walls, stairs, trenches, pits, access roads, culverts, trestles, silos, sumps, Limestone storage hopper & shed, Crusher House, Transfer points, Conveyor Galleries, Tunnels, Gypsum storage shed, Chimney, Gypsum dewatering building, Ball Mill building, FGD control room building, Tank Foundations, absorber tower foundation, transformer foundation, MCC Building, finishes, complete architectural aspects, drainage, sanitation, water supply (from terminal points to various buildings/facilities) and all other civil, structural and architectural works associated with the complete FGD package.</p>		
1.02.00	<p>The specifications are intended for the general description of the work, quality and workmanship. The specifications are not, however, intended to cover minutest details and the work shall be executed according to the relevant latest Indian Standard Codes / I. R. S. / I. R. C. specifications. In absence of the above, the work shall be executed according to the best prevailing local Public Works Department practices or to the recommendations of relevant American and British Standards or to the instructions of the Engineer. Some of the relevant I. S. Codes to be followed is mentioned in the Technical Specifications. The Contractor is expected to get clarified on any doubts about the specifications, etc. before bidding, in writing with the Employer in respect of interpretation of any portions of this document.</p>		
1.03.00	<p>Bidder or his agencies engaged as detailer for fabrication drawings should have the experience of detailing for power plant structures or steel plant or Industrial structures like Petro/ Chemical/ Refinery/ Cement/FGD Plant/Coal Handling Plant/Ash Handling Plant etc.</p> <p>The designer responsible for preparation of scope drawings shall review and approve the fabrication drawings prepared by the detailer before releasing them for fabrication.</p>		
2.00.00	Sub QR for Civil Works:		
2.01.00	<p>Bidder or its agency should have in past executed civil and structural works for 500 MW or higher capacity coal based/Lignite based power plant including earthwork in filling involving mechanical compaction and cutting in hard rock, foundations, Bulk material handling plant involving underground storage hopper and underground tunnels.</p>		
2.02.00	<p>Bidder can engage more than one agency, in case the Bidder itself is not able to meet the requirement at 2.01.00. The agency being engaged for a particular work should have in the past executed such works of 500 MW or higher capacity plant.</p>		
<p align="center">LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p align="center">SUB-SECTION-IV-D CIVIL WORKS</p>	<p align="center">PAGE 1 OF 69</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.03.00	For Chimney, Bidder or its agency should have in the past built at least one (1) reinforced concrete chimney of minimum 100m height.		
2.04.00	<p>In case Bidder or its agency do not meet the requirements at 2.01.00 and the Bidder proposes to engage agency (ies) for civil & structural works on work volume basis (except for Chimney), Bidder or its agency (ies) should have executed such works in the past and the annual rate of execution in the reference works should not be less than eighty percent (80%) of the asking rate of such works, (structural steel fabrication & erection, RCC, earthwork in filling involving mechanical compaction and cutting in hard rock, RCC in underground storage hopper and underground tunnels) for which it is being engaged.</p> <p>Successful Bidder shall finalize the agency (ies) for each work in consultation with Engineer-in-charge at site before engaging them.</p>		
2.05.00	<p>Design agency for Civil & Steel Structural Works:</p> <p>Bidder or its agency (ies) should have carried out the design and detailed engineering of following works:</p> <ul style="list-style-type: none"> (i) Civil & Structural works associated with at least one bulk material handling plant for 500 MW or higher capacity coal based/Lignite based power plant. (ii) For Chimney, Bidder or its design agency (ies) should have carried out design & detailed engineering of at least one reinforced concrete chimney with steel flues, of minimum 100m height. (iii) Machine foundations such as Mill foundations/ Block foundations. 		
2.06.00	<p>Bidder can engage more than one agency (of repute), in case the Bidder itself is not able to meet the requirement at 2.05.00.</p> <p>The design agency (ies) proposed by the Bidder shall be subject to Employer's approval.</p>		
3.00.00	Work Description		
3.01.00	<p>Truck Hopper, Limestone Storage hopper and Underground Tunnel</p> <p>Truck Hopper shall consist of underground portion, which shall be of R. C. C. with structural steel shed covered with permanently Colour coated profiled steel sheets.</p> <p>Limestone storage hopper shall be of RCC with structural steel shed covered with permanently Colour coated profiled steel sheets.</p> <p>The structural arrangement to be adopted for the design and construction of Limestone Storage hopper shall essentially consist of R. C. C. frames spaced at approx. 3.0M centers with R. C. C. wall panels on the sides and R. C. C. raft at the bottom, fixed to the frames. Minimum thickness of R. C. C. raft at bottom shall be 600</p>		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 2 OF 69</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>mm. Minimum thickness of RCC side walls shall be 600 mm at bottom and 300 mm at top.</p> <p>The vertical and inclined portion of hopper shall be provided with 50 mm thick guniting (shotcreting). Details of shotcreting have been given elsewhere in this specification.</p> <p>Expansion joints shall be provided at a maximum distance of 40m. 600 mm wide water stop fabricated with 22G copper plate with bitumen board fillers and polysulphide sealing compound as specified elsewhere shall be used as expansion joint material.</p> <p>Floor shall be provided with cross slope not flatter than 1 in 50 towards side drains. Side drains shall be sloped towards sump where sump pumps as specified elsewhere, shall be provided. The slope of side drains shall not be flatter than 1 in 400. Side drains and sump shall have removable type steel grating cover.</p> <p>Water proofing / Damp proofing of under ground Truck hopper, Limestone Storage hopper, tunnels and underground (i. e. basement) portion of transfer houses shall be done by providing the following treatments:</p> <p>Chemical injection grouting for inner faces (details as specified elsewhere).</p> <p>Polymer modified cementitious coating on earth side face as per the following :</p> <ol style="list-style-type: none"> (1) On the outer surface of walls, frames and roof slabs coming in contact with earth, polymer modified cementitious coating in two layers as specified and as per manufacturer's specifications shall be provided directly on the concrete surface. (2) 50 mm thick P. C. C. (1 : 2 : 4 with 10 mm nominal size stone aggregates) shall be provided under the raft i.e. over the lean concrete, followed by polymer modified cementitious coating in two layers (slurry mix application) as per manufacturer's specification. 50 mm thick P. C. C. (1 : 2 : 4) with 10 mm nominal size stone aggregates shall then be laid over the polymer modified cementitious coating before laying the raft. <p>Truck hopper and its gratings shall be designed for movement of front end loader/ bulldozer over them. Bull dozer weight shall be considered as about 35T. The gratings shall be built of min. 200x28mm thick flats in main direction and min.100mm x 20mm thick in secondary direction. No painting/galvanization shall be provided in gratings. However, two coats of Red oxide Primer to be provided immediately after fabrication.</p> <p>Plinth protection along with drains shall be provided along the Hopper complex. However, 5m wide paving shall also be provided around machinery hatches.</p> <p>Earth pressure to be considered for design shall be due to earth pressure at rest (Ko) condition only. Earth pressure due to surcharge intensity of Uniformly Distributed Load (U. D. L) of intensity 2 T / Sq. M. shall be considered in the design.</p> <p>A minimum safety factor of 1.2 against uplift due to ground water shall be ensured during execution and after execution, considering dead weight of the structure to be</p>		
<p align="center">LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p align="center">SUB-SECTION-IV-D CIVIL WORKS</p>	<p align="center">PAGE 3 OF 69</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.02.00	<p>0.9 times only, ground water table to be taken at adjoining formation level and soil wedge angle of not more than 15 degrees.</p> <p>Also, FOS against uplift, to be taken as 1.0, considering the dead wt. of structure and soil resting on side projections if any in the vertical plane. Inclined wedge action of soil shall not be considered in this case.</p> <p>Wherever, slope of tunnel exceeds 10°, R. C. C. steps shall be provided for the entire width of each walkway.</p> <p>Overhead / Ground Conveyor Galleries and Trestles</p> <p>Overhead conveyors shall be located in a suitably enclosed gallery of structural steel. The overhead gallery shall consist of two vertical latticed girders having rigid jointed portal frame at both ends. Cross beams at floor level supporting conveyor stringer beams shall be made of single rolled steel beam or single channel section (ISMB or ISMC) or plate girder. Horizontal bracings are to be provided at top & bottom plan of the gallery (latticed girders shall be braced together in plan at the top and bottom). Common end portal frame shall not be used for adjacent conveyor spans. Roof truss shall be provided at upper node points of latticed girders to form an enclosure. Contractor can also use tubular steel sections for roof truss only of conveyor galleries. The tubular steel section shall be of circular/rectangular/square shape. The circular steel tube shall conform to IS 1161 and rectangular/square steel sections shall conform to IS 4923. The steel structures using tubular sections shall be designed and fabricated as per IS 806 – “Code of Practice for use of steel tubes in general building construction.” and EN 1993-1-8:2005. The maximum span of overhead gallery shall be limited to 25 meters unless higher span is required due to site conditions, which shall be subject to approval of the Engineer. The gallery should as far as possible be erected as a box section keeping all the vertical and horizontal bracing tied in proper position. The gallery should be checked for all erection stresses that are likely to develop during handling and erection and if required, temporary strengthening of gallery members during erection shall be made.</p> <p>Seal plates under the conveyor galleries shall be provided in such a way that complete gallery bottom shall form a leak proof floor.</p> <p>The ground conveyors shall be located in suitably enclosed gallery of structural steel consisting of rigid portal frames spaced at regular intervals and suitably braced. Plinth protection along with drains shall be routed along the ground conveyors.</p> <p>For double stream conveyor gallery, two side and one central walkway of width 800 mm and 1100 mm respectively shall be provided. The width of two side walkways for single stream conveyor gallery shall be 800 mm and 1100 mm respectively. Both sides of central and side walkways shall be provided with pipe handrails all along the conveyor gallery. Hand railing should not be supported on conveyor supporting stringers. The walkways shall be chequered plate construction with anti - skid arrangement. The anti - skid arrangement will consist of welding of 10 mm square steel bars at a maximum spacing of 500 mm along the length of the gallery. Where the slope of walkway is more than 10°, chequered plate steps with nosing and toe guard shall be provided. The floor of conveyor gallery all along the gallery length, shall be provided with minimum 12 gauge thick seal plates and other drainage arrangements as specified elsewhere</p>		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 4 OF 69</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>Conveyor gallery shall have permanently colour coated steel sheet covers on roof and both sides. However in roof, a panel of minimum 1.5 m x 1.5 m area at about 6.0 m center shall be provided with translucent sheets of polycarbonate material for natural lighting. A continuous slit opening of 500 mm shall be provided on both sides just below the roof sheeting. Adequate provision of windows shall be kept on both sides of conveyor gallery as appended in Mechanical Section (Belt conveyor system). Windows shall be provided with wire mesh as specified elsewhere in this specification.</p> <p>Cross - over with chequered plate platform and ladder for crossing over the conveyors shall be provided at approximately every 100 M intervals of conveyor. Crossover shall preferably be located over four-legged rigid trestle location.</p> <p>For railway tracks passing below overhead conveyor gallery and along conveyors, the railway clearances both underground as well as over ground shall have to be adhered to for design, execution and erection of foundations, trestles, galleries etc., so that movement of locomotives and wagons is not hampered in any way during execution and afterwards. However at the location where the overhead conveyor gallery crosses road / rail line, minimum clearance of 8.0m above the road crest / rail top shall be provided.</p> <p>For calculation of material load on moving conveyor, a multiplication factor 1.6 shall be used to take care of inertia force, casual over burden and impact factor etc.</p> <p>Thus material load per unit length of each moving conveyor shall be</p> $1.6 \quad X \quad \frac{\text{Rated capacity of conveyor system}}{\text{Conveyor Belt Speed}} \quad x \quad F$ <p>Where, F = 1700/1400 for lime & 1250/900 for gypsum</p> <p>It should be noted that for structural design, unit weight of lime shall be assumed as 1700 Kgs. / Cu. M. instead of 1400 Kgs. / Cu. M., unit weight of gypsum shall be assumed as 1250 Kgs. / Cu. M. instead of 900 Kgs. / Cu. M. considered for system sizing purpose. Conveyor Gallery structure shall be designed considering both conveyors operating simultaneously.</p> <p>Conveyor gallery and supporting trestles located between transfer houses / buildings shall be arranged in any one of the following ways.</p> <p>a) All gallery supporting trestles shall be four legged type only. One end of each gallery span shall be hinged to the supporting trestle and the other end shall be slide type. Slide type support shall be with P. T. F. E. bearings to allow both rotation & longitudinal movements.</p>		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 5 OF 69</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
3.03.00	<p>b) In between transfer houses / buildings, four legged trestles shall be placed at a maximum interval of 90 metres. The arrangement shall be such so as to ensure that force in the longitudinal direction (i. e. along the conveyor length) of conveyor gallery of length not more than 90 m is transferred to any four legged trestle. In the space between each successive four legged trestles, two legged trestles shall be provided at regular intervals. The end supports resting on the four-legged trestle can have either ends hinged or one hinge and the other on slide type depending on the arrangements. Slide type support shall be with P. T. F. E. bearings to allow both rotation & longitudinal movements.</p> <p>End of conveyor gallery which will be supported over transfer house, shall be so detailed that only vertical reaction is transferred from conveyor gallery and no horizontal force in longitudinal direction is transferred from conveyor gallery to transfer house structure and vice - versa.</p> <p>For trestles and trestle foundations for conveyor galleries located adjacent to existing structures, over ground and under ground facilities, location and details of these trestles and foundations shall have to be decided such that there is no interference both underground as well as over ground with existing structures and facilities. Trestle columns / ground conveyor portal column base shall be kept 300 mm higher than the existing ground level.</p> <p>Transfer Houses</p> <p>The over ground portion of the transfer house shall be framed structure of structural steel work with permanently colour coated profiled steel sheet side cladding (from lowest working floor level till top) and R. C. C. floors comprising of RCC slab over profiled metal deck sheets (to be used as permanent shuttering) over structural beams. Shear anchor studs shall be provided through metal deck at regular interval on all top flange/flange plate of structural beams. However, the lower portion of side cladding, at ground, for a minimum height of 0.9 m above the finished floor level shall be one brick thick wall plastered on both side. In some areas like MCC floors etc., one brick thick wall cladding shall be provided. Brick wall cladding shall be supported on encased wall beams and suitably anchored to adjoining columns and beams. Contractor shall have option to use tubular steel sections for roof truss only. Vertical bracings shall be provided only on four sides along the periphery. Grade slab with 0.9m height one brick thick wall plastered on both side at periphery shall be provided for all transfer houses.</p> <p>Adequate steel doors and windows for proper natural lighting and ventilation shall be provided. In addition to steel windows, panels of suitable size to suit the architectural treatment and made of translucent sheets of polycarbonate material shall also be provided on the side cladding for natural lighting.</p> <p>The roof of Transfer points shall be provided with pre-fabricated insulated metal sandwich panels. Composition of Insulated Metal Sandwich Panels shall be as described elsewhere in the Technical Specification. Adequate slope shall be provided for quick drainage of rain water.</p>		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 6 OF 69</p>

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<p>3.04.00</p>	<p>Crusher House</p> <p>The crusher house shall be framed structure of structural steel work with permanently colour coated profiled steel sheet side cladding. However, panels of suitable size to suit the architectural treatment and made of translucent sheets of polycarbonate material shall also be provided on the side cladding for natural lighting. The lower portion of side cladding, at ground, for a height of minimum 0.9m above the finished floor level shall be of one brick thick wall plastered on both faces. Floors shall be of R. C. C. slab over profiled metal deck sheets (to be used as permanent shuttering) over structural beams. Shear anchor studs shall be provided through metal deck at regular interval on all top flange/flange plate of structural beams. Within this building cubicles are to be provided for resting room of operators and these shall be constructed with one brick thick brickwork having both sides plastered and roof slab. Adequate steel doors and windows for natural lighting and ventilation shall be provided. Contractor shall have option to use tubular steel sections for roof truss only . Vertical bracings shall be provided only on four sides along the periphery.</p> <p>The roof of Crusher house shall be provided with pre-fabricated insulated metal sandwich panels. Composition of Insulated Metal Sandwich Panels shall be as described elsewhere in the Technical Specification. Adequate slope shall be provided for quick drainage of rain water.</p> <p>Crushers shall be supported on R. C. C. deck, which in turn will rest on suitable vibration isolation system consisting of springs and dampers. This R. C. C. deck shall be isolated from the floor. However, the vibration isolation system consisting of springs and dampers may rest on main building framework. Detailed specification of vibration isolation system including the unbalanced force, frequency and amplitude criteria and other design requirements are appended elsewhere in this specification</p>		
<p>3.05.00</p>	<p>Control building, M. C. C. Buildings</p> <p>These shall be steel or RCC framed building with R. C. C. roof and floor. For steel framed building roof /floor shall comprise of RCC slab over profiled metal deck sheets (to be used as permanent shuttering only) over structural beams. Cladding shall be of brickwork/concrete blockwork with plastering on both sides. Roof shall be provided with roof water proofing treatment, as specified elsewhere in the Technical specification. Suitable arrangement shall be provided so as to prevent ingress of water into the cable trenches inside the building from cable entry locations.</p> <p>All air - conditioned areas, shall be provided with the suspended permanently colour coated aluminium false ceiling system (details specified elsewhere) with under deck insulation.</p> <p>Adequate aluminium doors and windows shall be provided for natural lighting, ventilation and view. All windows in air conditioned rooms shall have hermetically sealed double glazing.</p>		
<p>3.06.00</p>	<p>Pent House</p> <p>These shall be of R. C. C. framed structures with columns, beams, slabs and foundations etc. Cladding shall be of brickwork with plastering on both sides. Roof</p>		
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	<p>shall be provided with roof water proofing treatment as specified elsewhere. Adequate nos. of steel doors and windows shall be provided for natural lighting and ventilation.</p>		
<p>3.07.00</p>	<p>Gypsum Storage Shed</p> <p>The Gypsum storage shed shall be RCC framed structure with structural steel work shed with permanently colour coated profiled steel sheet roof and side cladding, grade slab and RCC foundations etc. Roof shall be provided with troughed profile permanently colour coated sheet with adequate slope for quick drainage of rain water.</p>		
<p>3.08.00</p>	<p>Toilets</p> <p>Toilet with potable water line facilities shall be provided in each of the following locations:</p> <p>(a.) In all M. C. C. Rooms</p> <p>(b.) Control Building</p>		
<p>3.09.00</p>	<p>Staircases, Gratings, Handrails</p> <p>All floors of transfer points/crusher houses and other facility buildings shall be accessible through staircase. All staircases of Transfer points and crusher house shall be of steel. Cage ladders (min. 450mm wide) shall be provided for access to roof of penthouses, single storey mcc rooms & mumty. All Stairs shall be minimum 1200 mm wide, maximum rise should not be more than 180 mm and minimum tread with 250 mm. Numbers and arrangement (including enclosures etc.) of stair cases shall be such as to meet the fire safety requirement as per guide lines of statutory regulatory bodies. For steel staircases , Stringers shall be of rolled steel channel (minimum ISMC 250) and tread shall be of steel gratings. Out side stairs to transfer points/crusher house shall be open type. Minimum 50 x 50 x 6 mm size angles with lugs shall be provided as edge protection for treads of stairs in underground TP's</p> <p>All gratings shall be electro forged types. Minimum thickness of the grating shall be 40 mm for indoor installation and 32 mm for outdoor installation. However, at entry or road crossing point's minimum thickness of grating shall be 40 mm The opening size shall not be more than 30mmx100mm. The minimum thickness of the main bearing bar shall be 6 mm or as per design requirement whichever is higher. All gratings shall be designed for minimum imposed load of 500Kgs. / Sq. M. If actual expected load is more than the specified load, then actual load is to be considered. All gratings shall be hot dip galvanized at the rate of 610 g. per sq.m. after surface preparation by means of blast cleaning/ acid pickling.</p> <p>Minimum 1000 mm high hand railing shall be provided around all openings, projections / balconies, walkways, platforms, Stairs, etc. All handrails and ladder Pipes shall be 32 mm nominal bore MS Pipes (medium class) as per IS:1161. Handrails shall have top and middle rails at a height of 1000 mm and 500 mm and the vertical post spacing shall not exceed 1.50 M, with provision of kick Plates (100</p>		
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<p>3.10.00</p>	<p>mm high and 6 mm thick). All handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. M as per IS:4736.</p> <p>Trenches</p> <p>All trenches for cables or any other underground facility as detailed out elsewhere shall be of R. C. C. Cable trenches shall be provided with pre - cast R. C. C. covers / chequered plate cover. Cable trenches as well as pre - cast covers shall be provided with edge protection angles and lifting hooks. All embedments / block outs as required and specified elsewhere in these specifications shall be provided. Proper drainage arrangement shall be provided. Trench pre - cast cover weight shall not be more than 65 Kgs. Trench covers near entry or at road crossings shall be designed for 10 T wheel load at centre. Pre - cast covers shall be designed for central point load of 75 Kgs. R. C. C. cable trenches shall be filled with sand after erection of cables, up to top level and covered with pre - cast R. C. C. covers. For cable trenches outside buildings, top level shall be 200 mm above G. L and sand filling shall be overlaid with 50 thk. PCC.</p> <p>Minimum 50 x 50 x 6 mm size angles with lugs shall be provided as edge protection all around cut outs / openings in floor slabs, edges of drains supporting grating/precast RCC covers, edges of R. C. C. trenches supporting pre - cast covers, supported edges of pre - cast cover</p>		
<p>3.11.00</p>	<p>Cable gallery/trestles</p> <p>Cable galleries/trestles shall be made of structural steel. The contractor can use either rolled sections or tubular steel sections. The tubular steel section shall be of circular/rectangular/square shape. The circular steel tube shall conform to IS:1161 and rectangular/square steel sections shall confirm to IS:4923. The steel structures using tubular sections shall be designed and fabricated as per IS:806 – “Code of Practice for use of steel tubes in general building construction.” and EN 1993-1-8:2005.</p>		
<p>3.12.00 3.12.01</p>	<p>Transformer Foundation</p> <p>Foundations of transformers shall be designed for seismic and wind loads in addition to other applicable loads. Block foundations shall be provided for the main transformer block.</p> <p>The oil soak pit, if provided, shall be filled with gravel of size 40mm. The volume of the soak pit shall be sufficient to store complete oil of the transformer/reactor along with 10 minutes of fire water considering only 40% of the volume as available voids between gravel filling. However, in case a separate oil collection tank is provided for the transformer/reactor, oil soak pit of volume equivalent to one-third (1/3) the oil volume of transformer/reactor shall be provided around transformer/reactor. The oil collection tank, in such cases, shall be designed for an effective capacity of complete oil of the transformer along with 10 minutes of fire water. The oil soak pit shall also be provided with a sump at the corner to allow drainage of water/oil from the soak pit.</p> <p>Arrangement for moving the transformer into place using rail cum road, jacking pads and pulling blocks including inserts, as required, shall be provided along with the transformer/ reactor foundations.</p>		
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<p>3.12.02</p> <p>3.13.00</p> <p>3.14.00</p> <p>3.14.01</p>	<p>RCC Firewall shall also be provided between the transformers wherever required.</p> <p>300 mm thick PCC M20 encasement all around the Pylon supports inside soak pit for fire fighting system shall be provided up to top of gravel filling. Coarse aggregate filling inside the transformer oil soak pit shall be carried out only after construction/erection of Pylon supports and PCC encasement.</p> <p>Fencing</p> <p>Fencing with toe wall and steel gates shall be provided around the transformers. Fencing shall comprise of PVC coated GI chain link fencing of minimum 8G (including PVC coating) of mesh size 75 mm and of height 2.4 m above the toe wall. The diameter of the steel wire for chain link fence (excluding PVC coating) shall not be less than 12G. Fence posts shall be of pre – cast R. C. C. of minimum M20 grade. All corner posts will have two stay posts and every tenth post will have transverse stay post. Suitable R. C. C. foundation for the post and stays shall be provided based on prevailing soil conditions. Gates shall be sturdy with locking provisions.</p> <p>Toe walls of brick masonry shall be provided between fence posts all along the run of the fence with suitable foundation. Toe wall shall be minimum 200 mm above the formation level with 50 mm thick P. C. C. coping (1: 1. 5: 3) and shall extend minimum 300 mm below the formation level. Toe wall shall be plastered on both sides and painted with two coats of cement paint of approved colour and shade. Toe wall shall be provided with weep holes at suitable spacing</p> <p>Booster Fan Foundation</p> <p>Booster Fan foundations shall be RCC block foundation directly resting on virgin soil/ pile below Ground level. The vertical faces of this block foundation shall be isolated from adjacent footings by providing minimum 100mm thick polystyrene board of type-1 conforming to IS: 4671 with density 20 Kg/cum sandwiched between the vertical face of block foundation and 230 thick brick wall all round.</p> <p>CHIMNEY</p> <p>Salient Features</p> <p>Single-flue or multi-flue chimney(s) shall be provided. Chimney shall be of reinforced concrete construction. There shall be one flue (liner) for each unit. The flue gas emission point shall be minimum 150 meters above the plant grade level.</p> <p>The chimney shell (windshield) shall be constructed using slip form shuttering. Internal platforms of steel structure shall be provided for enabling access to various elevations of the chimney and to provide support to the flue liners. Spacing of internal platforms shall not exceed 45.0 M. The platform beams shall be supported on concrete shell using suitable load bearing arrangement in the recesses provided for the purpose. The platform beams getting supported in the chimney shell shall have complete bearing support within the thickness of shell at that location and shall in no case be supported completely/partially on corbels/ brackets from the shell. "Through openings" in shell if provided to facilitate erection of platform beams shall be closed with cast-in-situ RCC closure wall on the external face of the shell. Necessary dowel</p>		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 10 OF 69</p>

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	<p>bars shall be provided in the shell during construction for this purpose. Openings in the concrete shell for flue duct entry, access door & truck entry door at ground level, air ventilation etc shall be provided. Hand railing shall be provided all around internal staircase & around the ventilation voids in the internal platform using min. 32 mm nominal bore MS pipes of medium class conforming to IS:1161. Spacing of railing posts shall not be more than 1500 mm centre to centre with a minimum height of 1200 mm. The handrail shall have three rows of horizontal members between the railing posts including the top member. Kick plate of min. size 100x6 thick shall be provided in the hand railing.</p> <p>The flue duct outside the chimney shall be suitably connected to the flue liner inside the chimney through a transition duct. The transition duct shall be bottom supported and shall be profiled into a circular shape to connect to the flue liner. The flue duct shall be so designed that no load is transferred on the chimney shell due to the duct. The interface between the flue liner and the transition ducting shall be provided with non-metallic fluoroelastomeric fabric expansion joint.</p> <p>The expansion joint in the flue liner shall comprise of non-metallic fluoroelastomeric material suitable to withstand a temperature of 300 Deg C, shall be acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification and shall also prevent dust accumulation. The space between the expansion joint material and the liner shall be packed and sealed by providing a bolster made up of light weight compressible material suitable to withstand a temperature of 300 Deg C and acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification. The bolster shall be confined in texturized glass fabric having a final covering of stainless steel wire mesh.</p> <p>Chimney roof shall be of RCC slab over a grid of structural steel beams and provided with rainwater drainage system. An internal structural steel staircase supported from chimney shell with chequered plate floor panels and pipe handrails, shall be provided for full height of the chimney and an internal cage ladder for a small height, over last staircase landing to access the chimney roof through a roof access hatch.</p> <p>The other components of the chimney include liner test ports (for continuous pollution monitoring), liner hatches, grade level slab of RCC with metallic hardener floor finish, acid resistant treatment on roof slab, a large electrically operated grill type roll-up door and personnel access metallic door at grade level, roof drain basin, rain water down comer pipe (150 mm diameter galvanized pipe), connection to plant drains, louvers with bird screens for ventilation and all other openings in the wind shield, mild steel wind strakes (if required), all finishing works, electrical power distribution boards, lighting panels, power & control cabling and wiring systems, stair and platforms lighting, socket outlet, lightning protection and grounding system, aviation obstruction lighting with photoelectric controller etc, communication system, a rack and pinion elevator and other items, though not specifically mentioned but reasonably implied and necessary to complete the job in all respects.</p> <p>Aviation Warning Lights (AWL) shall be mounted on door panel of required size (open able from interior of chimney shell) fixed to openings in the chimney shell at locations and levels specified elsewhere. Suitable provision for approach to the AWL shall be provided at the platform level. AWL shall be located at about 1-1.5 metre above the top of platform to enable easy handling for maintenance.</p> <p>The size of roll-up door shall be determined based on minimum requirement for ventilation and transportation & erection of flue segments.</p>		
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<p>3.14.02</p>	<p>Design Concept</p> <p>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 Indian Standard, reference shall be made to ACI, BS, CICIND and other international standards.</p> <p>In case of any conflict between this document and the Indian and International Standards, the stipulations of this document shall prevail.</p> <p>Imposed loading for design of all chimney components shall not be less than 5 kN/Sq.m. An additional 25% of liner load shall be taken as impact loading for liner erection in addition to the liner load.</p> <p>The min. thickness of web for plate girders shall be kept as 12 mm.</p> <p>Seismic forces on the chimney system shall be determined based on site specific seismic information provided elsewhere in this document.</p> <p>Wind forces on the chimney system shall be determined based on site specific wind design criteria provided elsewhere in this document.</p> <p>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.</p>		
<p>3.14.03</p>	<p>Wind Shield</p> <p>The wind shield shall be designed for vertical loading, cross wind loading, seismic loading, circumferential wind loading, thermal gradients etc. The load calculation and load combinations shall be as detailed in IS 4998 (Part 1) : 1992. The wind shield shall be analysed for cases with and without flue liner loads.</p> <p>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.</p> <p>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.</p> <p>The cross wind 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.</p> <p>The effect of the openings/cut-outs in the chimney shell shall be duly considered in the design of the windshield. The minimum thickness of shell shall not be less than 500mm.</p> <p>The stresses for the shell design shall not exceed the limits given in Cl. 7.0 of IS:4998 (PART-I) 1975 for various combinations of loads, excepting the stress in concrete for the case of dead load + wind load which shall not exceed $0.30f_{ck}$ where f_{ck} is the characteristic compressive strength of concrete.</p> <p>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 maximum spacing of the reinforcement bars shall not be more than 200 mm on each face. The circumferential reinforcement in the top 3 meters of the windshield</p>		
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<p>3.14.04</p>	<p>shall be twice that required from design forces. The clear cover to reinforcement shall be 50 mm.</p> <p>There shall be a continuous ring of concrete shell without any opening for a height of atleast 5m below the soffit of flue duct openings.</p> <p>There shall not be any reverse (outward) slope in the inside face of chimney shell. Where there is a sudden change in slope/ profile of the shell, the circumferential reinforcement shall be increased to twice the requirement as per the design in a circumferential band extending atleast 3m above and below such slope/profile change level.</p> <p>The diameter of the reinforcing bar for the main vertical reinforcement of shell shall not be less than 25mm for a shell height upto the top level of flue duct opening.</p> <p>Shell thickness between any two 10m reference levels shall not vary more than 150mm.</p> <p>The minimum thickness of shell/closure wall at beam support recess/ opening locations shall be 100mm.</p> <p>Grade of concrete for chimney shell, and other super structure shall be minimum M 30. Only OPC cement shall be used for Chimney shell and other super structure.</p> <p>The final design shall be checked & verified by 'Wind Tunnel Test' and shall be conducted at a reputed institution. Dynamic interference effects due to additional chimney(s)/NDCTS's and other tall structures located in the area or in the future expansion stage of the project shall be determined along with the other topographical features of the local area through model test.</p> <p>Flue Liners</p> <p>The flue gas parameters & various operating conditions for selection of flue liner material, material specification for flue liner and the criteria of flue gas exit velocity for sizing the flue liner shall be as specified elsewhere in the specification.</p> <p>For flue liner with base metal as mild steel, the thickness of the base metal shall be determined from structural considerations. The thickness of any clad metal/coating/block lining etc. provided on the base metal shall not be considered for computing the structural strength of flue liner. The minimum thickness of the mild steel base metal shall, however, not be less than that specified elsewhere in the specification.</p> <p>Two manholes placed diametrically opposite shall also be provided in each flue at all internal platform levels.</p> <p>The supporting/restraining arrangements of the liners should be such that expansion of the liners longitudinally or circumferentially is not restrained.</p> <p>Clean-out door shall be provided below the flue for the removal of ash.</p> <p>3.14.05</p> <p>Internal Platforms</p> <p>The platforms shall be designed for dead, imposed (live), erection work and other possible loadings and temperatures effects. These platforms shall provide support and lateral restraint to the steel liners and provide access for inspections and maintenance. Forces imposed on the floors due to lateral restraint of flues shall be enhanced aptly for impact effects. These platforms shall also be designed suitably for</p>		
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3.14.06	<p>the liner erection works. The platform shall be made up of chequered floor panels supported on grid of structural steel beams. All beams shall have bolted connections. The maximum permissible deflection in main steel girders supporting flue liner shall be span/1000.</p> <p>Internal Staircase</p> <p>The staircase shall have a clear passage way width of not less than 800 mm and a clear headroom of not less than 2100 mm. The riser height shall not be more than 175 mm and tread width shall not be less than 225 mm.</p>		
3.14.07	<p>Foundation</p> <p>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. 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 any load case/combination with wind. No allowance shall be made in the stresses for design of foundation for wind loading. The foundation diameter to depth ratio shall be maintained to around 10 and should preferably not exceed 12. The diameter of the reinforcing bar for the main radial and tangential reinforcement for the foundation shall not be less than 25mm. The spacing of radial steel at the outer edge of the foundation shall not be more than 250mm. Grade of concrete for foundation shall be minimum M 25.</p>		
3.14.08	<p>Thermal insulation</p> <p>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 coefficient of thermal conductivity of insulation shall not be more than 0.52mW/cm/oC at a mean temperature of 100oC.</p> <p>The insulation thickness shall be determined based on the maximum/minimum 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 55 degree Celsius. 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.</p> <p>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 using MS galvanised pins and speed washer.</p>		
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<p>3.14.09</p>	<p>Chimney Painting</p> <p>(i) All exposed steel surfaces (including exterior surface of mild steel flue liner in case the design does not envisage provision of thermal insulation on the exterior surface of flue liner) except surfaces of steel wind strakes shall be painted as specified in corrosion protection clause of this specification.</p> <p>(ii) All exposed surfaces of steel wind strakes shall be painted with epoxy phenolic coating system having total 240 microns DFT.</p> <p>a) All steel surfaces shall be provided with two component epoxy primer coat (having solid by volume minimum 51% \pm2%) of minimum 70 micron DFT to be applied over blast cleaned surface conforming to Sa 2½ finish of ISO 8501-1 with surface profile 40-60 Micron. The primer coat shall be applied in shop immediately after blast cleaning by airless spray technique.</p> <p>b) Primer coat shall be followed with the application of Intermediate coat of epoxy phenolic coating (solid by volume minimum 63%) of minimum 100 micron DFT. This coat shall be applied in shop after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.</p> <p>c) Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% \pm2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This coat shall be applied in shop after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer.</p> <p>(iii) All steel parts embedded in concrete like Strake embedment assembly including bolts, nuts, washers, pipe sleeves and insert plate shall be galvanized as per IS:4736. The minimum weight for galvanizing shall be 610 g/sq.m and shall comply with relevant IS Codes.</p> <p>(iv) The inside surface of chimney shell above roof, horizontal surface of shell at top, underside of concrete roof slab, external surface of mini-shell above roof etc shall be painted with epoxy phenolic coating system having total 220 microns DFT.</p> <p>a) All concrete surfaces shall be provided with two component transparent polyamide cured epoxy sealer coating (having solid by volume minimum 40% \pm2%) of minimum 50 micron DFT to be applied over cleaned surface in multiple coats. Surface to be coated shall be absolutely dry, clean and dust free.</p> <p>b) Sealer coat shall be followed with the application of Intermediate coat of epoxy phenolic coating (solid by volume minimum 63%) of minimum 100 micron DFT. This coat shall be applied after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.</p> <p>c) Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% \pm2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours</p>		
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3.14.10	<p>exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This coat shall be applied after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer.</p> <p>d) The entire external surface of chimney shell shall be painted with epoxy phenolic coating as specified in (iv) above in alternate bands of 'signal red' and 'bright white' colours.</p> <p>Electrical System</p> <p>415V, normal and emergency AC power supply for chimney shall be derived from main plant power supply system. Emergency supply shall feed 20% of platform lighting, 50% of staircase lighting, aviation obstruction lighting and elevator load. All other loads shall be connected on normal power supply.</p> <p>Ambient temperature for design of all equipment shall be considered as 55 deg. C which is likely to be encountered inside the chimney. The equipment shall be suitable for installation and render trouble free operation at higher ambient temperature and rigorous weather conditions prevailing at chimney.</p> <p>All equipment supplied shall comply with relevant IS Standards.</p> <p>The distribution boards of chimney shall comprise switch fuse units of appropriate ratings. Emergency board shall have two incomers, one from emergency supply and other from normal AC distribution board itself. Auto changeover scheme shall be provided in emergency board to enable changeover to healthy source on failure of any source.</p> <p>Dry type isolating transformer of Dyn connection shall be provided in emergency board to obtain neutral lead, in case 3 phase 3 wire emergency supply is derived from main plant.</p> <p>Various platforms shall be illuminated by dust tight HPSV well glass lighting fixtures. Average illuminations level of 150 lux shall be maintained on equipment and 70 lux on platforms & 100 lux on staircases (minimum 1 lighting fixture at each landing). Any additional fixture to take care of dark patches/shadows shall also be provided. Lighting system shall be controlled through MCB provided in lighting panel.</p> <p>A lighting and power panel each shall be located at grade level and at other in between levels as required. All distribution boards, aviation lighting controls, etc. shall be located at grade level only. At each platform, 1 No. 63A, 415V welding receptacle and 1 No. 20A, 240V receptacle shall be provided and shall be fed from power panel. Wiring installation for lighting fixture shall be of PVC insulated copper/aluminium wires through galvanised steel conduits.</p> <p>Aviation obstruction lighting system shall conform to the requirements of the latest rules and regulations of the International Civil Aviation Organization (ICAO), National Airports Authority (NAA) and Directorate of Air Routes and Aerodromes (DARA). The type of aviation obstruction lighting system shall be of medium intensity aviation obstruction lights having an effective intensity of 2000 to 20,000 cd depending upon back ground illuminance. Obstacle lights shall have a day time effective intensity of minimum 20000 cd. The intensity of lights shall be 20000 cd \pm 25% at twilight and shall reduce automatically to a night time intensity of 2000 cd \pm 25% through the use of photo-cell. The obstacle lights shall flash simultaneously at a rate between 20 to 60 per minute. A minimum of three levels will be provided with aviation obstruction</p>		
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3.14.11	<p>lights and there will be four light units per level. The lowest level should not be lower than 45 meters above the ground and vertical spacing of the intermediate levels could vary between 45 and 105 meters. The intermediate lights shall be spaced as equally as possible. Aviation obstruction lighting shall be complete with lights, photo cell, controller, special cables, etc..</p> <p>A temporary aviation obstruction lighting system shall be provided during construction of the chimney.</p> <p>Cables from distribution board to lighting panels/power panels/receptacles shall be 1100V grade, multicore FRLS HR-PVC insulated, PVC inner sheathed, armoured, PVC outer sheathed stranded copper/ Aluminum laid on galvanised sheet steel cable trays. Cables shall be terminated using double compression type cable glands and solder less crimping type tinned copper cable lugs. Minimum size of the power cable shall not be less than 2.5 sq.mm copper or 4 sq.mm Aluminum. Minimum size of control cable shall not be less than 1.5 sq.mm.</p> <p>Lightning protection system shall comprise minimum 3 vertical air terminations for each flue liner, horizontal air terminations and minimum 4 Nos. of down conductors spaced 90 degrees apart routed all along chimney height on external surface and connected to the earthing system. Down conductors shall be of minimum 50x6 mm galvanized steel strip. Each down conductor shall be provided with a test link at 1 metre above ground level. Each test link shall be enclosed in a galvanised sheet steel enclosure. Above ground level earthing and lightning protection system shall comprise galvanised steel strips. These materials provided at top 12 meters shall have additional coating of 2 mm thick seamless lead cover and the accessories like nuts, bolts, washers etc. shall be of stainless steel to take care of corrosion. Chimney earthing system shall be interconnected to main plant earthing system.</p> <p>A temporary lightning protection & earthing system shall be provided during construction of the chimney till a permanent lightning protection & earthing system is installed. In no case reinforcement bars of Shell should be used as earthing Down Conductors</p> <p>Communication system comprising of telephone socket at every internal platform level and at grade level, necessary wiring installation, a telephone hand set, junction boxes etc. shall also be provided. Telephone cables shall be of minimum 0.6 mm diameter annealed high conductivity electro copper conductor, PVC insulated, twisted, PVC tape wrapped, screened, rip corded, PVC sheathed, conforming to relevant ITD (Indian Telephones Department) specifications.</p> <p>All equipment to be supplied shall be of type tested quality. The Contractor shall submit for Owner's approval the reports of all type tests as listed below:</p> <p>(A) Distribution boards/panels-Degree of protection tests</p> <p>(B) Aviation lights:</p> <p>(1) Intensity Test</p> <p>(2) Degree of protection test</p> <p>For various equipment, the technical requirements and practices shall conform to the relevant clauses of the main plant electrical specification.</p> <p>Rack and Pinion Elevator</p> <p>A rack and pinion elevator, with a load carrying capacity of 400 kg (min) (passenger cum goods), cabin floor size of 1100 mm x 1000 mm (min.) and an operating speed</p>		
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	<p>of 40 m/min. (approx.), shall be provided for travel from the grade level to the top of the chimney. A landing platform shall be provided at all access/ platform levels. The elevator shall be of a proven and approved make. Enclosure shall be fabricated from tubular steel and expanded metal or wire mesh, 2.1 m high (Approx.). A Safety device comprising of an over speed governor in constant mesh with the rack by means of a flame hardened steel pinion shall be provided to protect the cab against over speed during the cab downward motion and the same shall actuate the brake mechanism and stop the down ward motion gradually. The lift shall be installed using anchor fasteners. The electrical requirement of the system shall conform to the main electrical specification. Drive motor shall be of S3 duty class with CDF of 25% and maximum number of 120 starts per hour in 55 degree Celsius ambient temperature. The motor shall be provided with internal 220V AC single phase space heaters or an alternate heating system. The elevator shall be supplied, installed, painted, tested, commissioned etc. complete with all mandatory spares (as specified in Part-F of this specification) and operation maintenance manual</p>		
4.00.00	Drainage & Water Supply Works		
4.01.00	<p>Drainage System:</p> <p>The drainage arrangements shall be so planned so as to ensure quick disposal of drainage water without stagnation and / or overflow. It is envisaged to clean the facility buildings etc. with water periodically.</p> <p>Minimum 4 nos. down comers shall be provided in each building at corners.</p> <p>For Conveyors, each down comer shall lead the water / slurry to pit (of 2 Cu.M capacity) to allow settling of lime/gypsum. The water from the pit shall overflow into contractor's R.C.C drain, which will lead the discharge finally into owner's drain routed alongside the nearby road.</p> <p>For Ball Mill building, Gypsum dewatering building, FGD control room building, peripheral drains (Brick drains with steel gratings provided around the building) shall lead the water / slurry to a local pit (of 2 Cu. M. capacity) near each facility to allow settling. The water from the pit shall overflow into contractor's R.C.C drain, and finally into owner's drain routed alongside the nearby road.</p> <p>In case of Control rooms and M. C. C. buildings Pump houses, etc, water / slurry coming from down comers shall discharge into peripheral drains (Brick drains with steel gratings provided around the building) which will lead the water / slurry into contractor's R.C.C drain, which will lead the discharge finally into owner's drain routed alongside the nearby road.</p> <p>Contractor's scope shall also include construction of necessary culverts under the rail lines / roads as per railway / I. R. C. standards and approval of Railway culverts from concern Railway authorities.</p>		
4.02.00	<p>Internal and external water supply, drainage etc.</p> <p>The scope for potable water supply includes all distribution systems, tanks, pipes, fittings etc. as required and as described here or elsewhere in the specifications.</p>		
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	<p>The scope for service water supply and dust control water supply shall be as described elsewhere in the specifications.</p> <p>For water supply, medium class galvanized mild steel pipes conforming to IS: 1239 shall be used.</p> <p>All facility buildings shall be provided with open surface brick drains of minimum size of 300 mm width and 300 mm depth all around the periphery. All drains excepting the peripheral drains around facility building shall be of R. C. C. construction. Drains shall have removable steel grating cover and shall be provided with edge protection angles.</p> <p>The scope for foul water from toilets shall include layout and laying of sewers up to the Employer's main sewer line for sewerage system together with all fittings and fixtures and inclusive of ancillary works such as connections, manholes and inspection chambers within the building and from the building to the Employer's sewer line.</p> <p>For rain water down comer and those to be used for conveying water / slurry generated from cleaning of buildings floors, Galvanised MS pipes conforming to IS: 1239 (for 150 mm NB Medium grade pipes) with welded joints shall be used for MCC buildings, penthouse, control rooms, ball mill building, gypsum dewatering building, storage sheds.</p> <p>Galvanising shall be as per IS: 4736. The minimum mass of zinc coating shall not be less than 400 gms/sq.m. as per IS:6745. The zinc coating shall be smooth and shall be subjected to testing as per IS: 2633, for uniformity of coating. The zinc coating shall be free from all defects as per IS: 2629.</p> <p>All rain water down comers shall be provided with roof drain heads and complete with shoes bends, junctions, sockets, adapters, brackets and finished with anti corrosive painting over a coat or primer.</p> <p>For design of building drainage system IS: 1742 shall be followed.</p> <p>For sanitary / sewerage pipes above ground, sand cast iron pipes conforming to IS : 1729 with leak proof lead joints.</p> <p>For underground drain pipes, minimum class NP - 2 pipes conforming to IS: 458. At road crossings, concrete pipes of class NP 3 conforming to IS: 458 and at rail crossing R.C.C. box culvert to be provided.</p> <p>For sewerage below ground stoneware pipes conforming to IS: 651 with concrete bedding and haunch.</p> <p>5.00.00 COLOUR COATED AND OTHER SHEETING WORK</p> <p>5.01.00 Material</p> <p>a) Wall Cladding & Roofing Material</p> <p>Troughed permanently colour coated sheet of approved shade and colour shall be</p>		
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5.02.00	<p>i) either of steel with minimum 0.6mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150</p> <p>ii) or of minimum 0.5mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150</p> <p>iii) or of steel of minimum 0.4mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150</p> <p>Alternatively aluminium feed material of minimum bare metal thickness of 0.7 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254.</p> <p>b) Metal Deck Roof Material</p> <p>Troughed permanently colour coated metal decking sheets shall be</p> <p>i) either of steel with minimum 0.8mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275</p> <p>ii) or of minimum 0.6mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275</p> <p>iii) or of steel of minimum 0.6mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275.</p> <p>Alternatively aluminium feed material of minimum bare metal thickness of 0.9 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254 can also be used for metal decking.</p> <p>Thickness tolerance of (+/-) 0.04mm is permissible. However, all design calculations shall be carried out on the basis of lowest value of sheet thickness provided.</p> <p>Colour Coating</p> <p>Steel shall be colour coated with total coating thickness of at least 40 microns (nominal) comprising of silicon modified polyester (SMP with silicon content of 30% to 50%) paint or Super Polyester paint, of minimum 20 microns (nominal) dry film thickness (DFT) on external face over primer coat of minimum 5 microns (nominal) and minimum 10 microns (nominal) SMP or super polyester paint over primer coat of minimum 5 microns (nominal) on internal face. SMP and Super polyester paint systems shall be of industrial finish of product type 4 of AS/NZ2728.</p>		
5.03.00	<p>Design Criteria</p> <p>For wall cladding insulated / uninsulated sides and roof, permanently colour coated sheet of troughed profile shall be used. The nominal depth of trough shall be 30 mm.</p>		
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<p>5.04.00</p>	<p>For profiled metal decking sheets (to be used for RCC floor slab or roof slab) the sectional modulus and moment of inertia of troughed profile per meter width shall be so as to limit the deflection of sheets to span/250 under total super imposed loading (DL +LL) comprising the self-weight of metal deck sheet, dead weight of green concrete and an additional construction load 100kg per sq.m for two span condition. The section modulus and moment of inertia of troughed profile shall be computed as per the provisions of IS 801 for satisfying the deflection and strength requirements.</p> <p>For metal deck sheets used for roofing (with or without RCC) and side cladding, the sectional modulus and moment of inertia of troughed profile per metre width shall be such that the deflection of sheets is limited to span/250 under design wind pressure for two span condition. The sectional modulus and moment of inertia of troughed profile shall be computed as per the provisions of IS 801 for satisfying the deflection and strength requirements. No increase in allowable stress is permissible under wind load condition.</p> <p>Fasteners</p> <p>Side cladding/roofing/decking sheets shall be fixed to the runner/purlins using self-drilling special coated fasteners conforming to corrosion resistant class 3 of AS3566 and tested for 1000 hours salt spray test. Spacing of Self-drilling fasteners in transverse direction (along runners/purlin) shall be equal to the pitch of trough or 250(+/-100) mm, whichever is lesser and in longitudinal direction at every runner/purlin location.</p> <p>Shear anchor studs shall also be provided through troughed permanently colour coated metal decking sheets metal deck, which are to be used as permanent shuttering, at regular interval on all top flange / flange plate of structural beams.</p> <p>The shear anchor studs for fixing metal deck sheet to floor structural beams shall conform to Type-B studs specified in AWS D1.1/D1.1M or equivalent as shear connector of 19mm diameter and 100mm length manufactured from cold drawn round steel bars conforming to the requirement of ASTM A 29, of grade designation 1010 through 1020, of standard quality with either semi-killed or killed, welded by Drawn Arc Stud Welding through metal deck sheet.</p> <p>The shear anchor studs for fixing metal deck sheet to roof structural purlins shall conform to Type-B studs specified in AWS D1.1/D1.1M or equivalent as shear connector of 16mm diameter and 65mm length manufactured from cold drawn round steel bars conforming to the requirement of ASTM A 29, of grade designation 1010 through 1020, of standard quality with either semi-killed or killed, welded by Drawn Arc Stud Welding through metal deck sheet.</p> <p>Alternatively, J/U type hooks shall be used in roofing which shall be provided in transverse direction (along runners/purlin) at a spacing equal to the pitch of trough or 250(+/-100) mm, whichever is lesser and in longitudinal direction at every runner/purlin location.</p>		
<p>5.05.00</p>	<p>Miscellaneous Details</p> <p>To minimize the number of joints, the length of the sheet shall preferably be not less than 4.5m, cut pieces shall not be used, unless specifically approved by the Engineer. However, the actual length shall be such so as to suit the purlin / runner spacing.</p>		
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<p>5.06.00</p>	<p>Lap between the sheets shall be at least 150mm in the longitudinal direction and at least one crest wide in the transverse direction which shall be properly anchored / fixed with fasteners.</p> <p>Z spacers if required shall be made of at least 2 mm thick galvanised steel sheet of grade 350 as per IS 277</p> <p>Sealant used for cladding shall be butyl based, two parts poly sulphide or equivalent approved, non stainless material and be flexible enough not to interface with fit of the sheets</p> <p>Filler blocks as a trough filler shall be used to seal cavities formed between the profiled sheet and the support or flashing. The filler blocks shall be manufactured from black synthetic rubber or any other material approved by the Engineer.</p> <p>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 metal cladding. Overlap shall be min. 150 mm or as specified by manufacturer.</p> <p>Pre-Fabricated Insulated Metal Sandwich Panels</p> <p>For structures where Pre-Fabricated Insulated Metal Sandwich Panels shall be used for Roofing, the sandwich panels shall comprise top sheet as troughed permanently colour coated sheet & bottom sheet as plain permanently colour coated with 50mm thick insulation sandwiched between the two sheets. Each sheet shall be</p> <ol style="list-style-type: none"> i) either of steel with minimum 0.6mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 ii) or of minimum 0.5mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 iii) or of steel of minimum 0.4mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150. <p>Alternatively aluminium feed material of minimum bare metal thickness of 0.7 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254.</p> <p>Metal sheets (steel or aluminium) shall be colour coated with total coating thickness of at least 40 microns (nominal) dry film thickness (DFT) comprising of Silicon Modified Polyester (SMP with silicon content of 30% to 50%) paint or Polyester paint, of minimum 20 microns (nominal) SMP or polyester paint on one side (exposed face), over minimum 5 micron (nominal) primer coat and minimum 10 micron (nominal) SMP or Polyester paint over minimum 5 micron (nominal) primer coat on other side. SMP and Super Polyester paint shall conform to product type 4 of AS/NZS 2728. Troughed sheet shall be of approved profile, sectional properties, (suitable for the specified loading / deflection and purlins / runners spacing), colour and shade.</p>		
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5.07.00	<p>Special coated fastener conforming to corrosion resistant Class 3 of AS3566 and tested for 1000 hours salt spray test shall be used for fixing Pre-Fabricated Insulated Metal Sandwich Panels with the structural members below.</p> <p>The contractor shall prepare working drawings of sheeting system including end and side laps, fixing details etc. before starting sheeting work at site.</p> <p>Polycarbonate Sheets</p> <p>The polycarbonate sheet to be used for cladding and glazing purpose in conveyor galleries, Transfer points & pump houses shall have toughed profile to match with the metal cladding profile. Minimum 3.0mm thick fire retardant and UV resistant polycarbonate clean sheet of approved make shall be used. The polycarbonate sheet shall be installed along with the metal cladding so as to have a watertight lapping arrangement. Suitable detailing shall be made to cater for the thermal expansion. IS 14434 to be referred for other details</p>		
6.00.00	<p>Roof Details</p>		
6.01.00	<p>Roof slab shall be minimum 150 mm thick(above the top surface (crest) of the metal deck sheet) and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom.</p>		
6.02.00	<p>900 mm high and minimum 100 mm thick R. C. C. parapet wall shall be provided over roofs of all buildings. Parapet wall shall have suitable coping. External face of parapet wall of the buildings provided with metal cladding shall also be finished with metal cladding of design and colour as per approved architectural drawings.</p>		
6.03.00	<p>Junction of roof and parapet shall be provided with 150 x 150 mm size concrete fillet.</p>		
6.04.00	<p>Drain level shall be provided with 45 x 45 cm size khurras having minimum thickness of 30 mm of M-15 concrete over PVC sheet of 1 m x 1m x 400 micron and finished with 12 mm 1 : 3 cement : sand plaster.</p>		
6.05.00	<p>Roofs of all control rooms, M. C. C. rooms, penthouse etc., shall have roof water proofing treatment. Roof water proofing treatment shall be as follows:</p> <ol style="list-style-type: none"> 1) Application of polymerised mastic over the RCC roof to achieve smooth surface as primer coat. 2) Application of high solid content liquid applied urethane based elastomeric water proofing membrane, over the primer coat, to give uniform joint less dry film thickness of minimum 1.5 mm (as per ASTM C 836 and C 898). 3) For efficient disposal of rain water, the run off gradient for the roof shall not be less than 1: 100. This gradient shall be provided by screed concrete M-15 (using 12.5 mm coarse aggregate) and / or cement mortar (1: 4) over the elastomeric water proofing membrane with 25mm thick cement mortar (1:4) topping. 4) Wearing course at top, shall consist of 25 mm thick P. C. C. (M-15) cast in panels of maximum 1.2 x 1.2 m size and reinforced with 0.56 mm diameter galvanized chicken wire mesh and sealing of joints using sealing compound / elastomeric water proofing membrane. Pathways for handling of materials and movement of personnel shall be provided with 22 mm thick chequered cement concrete tiles as per IS : 13801 for a width of 1000 mm in place of P. C. C. 		
6.06.00	<p>For efficient disposal of rain water, the run off gradient for the roof shall not be less than 1:100. This gradient can be provided either in structure or subsequently by</p>		
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	<p>screed concrete M-15 (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.</p>		
6.07.00	<p>Medium class galvanised mild steel pipes conforming to IS: 1239/ IS: 3589 with welded joints shall be provided for rain water down comers to drain off rain water from the roof. These shall be suitably concealed with masonry work, to match with the exterior finish. The number and size of down comers shall be governed by IS: 1742 and IS: 2527. RCC roof shall be provided with 45 x 45 cm size Khurras having minimum thickness of 30 mm with M-15 concrete over PVC sheet of 1mx1mx400micron and finished with 12 mm thick cement sand plaster 1:3.</p>		
6.08.00	<p>Access to RCC roof of Gypsum dewatering building, FGD Control room building, MCC building, Ball mill building shall be through RCC staircase, and roof access to all other buildings all shall be through cage ladder as per requirement.</p>		
6.09.00	<p>Fillets at junction of roof and vertical walls shall be provided with cast - in - situ cement concrete (M-15) nominal mix followed by 12 mm thick 1:4 cement sand plaster.</p>		
6.10.00	<p>The rainwater down comers shall be provided with suitable C.I. grating at inlet point.</p>		
7.00.00	<p>RCC Floors, Paving & Grade Slab details</p> <p>The floor slabs shall be minimum 150 mm thick (above the top surface (crest) of the metal deck sheet) and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom.</p> <p>In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.8mm as permanent shuttering. The detailed material property requirement of metal deck sheet is specified elsewhere in the specification. These profiled metal deck sheets shall be fixed to the structural steel beams/ purlins using headed shear anchor studs specified elsewhere in the specification.</p> <p>Chequered plates (used for floors, walkways etc.) shall be minimum 6 mm thick. Mild steel flats/angles of suitable size shall be welded to the bottom portion of chequered plates at a designed spacing to stiffen chequered plates suitably. Chequered plates shall be fixed by staggered welding of suitable size. Floors of trenches shall have integral finish to concrete base.</p> <p>Toe guard of size 100 x 6 mm shall be provided at various openings provided in floors e.g. around stair case openings, chute openings and other similar cutouts. For conveyor walkways, angle runner to act as toe guard shall be provided.</p> <p>R. C. C. floors (where no brick masonry walls are provided) shall be provided with handrails all along the periphery.</p> <p>RCC paving of minimum 150 mm thick with M25 grade concrete, 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 200mm compacted thick for normal duty paving and 400mm</p>		
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	<p>compacted thick for heavy duty paving with 63 mm and down aggregate with interstices filled with selected moorum/ non-expansive soil 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. For normal duty paving, reinforcement of the RCC paving shall consist of minimum 8mm dia bars @ 200 mm c / c in both directions at the centre of the slab. For heavy duty paving/ passage, reinforcement of the RCC paving shall consist of minimum 10mm dia bars @ 200 mm c / c in both directions at the centre of the slab.</p> <p>Paving areas shall be provided with the metallic hardener floor finish as specified elsewhere in the specification.</p> <p>Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings. These passage areas shall be provided with heavy duty paving for movement of heavy vehicles. The top surface of the passages shall be finished with 50 mm thick metallic hardener topping. Heavy duty paving shall also be provided for the areas in the equipment lay down area, unloading & maintenance area with 50 mm thick metallic hardener topping.</p> <p>Lightly loaded areas such where no heavy traffic movement is envisaged shall be provided with Normal Duty paving.</p> <p>All facility buildings shall be provided with 750 mm wide plinth protection all around. It consists of 50 mm thick P.C.C. M-20 grade with 12 mm maximum size aggregate over 200 mm thick stone soling using 40 mm nominal size rammed, consolidated and grouted with fine sand</p> <p>An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection. Further, heavy duty paving shall be provided for passages connecting the outer periphery road to have access to the various facilities/buildings.</p> <p>Plinth level of all buildings shall be kept at least 500 mm above the finished grade / formation level.</p> <p>Suitable open RCC drains shall be provided to dispose off storm water drain. The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain.</p> <p>Sewer lines (Cast Iron), interconnected by sewer manholes (RCC) at regular intervals (not exceeding 30 meter centre to centre) shall be provided to dispose off sewage from FGD block to sewage pump house.</p> <p>GRADE SLAB OF BUILDINGS AT GROUND FLOOR</p> <p>In buildings, the grade slab shall consist of 150mm thick RCC M25 grade base slab over an under bed as specified below. The under bed for ground floor slab shall consist of 75mm thick 1:4:8 PCC on stone soling of 200mm compacted thick with 63 mm and down aggregate with interstices filled with well graded selected sand/ moorum/ non-expansive soil on compacted and dressed sub - grade. Reinforcement for the slab shall consist of minimum 8mm dia. bars @ 200 mm c/c at top & bottom of the slab in both directions. However, at unloading & maintenance area, stone soiling of minimum 400mm thick and grade slab with minimum 10mm dia bars @ 200 mm c/c at top and bottom in both directions shall be provided.</p> <p>Further, top surface of grade slabs shall be finished with 50mm thick metallic hardener topping.</p>		
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<p>8.00.00</p>	<p>Brickwork and allied masonry works</p> <p>All brick walls shall be non - load bearing in-filled panel walls.</p> <p>All brickwork shall be designed as per Indian Standards and shall be plastered on both faces. All external walls shall be minimum one brick thick in 1: 6 cement: sand mortar. Brick walls shall be provided with 12 mm and 18 mm thick 1: 6 cement: sand plaster on smooth and rough face of the brick work respectively.</p> <p>Bricks to be used in brickwork shall be of minimum Class designation 50.</p> <p>Brickwork cladding for various structures shall be so provided that there is a clear gap of 40 mm between inside face of external brick wall and outside face of column flange. Structural steel wall beams supporting brickwork shall be suitably encased with plaster or 1: 2: 4 concrete as the case may be. In case of box type steel beam, encasement shall be done with cement sand plaster in specified thickness and proportions over G. I. wire netting of 0.9 mm thickness.</p> <p>Parapets, chajjas, windows and door heads, architectural faces, fins etc. shall be provided with drip course in 1 : 4 cement sand mortar.</p> <p>50 mm thick Damp proof course shall be provided at plinth level for all brick wall.</p> <p>All R. C. C. ceilings shall be rendered smooth and finished with whitewash unless otherwise specified. Ceiling of control rooms, M. C. C. rooms (except areas provided with false ceiling) shall be provided with 6 mm thick plaster.</p>		
<p>9.00.00</p>	<p>Earthing Mat</p> <p>40 mm Dia MS Rods as earthing mat, placed at a distance of 1.0M away and at depths between 0.60M and 1.00M shall be supplied and laid all around the periphery of buildings, structures, and outdoor equipment, as per the approved drawings. Risers of 40 mm Dia MS Rods and connecting to the above Earthing mat shall also be supplied and laid in position by the Contractor, as per the approved drawings. Risers shall be laid up to a height of 300 mm above the local Ground level, at each of the columns of the buildings on outside of the buildings, and minimum 2 (Two) numbers for structures and outdoor equipment. The contractor also supply and lay necessary number of 3.0 M deep vertical 40 mm Dia MS Rods Earthing electrodes and connecting them to the Earthing mat, as per the approved drawings and the supplying and laying of 40 mm Dia MS Rods for connecting the Contractor's earthing mat with the Employer's earthing mat separately at two locations.</p>		
<p>10.00.00</p>	<p>SITE LEVELLING</p> <p>Site leveling of gypsum storage area , lime storage area , gypsum dewatering area , truck hopper and associated areas to be levelled in one block. Each block shall be finished to the formation level as specified in drawing. Bidder shall deploy adequate number of experienced site leveling contracting agency(s) with requisite earth moving and compacting equipment to complete the work as per schedule.</p> <p>Bidder shall carry out the topographical survey before he commences detailed design and site leveling. This survey shall cover the entire FGD area including gypsum</p>		
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	<p>storage ,gypsum handling area , lime storage area ,gypsum dewatering area , truck hopper area, limestone grinding and slurry storage area in Bidder's scope of work. Based on field observations the contractor shall prepare and submit for Owners review the survey maps of the surveyed sited on suitable scale, indicating grid lines, contour lines and demarcating all permanent features like roads, railways, waterways, buildings, power lines, natural streams, trees etc. For each area two sets of survey maps shall be prepared and submitted, one showing the spot levels and contours with grid lines and the other showing the grid lines, contours and permanent features</p> <p>Since the construction of roads and drains for the FGD area including gypsum storage ,gypsum handling area , lime storage area ,gypsum dewatering area , truck hopper area, limestone grinding and slurry storage area is included in the scope of Bidder, it shall be the responsibility of the Bidder to ensure that these facilities are also constructed along with site leveling works. Bidder shall ensure that road access and drainage facilities for each block is available when site leveling in that block is completed. Unless otherwise instructed by the Engineers, all roads and drains within a block shall be constructed by the bidder within a month from the date of completion of site leveling of that block.</p> <p>The specified formation level(s) shall be achieved either by excavation where the existing ground levels are higher than the specified formation level or by raising by controlled filling with borrowed earth where the existing ground levels are lower than the specified level</p> <p>All materials arising out of site clearance and excavation shall be the property of owner. They shall be dealt with in the manner specified by the Engineer. Earth / boulders / rock etc. excavated and useful portion (serviceable materials) of trees cut shall be stacked at suitable places within Owner's acquired land for the plant including the reservoir and the ash disposal area in a manner as directed by the engineer. Woods, branches, trunks of trees shall be termed as serviceable material. Other materials like twigs, leaves, roots, vegetable and organic matters etc. shall be termed as unserviceable material and shall be sorted out from the serviceable materials before disposal. They shall be cleared from the area and disposed off at places within Owner's acquired land for the plant including the reservoir and the ash disposal area in a manner as directed by the engineer.</p> <p>If the excavated material is suitable and accepted by the Engineer as fill material, the same can be used for filling in other areas where raising by filling is required. Otherwise the same shall be taken and stacked at places(s) within the plant boundary as directed by the Engineer.</p> <p>Filling with rock shall be done only after the written permission of the Engineer in the following manner:</p> <p>Filling with rock shall be done only in areas identified for laydown and preassembly .</p> <p>Original ground after removal of all organic and vegetable matters shall be consolidated by rolling as directed by the engineer subject to a minimum of six passes of 8-10 tonnes roller.</p>		
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	<ul style="list-style-type: none"> - Excavated rock shall be laid (on original ground or after filling 300 mm thick layers of soil as specified), in layers not exceeding 1000 mm and rolled with vibratory roller (10-15 tonnes static weight) with minimum six passes. - Over the compacted layer of rock, soil shall be filled in horizontal layers not exceeding 300mm in compacted thickness. The soil shall be compacted as specified elsewhere. - It shall be ensured that the top soil layer is in minimum 3 layers of 300 mm each. To achieve this the thickness and number of rockfill layers below can be suitably adjusted. <p>Contour map and spot levels of the area based on the preliminary survey carried out by Owner is enclosed for the purpose of guidance of Bidder. However, Owner does not take any responsibility about the accuracy of the survey details furnished and any variation of the said data shall not constitute a valid reason for changing the terms and conditions of the contract. Bidder is requested to carry out his independent assessment of the existing ground levels before furnishing his bid. Detailed survey shall be carried out by Bidder after award of work and all findings as stated earlier shall be submitted for Owner's review.</p> <p>Before commencement of cutting/filling, all organic and vegetable matters like grass, plants, shrubs, bushes, weeds, trees (with girth less than 30 cm measured at height of 1m above ground level) etc. in the areas to be filled, shall be completely removed along with their roots and disposed off. It shall also be ensured that the area to be filled is clear of any water, slush etc. Original ground shall be compacted by rolling as directed by the Engineer subject to a minimum of six passes of 8 to 10 tonne roller. The earth shall then be spread in horizontal layers not exceeding 300 mm in compacted thickness. Each layer shall be watered and compacted with proper moisture content and with such equipment as may be required to obtain a compaction of 95% or more of Standard Proctor's maximum dry density. The moisture content of the fill material shall be controlled to obtain near optimum moisture content during compaction.</p> <p>The fill material shall be tested for determining optimum moisture content and maximum dry density by Standard Proctor Test as per IS : 2720 (Part-VII). The fill material shall also be tested for determining moisture content before compaction as per IS:2720 (Part-II). For each of the above tests, one sample for every 10,000 cubic metre of fill material shall be tested. Additional samples shall be tested, whenever there is a change in the source or type of fill material. The compacted soil shall be tested for its dry density as per IS2720 (Part-XXIX) or Part-XXVIII). Samples shall be taken at the rate of one sample for every 10,000 sq.m. area for each compacted layer. In addition random checks shall be carried out in compacted soils by means of Proctor needle penetration. Bidder shall submit to the Engineer, the test results immediately after completion of the tests. A sample shall be deemed to have passed the test when the in-situ dry density is equal to or more than the specified percentage of maximum dry density. If a sample taken from a layer fails to pass the test, the layer shall be further compacted till two samples</p>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>taken and tested from this layer pass without any negative deviation. Only after this. spreading of further layers shall be taken up.</p> <p>Before start of filling, the Bidder shall submit to the Owner his proposal for the methodology to be adopted for compaction for each type of fill material. The Bidder shall also carry out compaction trials to establish the proposed methodology. The Bidder shall start the compaction work only after approval of the methodology by the Owner</p> <p>The surface of the cut/filled up areas after reaching final level shall be dressed to the required levels and slopes. The difference in levels shall not be more than +/- 10cm locally.</p> <p>The borrow areas outside the overall plant boundary limits for obtaining suitable fill material which is required over and above the earth available after cutting high grounds within the plant area, for site levelling shall be arranged by the Bidder himself and all expenses in respect of royalties, taxes, duties, etc. for borrow areas/fill material shall be borne by him. He shall also obtain and submit to the Owner the necessary clearances/permission from the concerned authorities for the borrow areas/fill material.</p> <p>Material suitable for filling shall be loaded and transported to the filling site by the Bidder.</p> <p>Any coarse grained or fine grained low plastic soil, free from shingle, salts, organic matter, sod or any other foreign substances, may be used for filling. The Bidder shall test the fill material to establish its suitability and submit its results to the Owner. Fill material shall be approved by the Owner. The following types of materials shall not be used for filling:</p> <ol style="list-style-type: none"> a) Material from swamps, marshes and bogs. b) Expansive clays c) Peat, logs, stumps, sod and perishable materials. d) Materials susceptible to combustion e) Any material or industrial and domestic produce which will adversely affect other materials in the work. f) Materials from prohibited areas <p>Bidder shall include in his offer any extra filling that may be required on account of subsidence of the original ground due to overburden of filling above and/or compaction works for site levelling.</p>		
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<p>11.00.00</p>	<p>After levelling, the contractor shall establish concrete pillars at the intersection points of the grid lines for future reference. These pillars shall project at least 450 mm above the formation level and shall be labelled permanently with their respective coordinates and reduced levels.</p> <p>Filling upto the specified formation level shall extend at least 2.0m beyond the outside face of boundary wall/fence. Thereafter, it shall be finished at a suitable slope (not steeper than 1 Vertical:2 Horizontal) and provided with good quality dry stone pitching minimum 300mm thick for slope upto level difference of 3m. If the level difference is more than 3m, the stone pitching shall be provided with RCC bands with suitable design and benching.</p> <p>FENCING</p> <p>Fencing with toe wall and steel gates shall be provided around the gypsum storage area , lime storage area , gypsum dewatering area , truck hopper and associated areas . Fencing shall comprise of PVC coated GI chain link fencing of minimum 8G (including PVC coating) of mesh size 75 mm and of height 2.4 m above the toe wall. The diameter of the steel wire for chain link fence (excluding PVC coating) shall not be less than 12G. All Fence posts shall be of 75 x 75 x 6 MS angles spaced at 2.5 m c/c distance. All corner posts will have two stay posts and every tenth post will have transverse stay post. Suitable R. C. C. foundation for the post and stays shall be provided based on prevailing soil conditions. Gates shall be sturdy with locking provisions.</p> <p>Toe walls of brick masonry shall be provided between fence posts all along the run of the fence with suitable foundation. Toe wall shall be minimum 200 mm above the formation 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 on both sides and painted with two coats of cement paint of approved colour and shade. Toe wall shall be provided with weep holes at suitable spacing.</p>		
<p>12.00.00</p>	<p>ROADS</p> <p>All roads shall be of rigid pavements unless otherwise specified. The design of rigid pavement shall be carried out as per IRC: 58. The effects of design wheel load, maximum tyre inflation pressures, tyre contact area for the vehicle, traffic loads, environmental factors such as temperature changes in the pavement, other factors, like impact, load repetitions, etc., are to be taken. Detailed plate load tests to determine the modulus of sub grade reaction “K” shall be carried out as per the procedure outlined in IS: 1888. The design traffic load shall be a minimum value of 4 million standard axles. The road shall be designed for 30 years of life and considering a minimum traffic growth rate of 1 per cent per annum. The concrete pavement for roads shall be minimum 250 mm thick slab.</p> <p>The road construction including its shoulders, base, sub base and concrete pavement shall be as per IRC standards. IRC: 58 shall be followed for the pavement design and IRC: 15 shall be followed for the construction of the concrete pavement.</p>		
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	<p>The road base shall be with minimum 150 mm thick dry lean concrete over granular sub base. Dry lean concrete shall be laid by a mechanical paver and compacted by vibratory rollers. Concrete pavement of the road shall be done with fully mechanized paver fitted with electronic sensors for construction techniques. Dry lean concrete shall be minimum M10 grade and concrete pavement slab shall be minimum M35 grade concrete.</p> <p>The finished top (crest) of all roads shall be 350 mm above the surrounding finished ground level.</p> <p>The sub grade under all roads and its shoulders shall be compacted to achieve 95 per cent or more of Standard Proctor's Density MDD using mechanical means.</p> <p>Cutting / extending / rerouting / remaking of existing roads including associated works to maintain continuity of road system / network shall also be carried out.</p> <p>All culverts and RCC bridges at crossings of all roads / rail tracks / facilities with drains / nallahs / channels / roads / rail tracks / pipes / other facilities, etc. are to be designed and constructed.</p> <p>Unless otherwise specified, all roads shall be double lane roads.</p> <p>13.00.00 GATE ALONG BOUNDARY WALL:</p> <p>The gate shall be complete with fabricated hinges, MS aldrops with locking arrangement, tempered steel pivot, guide track of MS tee, bronze aluminum ball bearing, castor wheel etc.</p> <p>All gates shall be given anti-corrosive treatment in three coats.</p> <p>The structural steel shall confirm to IS: 2062 (latest) and all other relevant IS codes.</p> <p>Beside the each gate one room of size not less than 3m X 3m shall be provided for security guards. The room shall be made of brick/ RCC and with RCC roof. In addition to the room, one toilet block shall also be provided.</p>		
14.00.00	<p>LIME & GYPSUM HANDLING AND ASSOCIATED BUILDINGS STORM WATER DRAINAGE SYSTEM</p> <p>Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc with a return period of 50 years. These values shall be based on rainfall intensity of 90mm/hr. All RCC drains shall be either RCC Cast-in-Situ or RCC Pre-cast drains. The minimum grade of concrete shall be M25 for RCC Cast-In-Situ drains and M30 for RCC Pre-cast drains. The maximum velocity for RCC open drains shall be limited to 1.8 metre per second. However, minimum velocity of 0.6 metre per second for self - cleansing shall be ensured. Bed slope not milder than 1 in 1000 shall be provided.</p> <p>Open RCC rectangular section, unless required otherwise due to functioned requirement, shall be provided for all drains. The thickness of side walls and bottom slab of RCC drains shall be minimum 150mm or as per design considerations whichever is higher for drains upto depth of 1m from formation level. For depth of drain more than 1m from formation level, the thickness of side walls and bottom slab</p>		
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15.00.00	<p>of RCC drains shall be minimum 200mm or as per design considerations whichever is higher. The drains shall be provided on both sides of roads. These shall be designed to drain the road surface as well as all the free and covered areas, etc. Box culverts shall be provided at all rail, road and other crossings.</p> <p>All drains inside the building shall have minimum 40 mm thick grating covers. In areas where heavy equipment loads would be coming, precast RCC covers shall be provided in place of steel grating.</p> <p>The invert levels of the in-plant and plant peripheral drains shall be kept such that water can be discharged by gravity to the main / trunk drains under all conditions.</p> <p>The invert levels of the drains shall be decided in such a way that the water can easily be discharged to the natural water bodies above the high flood.</p> <p>SEWERAGE SYSTEM</p> <p>The connection of sewer pipe line for the associated buildings of FGD and Lime and gypsum handling area to nearest owner's sewage network is in bidder's scope.</p> <p>Cement concrete pipes of class NP-3 as per IS:458 shall be used below ground level for sewage disposal in all areas. However, for pressure pipes and under roads spun C.I. pipes conforming to IS:1536 of required class shall be used.</p> <p>RCC manholes with CI cover shall be provided at every 30m along the length, at connection points, and at every change of alignment, gradient or diameter of a sewer pipeline. This shall be as per IS:4111.</p> <p>Sewage pump house shall be provided as per IS:4111.</p>		
16.00.00	<p>LOADING</p>		
16.01.00	<p>For consideration of loads on structures IS : 875 - 'Code of practice for structural safety of buildings' shall be followed. In addition to the dead load, live load, equipment load (including impact / vibration). Temperature loads etc. various loading conditions arising due to operation and maintenance of equipment shall be considered in the design. The structure and equipment shall also be designed for seismic loads as per the "Criteria for Earthquake Resistant Design of Structures and equipment" and the "Criteria for Wind Resistant Design of Structures and equipment" specified in the "Project Information section" of technical specification. Wind and seismic forces shall not be considered to act simultaneously. The following minimum live loads shall be adopted for the design of various structures. If actual expected load is more than the specified load, then actual load is to be considered.</p>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>a) Roofs</p> <p>b) R. C. C. floors</p> <p>c) Stair and balconies</p> <p>d) Toilet rooms</p> <p>e) Chequered plate floors</p> <p>f) Walkways (including walkways in conveyer galleries)</p> <p>g) Conveyor galleries</p> <p>h) Road Culverts and its allied structures including R. C. C. pipe crossing & road crossing of trenches.</p> <p>i) Channels / trenches</p> <p>j) Covers for trenches / channels</p>	<p>150 Kgs. / Sq. M. for accessible roofs and 75 Kgs. / Sq. M. for non - accessible roofs. In addition to this dust load (Dead load) of 150 Kgs. / sq. m. on flat roofs & 75 Kgs. / sq. m. on inclined roofs shall also be considered.</p> <p>500 Kgs. / Sq. M.</p> <p>500 Kgs. / Sq. M.</p> <p>200 Kgs. / Sq. M.</p> <p>400 Kgs. / Sq. M.</p> <p>300 Kgs. / Sq. M.</p> <p>In addition to the live loads, loads due to cable trays, fire fighting / service water pipes shall also be considered @ 125 Kgs. / m (minimum) on each of the longitudinal girder. Roof-truss members are to be checked for supporting fire fighting pipes/ Service water pipes.</p> <p>For class 'AA' loading and checked for class A loading as per IRC standard.</p> <p>In addition to earth pressure and water pressure, etc. additional earth pressure due to surcharge of 2T / Sq. M. shall also be considered for design.</p> <p>Covers for channels & trenches, shall be designed for a live load of 0.4T Sq. M. and loading as mentioned under clause in trenches, whichever is critical.</p>	
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	<p>k) Sumps and tanks and other underground basement type structures</p> <p>In addition to earth pressure with a surcharge of 2T / Sq. M. (or surcharge due to Railway loading whichever is critical for Railway load bearing structures etc.) and sub - soil water pressure etc. These are also to be designed for the following conditions :</p> <p>i) Water / liquid inside and no earth outside (applicable only to such structures which are liable to be filled up with water or any liquid).</p> <p>ii) Earth with surcharge outside and no water / liquid inside</p> <p>iii) For underground (basement) structures protection against buoyancy during execution and after execution shall be ensured without superimposed loadings with minimum factor of safety of 1.2 against buoyancy.</p> <p>If the erection load is higher than the specified live loads on any floor or part thereof, then the erection loads are to be considered for the design.</p> <p>Permissible increase in stresses of materials and bearing pressure of soil due to wind load or seismic load shall be as per relevant I. R. S. and I. S. code.</p> <p>16.02.00 Crane load</p> <p>For crane loads, an impact factor of 25% and lateral crane surge of 10% (of lifted weight + trolley weight) shall be considered in the analysis of frame according to the provisions of IS:875. The longitudinal crane surge shall be 5% of the static wheel load. Longitudinal surge and lateral surge shall not be considered to act simultaneously.</p> <p>16.03.00 Temperature load</p> <p>For temperature loading, the total temperature variation shall be considered as 2/3 of the average maximum annual variation in temperature. The average maximum annual variation in temperature for this purpose shall be taken as the difference between the mean of the daily minimum ambient temperature during the coldest month of the year and mean of daily maximum ambient temperature during the hottest month of the year. The structure shall be designed to withstand stresses due to 50% of the total temperature variation.</p> <p>Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with provision of twin columns. The maximum distance of the expansion joint shall be as per the provisions of IS: 800 and IS: 456 for steel and concrete structures respectively.</p> <p>17.00.00 DESIGN CRITERIA</p> <p>17.01.00 The design of all R. C. C. structures shall be carried out as per 'code of practice for plain and reinforced concrete for general building construction', IS : 456 (latest).</p>		
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17.01.00	Design of steel structures shall be done by the Working stress method. Design shall be as per provisions of IS:800 :1984 and other relevant IS standards.		
17.02.00	Minimum size of the angle section to be used as structural members shall be 50 X 50 X 6. Minimum weld size shall be 6 mm. Connections shall be designed for 70 % of shear capacity of the member or the actual shear force, whichever is higher. The steel structures using tubular sections shall be designed and fabricated as per IS:806 – “Code of Practice for use of steel tubes in general building construction.” and EN 1993-1-8:2005. Minimum grade of steel & thickness of Tubular/Hollow sections shall be Yst 240 Mpa & 4.0mm respectively		
17.03.00	The building shall conform to local bye - laws, rules and regulations for industrial buildings and also B. I. S. publications, SP 32 and 41.		
17.04.00	Slotted holes shall not be assumed to act as expansion joint for relieving of stresses and suitable bearings shall be provided at the supports.		
17.05.00	Stresses for all structures shall be checked for the higher of the forces obtained from gust factor method and the peak wind speed method.		
17.06.00	Horizontal bracing system shall be provided at floor levels around the openings.		
17.07.00	Shear force in steel columns shall be transferred to the pedestals / foundations exclusively either through foundation bolts or the shear key arrangement.		
17.08.00	For design of liquid retaining structures, IS : 3370 (Part - I to IV) (latest) shall be followed. Face of the structure in contact with liquid shall be designed as un - cracked section. For design of R. C. C. pipes for culverts, latest editions of IS : 458, IS : 783 should be followed.		
17.09.00	For design of all underground structures / foundations, ground water table shall be assumed at the formation level (i. e. the adjoining ground level). For all underground structures like tunnel, underground transfer point and underground hopper etc. crack width shall be limited to 0.2mm.		
17.10.00	Design of masonry walls shall be made as per IS : 1905.		
17.11.00	Civil task drawing indicating various equipment loading and supporting arrangement and floor loads to be submitted along with the design calculation.		
17.12.00	Minimum 0.12% of reinforcement shall be provided on the top face of the foundation concrete on either direction and minimum percentage of reinforcement at bottom face of foundation shall be same as that stipulated for beam as per IS:456.		
17.13.00	Foundations for all tanks shall be designed for as per IS: 803.		
17.14.00	Footings shall be so proportioned to as to minimise the differential settlement.		
17.15.00	All gallery supporting trestles shall be so proportioned that the transverse deflection of gallery due to wind / seismic load should not exceed trestle height / 1000 as stipulated in IS: 11592. This deflection condition shall be strictly followed. Peak wind speed method shall be considered for checking the transverse deflection.		
<p align="center">LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p align="center">SUB-SECTION-IV-D CIVIL WORKS</p>	<p align="center">PAGE 35 OF 69</p>

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17.16.00	The crusher and transfer house structures shall be so designed that transverse deflection at places where conveyor galleries meet, should be equal to the respective transverse deflection of conveyor supporting trestles.									
17.17.00	<p>Deflection criteria</p> <p>The maximum Horizontal Deflection for various structures shall not exceed and be limited to the following:</p> <table border="1"> <thead> <tr> <th>Sl. No.</th> <th>Description</th> <th>Maximum value of</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)</td> <td>Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)</td> </tr> <tr> <td>2.</td> <td>For other Buildings</td> <td>Height/325</td> </tr> </tbody> </table>	Sl. No.	Description	Maximum value of	1.	For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)	Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)	2.	For other Buildings	Height/325
Sl. No.	Description	Maximum value of								
1.	For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)	Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)								
2.	For other Buildings	Height/325								
17.18.00	<p>a) Permissible deflection (unless specified otherwise in this specification) for latticed framework and beams of floors other than drive floor shall be span/325.</p> <p>b) The allowable deflection for beams directly supporting drive machinery shall be restricted to span/500 unless specified otherwise in this specification.</p> <p>c) The deflection for manually operated cranes & monorail supporting beams shall not exceed span/500. For electric overhead cranes :</p> <p>1) upto 50 t capacity : span/750 2) over 50 t capacity : span/1000</p> <p>d) The vertical deflection of metal deck sheet for roofing and side cladding shall be limited to span/250</p> <p>e) The permissible vertical deflection for beams supporting drive machinery shall be restricted to span / 500 and for other beams it shall be within span / 325.</p> <p>f) Permissible deflection for all purlins, cladding runners, roofing/cladding sheets and grating / chequered plates shall be span/250. However, the maximum vertical deflection of Grating/ Chequered plate shall be limited to 6 mm.</p>									
17.19.00	<p>a) Dispersion of load in any direction through soil shall be as per IS: 8009 (relevant part).</p> <p>b) Dispersion of load through concrete shall be considered at an angle of 45 degrees with horizontal from the edge of contact area.</p>									
17.20.00	a) The design and construction of RCC structures shall be carried out as per IS: 456. Working stress method shall be adopted for the design wherever									
<p align="center">LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p align="center">SUB-SECTION-IV-D CIVIL WORKS</p>	<p align="center">PAGE 36 OF 69</p>							

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17.21.00	<p>specifically mentioned in this specification.</p> <p>b) For design and construction of steel-concrete composite members, IS: 11384 shall be followed.</p> <p>c) For reinforcement detailing, IS: 5525 and SP: 34 shall be followed.</p> <p>d) Two layers of reinforcement (on both inner and outer faces) shall be provided for RCC wall sections having thickness 150 mm or more.</p> <p>a) All RCC liquid retaining/conveying shall be designed by working stress method as outlined in clause no. 4.5 of IS 3370 (Part-2) 2009 unless specified other wise.</p> <p>b) Water proofing treatment shall be provided for liquid retaining/ carrying structures and basement type structures (requiring dry working condition). Dense and durable concrete with water cement ratio not more than 0.45 shall be used. Plasticiser /super-plasticiser cum water proofing compound shall be added to the concrete. All the construction/expansion joints shall be provided with PVC water bar and/or chemical injection grouting as per IS:6494. As applicable internal/external surface of such structures shall be provided with acrylic based polymer modified cementitious composite coating system for critical structures. For liquid carrying/retaining structures, minimum two coats of such coating shall be applied. For external application wherever the surface is in contact with the earth, fine silica/quartz sand of 0.6 mm nominal size shall be added in the coating mix for better abrasion resistance and total nominal thickness of such coating shall be minimum 1.5 mm. For non critical structures minimum two coats of bitumen grade 85/25 as per IS:702, mixed with 1% of anti-stripping compound meeting the requirement of IS:6241, shall be applied. The total application of bitumen shall not be less than 1.7 kg/sq.m.</p> <p>Bidder shall submit a comprehensive scheme for water proofing treatment based on above or any other alternative scheme, internationally accepted for Employer's approval prior to commencement of work.</p> <p>c) All liquid retaining/carrying structures shall be tested for water tightness as per the provisions of IS: 3370 and IS: 6494 and in case of leakage, the same shall be rectified by chemical injection grouting through nozzles.</p>		
17.22.00	For design of all underground structures, foundations, etc. ground water table shall be assumed at the finished ground level unless specified otherwise.		
17.23.00	Earth pressure for all underground structures shall be calculated using coefficient of earth pressure at rest or co-efficient of active earth pressure, whichever is applicable, depending upon the structural configuration. However, for the design of substructure of pump houses, earth pressure at rest shall be considered. Co-efficient of passive earth pressure shall be used only in design of shear keys for stability against sliding.		
17.24.00	<p>a) Following loading conditions shall be considered in addition to the loading from super structure for the design of substructure of pump house, channels, sumps, tanks, trenches and other underground structures containing liquid</p> <p>i) Water pressure from inside and no outside pressure, like earth pressure, ground water and surcharge pressure (applicable only to structures, which are liable to be filled up with water or any other liquid.)</p> <p>ii) Earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside.</p>		
<p align="center">LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p align="center">SUB-SECTION-IV-D CIVIL WORKS</p>	<p align="center">PAGE 37 OF 69</p>

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	<p>iii) Design shall also be checked against buoyancy due to the ground water during construction as well as after construction stages. Minimum factor of safety of 1.2 against buoyancy shall be ensured considering empty condition inside and ignoring the superimposed loadings. Provision of pressure relief valves/flap valves, etc., shall not be permitted to counter the buoyancy unless specified otherwise.</p> <p>iv) Base slab and piers of the pump houses shall also be designed for the condition of different combination of pump sumps being empty during maintenance stages with maximum ground water level.</p> <p>b) Intermediate dividing pier of pump sumps and partition wall (if applicable) in channel shall be designed considering water on one side only and other side being empty for maintenance.</p> <p>c) All pump houses and other substructures (wherever applicable) shall be checked for stability against sliding and overturning during construction as well as operating conditions for various combinations of loads.</p> <p>17.25.00 Design of Block Foundation</p> <p>a) Block foundation resting on soil shall be analyzed using elastic half space theory. In case the foundation is supported over piles, Novak's approximation shall be used for determining the spring constant and damping ratio of pile groups. The mass of the RCC block shall be at least three times the mass of machine. Free vibration analysis of the foundation shall be carried out to evaluate the natural frequencies. The fundamental natural frequency shall be kept at least 20% away from the operating frequency (speed). Forced vibration analysis shall be carried out if the dynamic forces are made available by the machine supplier in which case the amplitude limits stipulated by the machine supplier and ISO 10816, whichever is lower, shall be satisfied.</p> <p>Reinforcement design shall be done by working stress method as per IS:456-2000 and IS:2974 (Part-IV).</p> <p>b) For the foundations supporting minor rotating 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 structure, floors, etc., suitable vibration isolation shall be provided by means of springs, neoprene pads, etc., and such vibration isolation system shall be designed suitably.</p> <p>18.00.00 Coating on RCC water retaining structures (other than drinking water)</p> <p>Epoxy phenolic coating shall be applied on internal surfaces of the RCC water retaining structures, as per details specified below:</p> <p>All concrete surfaces shall be provided with two component transparent polyamide cured epoxy sealer coating (having solid by volume minimum 40% \pm2%) of minimum 50 micron DFT. Surface to be coated shall be absolutely dry, clean and dust free.</p> <p>Sealer coat shall be followed with the application of epoxy phenolic coating (solid by volume minimum 63%) of minimum 400 micron DFT. This coat shall be applied after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.</p>		
<p align="center">LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p align="center">SUB-SECTION-IV-D CIVIL WORKS</p>	<p align="center">PAGE 38 OF 69</p>

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	<p>Coating on RCC water retaining structures (drinking water)</p> <p>Internal surfaces of RCC water retaining structures shall be provided with minimum 400 micron Food grade epoxy coating complying to FDA Title 21, Part 175.300. Surface to be coated shall be absolutely dry, clean and dust free</p>		
19.00.00	<p>Fabrication</p> <p>All steel structures shall be fabricated in factory, transported and erected at site. All factory fabricated structures shall have bolted field connections.</p> <p>Chimney flue liners can either be fabricated at factory in segments, transported and welded at site before erection or fabricated at site. For Chimney flue liners, to prevent flue gas leakages, the applicable field joints shall necessarily be welded.</p>		
20.00.00	<p>Electrodes</p>		
20.01.00	<p>The electrodes used for welding shall be of suitable type and size depending upon specifications of the parent material, the method of welding, the position of welding and quality of welds desired. Only low hydrogen electrodes shall be used for welding of medium /high tensile steel and for mild steel plate thickness above 20 mm.</p>		
20.02.00	<p>All low hydrogen electrodes shall be baked and stored before use as per manufacturer's recommendation. The electrodes shall be re-baked at 250°C - 300°C for one hour and later on cooled in the same oven to 100° C. It shall be transferred to a holding oven maintained at 60°C - 70°C. The electrodes shall be drawn from this oven for use.</p>		
20.03.00	<p>Where coated electrodes are used they shall meet the requirements of IS: 814 and relevant ASME - Sec. II. Covering shall be heavy to withstand normal conditions of handling and storage.</p>		
20.04.00	<p>Only those electrodes that give radiographic quality welds shall be used for welds, which are subjected to radiographic testing.</p>		
20.05.00	<p>Where bare electrodes are used these shall correspond to specification of the parent material. The type of flux-wire combination for submerged arc welding shall conform to the requirements of F-60 class of AWSA-5-17-69 and IS: 3613. The electrodes shall be stored properly and the flux shall be baked before use in an oven in accordance with the manufacturer's requirements as stipulated.</p>		
20.06.00	<p>The contractor shall take specific approval of the weld for the various electrodes proposed to be used on the works before any welding is started.</p>		
20.07.00	<p>Edge Preparation for Welding</p> <p>Suitable edge as per weld joint detail shall be prepared either by machines or by automatic gas cutting. All edges cut by flame shall be ground before they are welded.</p>		
20.08.00	<p>Pre Heating and Post Heating</p> <p>Mild steel and medium / high tensile steel plates thicker than 20mm, will require Pre-Heating of the parent plate prior to welding as mentioned in Table - 1 for mild steel and Table - 2 for medium / high tensile steel, however, higher pre heat temperature</p>		
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20.09.00	<p>may be required as per approved welding procedure and it shall be followed. In welding materials of unequal thickness, the thicker part shall be taken for this purpose.</p> <p>Base metal shall be preheated, notwithstanding provisions of IS: 9595 to the temperature given in Table - 1 for mild steel and Table - 2 for medium / high tensile steel, prior to welding or tack welding. When base metal not otherwise required to be pre heated is at a temperature below 0°C it shall be pre heated to atleast 20°C., prior to tack welding or welding. Pre heating shall bring the surface of the base metal to the specified pre heat and this temperature shall be maintained as minimum inter-pass temperature welding is in progress.</p> <p style="text-align: center;">TABLE - 1 MINIMUM PREHEAT AND INTERPASS TEMPERATURE FOR WELDING MILD STEEL</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="text-align: center;">Thickness of thicker part at Point of welding</th> <th colspan="2" style="text-align: center;">Welding Using</th> </tr> <tr> <th style="text-align: center;">Low hydrogen electrode or submerged arc welding</th> <th style="text-align: center;">Other than low hydrogen electrode</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Upto and including 20mm</td> <td style="text-align: center;">None</td> <td style="text-align: center;">None</td> </tr> <tr> <td style="text-align: center;">Over 20mm and up to and including 40mm</td> <td style="text-align: center;">20°C</td> <td style="text-align: center;">Not allowed</td> </tr> <tr> <td style="text-align: center;">Over 40mm and up to and including 63mm</td> <td style="text-align: center;">66°C</td> <td style="text-align: center;">Not allowed</td> </tr> <tr> <td style="text-align: center;">Over 63mm</td> <td style="text-align: center;">110°C</td> <td style="text-align: center;">Not allowed</td> </tr> </tbody> </table> <p>Note: Type of electrode and the preheating requirements for welding shall be as per approved welding procedure.</p> <p style="text-align: center;">TABLE - 2 MINIMUM PREHEAT AND INTERPASS TEMPERATURE FOR WELDING MEDIUM / HIGH TENSILE STEEL</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="text-align: center;">Thickness of thicker part at Point of welding</th> <th colspan="2" style="text-align: center;">Welding Using</th> </tr> <tr> <th style="text-align: center;">Low hydrogen electrode or submerged arc welding</th> <th style="text-align: center;">Other than low hydrogen electrode</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Upto and including 20mm</td> <td style="text-align: center;">None</td> <td style="text-align: center;">Not Allowed</td> </tr> <tr> <td style="text-align: center;">Over 20mm</td> <td style="text-align: center;">120oC - 140°C</td> <td style="text-align: center;">Not Allowed</td> </tr> </tbody> </table> <p>Note : Type of electrode and the preheating requirements for welding of medium and high tensile steel shall be as per approved welding procedure.</p> <p>Pre heating may be applied by external flame which is non-carbonizing like LPG, by electric resistance or electric induction process such that uniform heating of the</p>	Thickness of thicker part at Point of welding	Welding Using		Low hydrogen electrode or submerged arc welding	Other than low hydrogen electrode	Upto and including 20mm	None	None	Over 20mm and up to and including 40mm	20°C	Not allowed	Over 40mm and up to and including 63mm	66°C	Not allowed	Over 63mm	110°C	Not allowed	Thickness of thicker part at Point of welding	Welding Using		Low hydrogen electrode or submerged arc welding	Other than low hydrogen electrode	Upto and including 20mm	None	Not Allowed	Over 20mm	120oC - 140°C	Not Allowed
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	<p>surface extending up to a distance of four times the thickness of the plate on either side of the welded joint is obtained.</p>		
20.10.00	<p>Thermo-chalk, thermo-couple or other approved methods shall be used for measuring the plate temperature.</p>		
20.11.00	<p>All butt welds with plates thicker than 50mm and all site butt welds of main framing beam supporting the bunker shall require post weld heat treatment as per procedure given in AWS D-1.1. Post heating shall be done up to 600oC and rate of application shall be 200oC per hour.</p>		
20.12.00	<p>The post heat temperature shall be maintained for 60 minutes per 2.5cm thickness. For maintaining slow and uniform cooling, asbestos pads shall be used for covering the heated areas.</p>		
21.00.00	<p>Paving, Drainage and Sewage</p> <p>RCC paving of minimum 150 mm thick with M25 grade concrete, over an underbed as specified herein shall be provided. 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 200mm compacted thick for normal duty paving with 63 mm and down aggregate with interstices filled with selected moorum 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.</p> <p>2.5 m wide paving with metallic hardener around periphery of all sumps and underground tanks shall be provided.</p> <p>Suitable drains shall be provided to dispose off storm water as well as floor wash of the FGD area block. The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain.</p> <p>Sewer lines (Cast Iron), interconnected by sewer manholes (RCC) at regular intervals (not exceeding 30 meter centre to centre) shall be provided to dispose off sewage from FGD area to the nearest available manhole of the owner.</p> <p>The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr. The maximum velocity for pipe drains and open drains shall be limited to 2.4m/sec and 1.8 m/sec. respectively. However, minimum velocity of 0.6m/sec. for self-cleansing shall be ensured. Bed slope not milder than 1 in 1000 shall be provided. The open drains shall be open rectangular drains of RCC unless required otherwise due to functional requirement. RC box culverts shall be provided at rail, road or other crossings.</p> <p>Sewers shall be designed for a minimum self-cleansing velocity of 0.75m/sec and the maximum velocity shall not exceed 2.4m/sec.</p>		
22.00.00	<p>Statutory Requirements</p> <p>Bidder shall comply with all the applicable statutory rules pertaining to Factories Act, Fire Safety Rules at Tariff Advisory Committee. Water Act for pollution control, Explosives Act, etc.</p>		
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<p>23.00.00</p>	<p>Provisions of safety, health and welfare according to Factories Act shall be complied with. These shall include provision of continuous walkways along the crane - girder level on both sides of building, comfortable approach to EOT crane cabin, railing, fire escape, locker room for workmen, pantry, toilets, rest room etc.</p> <p>Provisions for fire proof doors, number of staircases, fire separation wall, lath plastering/encasing the structural members (in fire prone areas), type of glazing etc. shall be made according to the recommendations of Tarrif Advisory Committee.</p> <p>Statutory clearances and norms of State Pollution Control Board shall be followed.</p> <p>Bidder shall obtain approval of Civil/Architectural drawings from concerned authorities before taking up the construction work.</p> <p>INSPECTION, TESTING AND QUALITY CONTROL</p> <p>Sampling and testing of major items of civil works viz. earthwork, concreting, structural steel work (including welding), piling, sheeting, etc. shall be carried out in accordance with the requirements of this specification. Wherever nothing is specified relevant Indian Standards shall be followed. In absence of Indian Standard equivalent International Standards may be used.</p> <p>The Bidder shall submit and finalise a detailed field Quality Assurance Programme before starting of the construction work according to the requirement of this specification. This shall include frequency of sampling and testing, nature/type of test, method of test, setting of a testing laboratory, arrangement of testing apparatus/equipment, deployment of qualified/experienced manpower, preparation of format for record, Field Quality Plan, etc. Tests shall be done in the field and/or at a laboratory approved by the Engineer. The Bidder shall furnish the test certificate from the manufacturer's of various materials to be used in the construction.</p>		
<p>24.00.00</p>	<p>CONCRETE</p> <p>All R. C. C. works to be done under this specification, unless specified otherwise shall be design mix concrete. Minimum grade of concrete for various structures shall be as follows:</p> <p>a) M25 - For all underground / sub-structural/ super-structure R. C. C. work.</p> <p>b) M30- For Block Foundation</p> <p>c) M35- For spring supported RCC deck</p> <p>Minimum 75 mm thick P.C.C M-7.5 shall be provided as mud mat below all foundations.</p> <p>For concreting of underground structures requiring water tightness, plasticizer cum water proofing admixture shall be added to the concrete mix.</p> <p>Both coarse and fine aggregates shall conform to IS: 383 for concrete, shotcreting etc. unless otherwise mentioned.</p>		
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<p>25.00.00</p> <p>25.01.00</p>	<p>Excavation, Backfilling, Disposal and Stacking of materials Details</p> <p>Excavation in Soil</p> <p>Excavation for foundation shall be to the bottom of lean concrete and as shown on drawing or as directed by the Engineer. The bottom of all excavations shall be trimmed to required levels and when excavation is carried below such levels by error, it shall be brought back to the specified level by filling with concrete of nominal mix 1 : 3 : 6 (cement: coarse sand: 40 mm down aggregates), as directed by the Engineer.</p> <p>The Contractor shall ascertain for himself the nature of materials to be excavated and the difficulties, if any, likely to be encountered in executing this work. Cofferdams, sheet piling, shoring, bracing to maintain suitable slopes, draining etc. shall be provided and installed by the contractor, to the satisfaction of the Engineer.</p> <p>Surplus excavated materials shall be disposed off by the contractor at locations up to a lead of 5 kms from the plant boundary wall as directed by the engineer.</p> <p>The Contractor shall have to constantly pump out any water collected in excavated pits and other areas due to rain water, springs etc. and maintain dry working conditions at all times until the excavation, placement of reinforcement, shuttering, concreting, Backfilling is completed. The Contractor shall remove all slush/muck from the excavated areas to keep the work area dry. The Contractor, if required, shall employ sludge pumps, for this purpose.</p> <p>For other details, excavation clauses as given at “Foundation system and Geotechnical Data Chapter” given at “Project Information section” of technical specification, are to be referred.</p>		
<p>25.02.00</p>	<p>Excavation in Rock</p> <p>For the work of excavation in rock, Contractor shall engage specialised agency having experience of excavation in rock involving wedging and blasting. The agency shall be subject to approval of Engineer and the Contractor shall furnish details of relevant experience in support while seeking approval for the agency.</p> <p>Blasting shall be resorted to only with the written permission of the Engineer. All the statutory laws, (Explosives Act etc.) rules, regulations, Indian Standards etc. pertaining to the acquisition, transport, storage, handling and use of explosives etc. shall be strictly followed.</p> <p>The contractor shall obtain Licenses from Competent Authorities for undertaking blasting work as well as for procuring, transporting to site and storing the explosives as per Explosives Act. The Contractor shall be responsible for the safe transport, use, custody and proper accounting of the explosive materials.</p> <p>Surplus excavated materials shall be disposed off by the contractor at locations up to a lead of 5 kms from the plant boundary wall as directed by the engineer. The Contractor shall have to constantly pump out any water collected in excavated pits and other areas due to rain water, springs etc. and maintain dry working conditions at all times until the excavation, placement of reinforcement, shuttering, concreting, backfilling is completed. For other details for excavation in rock, clauses as given at</p>		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 43 OF 69</p>

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<p>25.03.00</p>	<p>“Foundation system and Geotechnical Data Chapter” given at “Project Information section” of Technical specification, are to be referred.</p> <p>Backfilling, Disposal and Stacking of materials</p> <p>Backfilled earth shall be compacted as per “Foundation system and Geotechnical Data Chapter” given at “Project Information section” of technical specification.</p> <p>However, the backfill under the rail lines and roads shall be compacted to minimum 95 % of the standard proctor density at OMC unless otherwise stated by rail Authorities.</p> <p>The contractor is required to excavate upto any depth as shown on the drawings or as directed by the Engineer. Lifting of excavated materials shall be done either by manual or mechanical or both means if called for by the Engineer.</p> <p>The disposal / stacking areas for excavated materials shall be indicated by the Engineer. The carriage of excavated materials shall be done by the methods mentioned below:</p> <p>The excavated materials shall be carried beyond the initial lead of 50 m but upto 500 m by manual / animal labour or by mechanical means. If directed by the Engineer this material shall be used directly for filling purposes.</p> <p>For leads exceeding 500 m the Contractor shall transport the excavated materials by mechanical means only and as directed by the Engineer. The Contractor may be allowed to carry materials through Kuccha roads. Providing and maintaining of the Kuccha roads shall be the responsibility of the Contractor. The transported material shall be neatly stacked as directed by the Engineer.</p> <p>Some excavated materials required for filling purposes, may have to be carried upto a lead of 500 m and stacked as per instructions of the Engineer. Excavated materials carried beyond 500 m shall normally be for disposal purpose only. Double handling of materials shall be avoided as far as possible. However, depending on site condition excavated materials carried beyond a lead of 500 m may also be required to be brought back for filling purpose.</p> <p>Materials to be used for filling purpose shall be stone, sand or other inorganic materials and they shall be clean and free from shingle, salts, organic matter, large roots and excessive amount of sod, lumps, concrete or any other foreign substances which could harm or impair the strength of the substances in any manner. All clods shall be suitably broken to small pieces. When the material is mostly rock boulders, these shall be broken into pieces not larger than 150 mm size before backfilling and shall be backfilled in layers of 300mm interstices filled with sand. In case of broken rock boulders used for back filling, the top cover shall be with 1.0m thick soil. The layers of rock boulders, interstices filled with sand shall be compacted by plate vibrators. Sand used for filling shall be clean, medium grained and free from impurities. Fines less than 75 microns shall not be more than 20%. In any case, the materials to be used for filling purposes shall have the prior written approval of the Engineer.</p>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
<p>26.00.00</p>	<p>In case the materials have to be brought from pits / quarries, then it shall be the Contractor's responsibility for identification of such quarry areas, obtaining approval from their use from concerned authorities, excavation / quarrying loading and carriage of such material, unloading and filling at specified locations. The Contractor shall pay any fees, royalties etc. that may have to be paid for utilisation of borrow areas.</p> <p>GALVANISING</p> <p>All burrs and irregular edges of the structural steel members to be galvanised shall be ground smooth before galvanising.</p> <p>Purity of Zinc to be used for galvanising shall be 99.5 % as per IS : 209 (latest edition).</p> <p>The weight of the zinc coating shall be at least 610 Gms. / m² unless noted otherwise.</p>		
<p>27.00.00</p>	<p>CHEMICAL INJECTION GROUTING</p> <p>Minimum, 12 mm dia (NB) threaded nozzle of suitable length, shall be provided over the surface and along the construction joint line in a grid pattern at a spacing not exceeding 1.5 m c / c before concreting operation. Adequate precaution shall be taken to keep the nozzles plugged at both ends to prevent them from getting closed by concrete.</p> <p>For fixing of any nozzle in set concrete suitable size hole shall be drilled, preferably by using percussive hammer drill electrically operated, in grid pattern and grouting nozzle shall be fixed in these holes.</p> <p>After the nozzles are fully set, neat cement slurry admixed with water soluble non - shrink polymer / monomer based chemical shall be injected through the net - work of nozzles with low pressure grout pumps at a pressure of about 2.0 Kgs. / cm². Cement slurry shall be prepared by mixing cement with non-shrink polymer/monomer @ 500 gm/50 kg bag of cement and water, ensuring that Water: Cement ratio does not exceed 2 (by weight). Wetter the structure, lesser should be the water cement ratio. The property of the polymer/monomer should be such that when it is mixed with water @0.5% by weight of water, the viscosity of the resultant solution (water and polymer/monomer) should not be more than 1.2 centipoises. Plasticizing agent shall be added wherever required. The grouting shall be started at very low pressure and increased gradually to a required pressure. The grouting shall continue, till the hole refuses to take any further grout, even at an increased pressure. Applied pressure shall not be more than the designed strength of the concrete. After completion of grouting operation, the nozzles shall be sealed properly to the satisfaction of the Engineer.</p>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
28.00.00	POLYMER MODIFIED CEMENTITIOUS COATING		
28.01.00	<p>Materials</p> <p>Modified liquid polymer blend shall be a dispersion containing 100 % acrylic based polymer solids. Polymer shall be mixed in the ratio of 1 cement: 0.5 polymer (for minimum solid content of polymer 30%).</p> <p>Portland cement based dry powder.</p> <p>Clean, fine specially prepared quartz sand approximately 0.6 mm size.</p>		
28.02.00	<p>Mixing</p> <p>The liquid polymer shall be stirred well and cement based powder shall then be added slowly to make a Slurry Mix. For preparation of Brush Topping Mix, quartz sand shall be added slowly and mixed well till a homogeneous mixture is obtained. The mix shall be used within half an hour of the preparation. Addition of quartz sand may not be necessary, in case dry power contains the same.</p>		
28.03.00	<p>Properties of Coating</p> <p>It must adhere to wet surface.</p> <p>It should develop adequate bond strength, with the concrete surface, not less than 2 N / Sq. mm.</p> <p>Co - efficient of permeability shall be about 5×10^{-10} Cm / Sec.</p> <p>Water absorption after continuous soaking shall not be more than 1 %.</p> <p>The materials shall be permeable under water vapour.</p> <p>The material shall be resistant to acids and alkalis present in the soil and underground water with normal pH value between 4 and 14.</p> <p>The co - efficient of thermal expansion of the material shall be close to that of concrete.</p>		
28.04.00	<p>Application</p> <p>The concrete surface shall be cleaned and made free from grease, oils or loosely adhered particles. The surface shall be damp without any free water. For exterior underground part, application (b) pertaining to Brush topping Mix shall be followed.</p> <p>(a) For Slurry Mix</p> <p>A minimum of 2 coats shall be applied on the surface. The first coat being applied, when the surface is still damp and left to harden for 4 to 6 hours. After 4 to 6 hours of the application of second coat, it shall be finished by rubbing down with a soft dry</p>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
29.00.00	<p>sponge. The coverage shall not be less than 1 : 1 Kgs. / m² in the 2 coats. A lap of 75 mm shall be provided at the joints.</p> <p>The coating shall be air dried for 4 to 6 hours and, thereafter, cured for 7 days after the application of last coat.</p> <p>(b) For Brush Topping Mix</p> <p>This shall be applied in two coats. A primary coat of slurry mix can also be first applied on the surface as first coat. After the coating has dried up, a coat of Brush Topping Mix shall be applied over it with a push broom or any other similar brush. It shall be left in broom finished condition. The nominal thickness shall be 1.5 mm and minimum thickness shall be 1.0 mm. A lap of 75 mm shall be provided at the joints. It shall be ensured that no pinhole exists and rebrushing shall be done to cover the pinholes, if any.</p> <p>The Coating shall be air dried for 4 to 6 hours and thereafter cured for 7 days after the application of last coat.</p> <p>Rate of application of coating shall be established to achieve the required thickness.</p> <p>Architectural Concepts</p> <p>Buildings shall be architecturally treated in such a way that it 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 comprehensive scale, blending with the surroundings and taking full consideration of the climatic conditions and the building orientation. All the buildings shall be architecturally treated in such a way so as to be in harmony with the surroundings. The over all composition may have straight or curvilinear profiles.</p> <p>Necessary projections, fins, parapets, chajjas etc. in addition to the minimum area specified elsewhere in this specification shall be provided as required.</p> <p>Nothing extra shall be payable for any changes required while getting the drawings / scheme approved and for executing the same.</p> <p>All structures, buildings and facilities shall be designed as per provisions of National Building Code 2005 and Local building by - laws as applicable including provisions of the Factories Act of the State concerned, with regard to requirement of free access, stairs, minimum head room, walkways, ventilation, toilets etc. and safety requirements like railings, fire escapes etc. Further all layouts and detailed drawings shall meet the relevant statutory requirements specified in recommendations of Petroleum act, Explosives act and Indian Electricity rules' as applicable.</p>		
29.01.00	FINISHING SCHEDULE		
29.01.01	<p>Flooring</p> <p>The nominal total thickness of floor finish shall be 50mm i.e. underbed & topping. The floor shall be laid on an already laid and matured concrete base.</p>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
<p>29.01.02</p> <p>29.02.00</p>	<p>Flooring of tiles / stone shall be fixed with 18 mm thk cement sand mortar 1:4, above PCC under bed (M 20 (with graded aggregate of nominal size 12.5mm) design mix)</p> <p>Flooring of Concrete hardener topping shall be provided above the PCC underbed (M 20 (with graded aggregate of nominal size 12.5mm) design mix).</p> <p>Wherever specified Heavy duty ceramic tiles of size 300x300x7 mm thick (minimum) of reputed manufacturer (Kajaria, Orient, Johnson or equivalent) of approved finish shade and colour to be used. Vitrified ceramic tiles wherever specified shall be 600x600 mm with minimum 9.5 mm thickness and of reputed manufacturer (Kajaria, Johnson, Orient or equivalent).</p> <p>Floor finish & skirting:</p> <p>The nominal thickness of floor finish shall be 50 mm.</p> <p>Floors of toilets, pantries / kitchen shall be finished with Heavy duty (grade-5) dust pressed ceramic tiles 300mmx300mm x7 mm thick as per IS:15622, including pointing the joints with white cement mixed with matching pigment, of approved make, size & colour shade.</p> <ol style="list-style-type: none"> (1) Floors of Office Room, Labs, Control Rooms, RIO Rooms and all other A/c Room shall be finished with Mirror polished Vitrified ceramic tiles (minimum 9.5 mm thk) with 3 mm groove joints as per approved pattern, pointed neatly with 3X4mm stainless epoxy grout SP- 100 of Laticrete or approved equivalent in approved colour to match colour of tile. (2) Suitable supporting arrangement shall be provided with M.S. angles / channels on cable trenches in MCC and Control rooms for mounting Control panels / MCC. (3) In rest of the areas, IPS (Cement concrete flooring) with Concrete hardener topping shall be 12mm thick with ordinary grey cement using uniformly graded, properly treated iron particles shall be provided. (4) Floors and sides of under ground RCC structures like valve pits, trenches and tanks shall have simultaneous (integral) neat cement finish at the time of concreting. (5) The interconnecting walkway between various structures, buildings and facilities shall be finished with 22 mm chequered concrete tiles at top. 1000 mm wide walkway of 22mm thick chequered concrete tiles shall be provided on terrace for maintenance purpose, in all RCC /Metal deck roof buildings. (6) Skirting in general shall be 150mm high, Dado in toilet, kitchen & pantry shall be up to specified height (up to 2200 mm for toilets, up to 600 mm high above counter top in kitchen and pantry area). The dado height shall be measured from finished floor level. Skirting and Dado shall match with the floor finish. (7) Battery Room shall be provided with Acid resistant tile on horizontal and vertical surfaces, at all levels for all type of works, including One coat of bitumen primer followed by 12 mm thick bituminastic layer, 20 mm thick Acid Resistant tiles, 6 mm thick under-bed by potassium silicate mortar, 6 mm thick pointing of joints of tiles with acid/alkali resistant epoxy/furane mortar up 		
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	<p>to a depth of 20 mm and bituminastic end sealing. 1200 mm high dado on wall shall be with 12 mm thk Acid resistant tiles of the similar finish and the joints to be finished as per flooring tiles, with the rest of wall height and ceiling finished in chemical resistant paint (chlorinated rubber based).</p> <p>(8) Well polished 18 mm thick Kota stone jointed with neat cement slurry mixed with pigment to match the shade of the stone including rubbing and cleaning, complete, to be provided in entrance area, entrance steps, Entrance area, staircases (tread, riser, landings, skirting).</p>		
29.03.00	<p>Sunken RCC slab shall be provided in false flooring area and toilet, Kitchen and pantry, so as to keep the finished floor level of these areas same as that of the surrounding area.</p>		
29.04.00	<p>Water proofing treatment to be provided on sunken portion of all vertical and horizontal surfaces of depressed portions of all toilets, W.C., kitchen, Pantry and the like consisting of :</p> <p>(i) Ist course of applying cement slurry @ 4.4 kg/sq.m mixed with water proofing compound conforming to IS 2645 in recommended proportions including rounding off junction of vertical and horizontal surface.</p> <p>(ii) IInd course of 20 mm cement plaster 1:3 (1 cement: 3 coarse sand) mixed with water proofing compound in recommended proportion including rounding off junction of vertical and horizontal surface.</p> <p>(iii) IIIrd course of applying blown or residual bitumen applied hot at 1.7 kg. per sq.m of area.</p> <p>(iv) IVth course of 400 micron thick PVC sheet. (Overlaps at joints of PVC sheet should be 100 mm wide and pasted to each other with bitumen @ 1.7 kg/sq.m).</p>		
29.05.00	<p>Acid / Alkali Resistant Treatment:</p> <p>Acid / alkali resistant lining treatment shall be provided in different areas as follows:</p> <p>Neutralization Pit: The walls shall be provided with one coat of bitumen primer, followed by 18 mm thick bitumastic layer, 115 mm thick A.R. bricks, 6 mm thick under bed of potassium silicate mortar, pointing the joints of bricks with acid / alkali resistant epoxy / furane mortar upto a depth of 20 mm and bitumastic end sealing. Suitable plasters shall be provided with A.R. bricks at regular intervals depending upon the height of lining, as per the specification.</p> <p>The floor of neutralization pit shall be provided with acid / alkali resistant lining treatment as given in the above para, except that the 115 mm thick A.R.tile layer shall be replaced by 75 mm thick A.R. tile layer and pilasters shall be omitted.</p> <p>The ceiling of neutralization pit shall be provided with one coat of epoxy primer followed by 2 coats of epoxy paint (150 micron).</p> <p>Acid / Alkali storage area / projections above the floor, pedestals projecting from the floor / saddles. : The floor shall be provided with one coat of bitumen primer followed</p>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>by 12 mm thick bitumastic layer, 20 mm thick A.R. tiles, 6 mm thick under - bed by potassium silicate mortar, 6mm thick pointing of joints of tiles with acid / alkali resistant epoxy / furane mortar up to a depth of 20 mm and bitumastic end sealing. Dado of 12 mm thk Acid Resistant tiles up to 1.0M high shall also be provided if applicable in case of walls nearby.</p> <p>Alum/Lime Storage area and first floor of Chemical House : One coat of bitumen primer followed by 12mm thick bitumastic layer, 20 mm thick A.R. tiles, 6 mm thick underbed of potassium silicate mortar, 6mm thick pointing of joints of tiles with acid /alkali resistant epoxy /furane mortar up to a depth of 20 mm and bitumastic end sealing.</p> <p>Alum solution preparation tank:</p> <p>The wall shall be provided with one coat of bitumen primer followed by 12 mm thick bitumastic layer, 75 mm thick A.R. tiles, 6 mm thick underbed by potassium silicate mortar, pointing of joints of tiles with acid / alkali resistant epoxy / furane mortar upto a depth of 20 mm and bitumastic end sealing.</p> <p>The floor shall be provided with acid / alkali resistant lining treatment as given in the above para except that the 75 mm thick A.R. tile layer shall be replaced by 12 mm thick A.R. tile layer.</p> <p>Basket of Alum solution preparation tank: 5 mm thick epoxy lining over a coat of epoxy primer.</p> <p>Curved surfaces of saddles shall have minimum 12 MM thick bitumastic layer to support the vessel / tanks.</p> <p>Effluent Drains: Acid Resistant lining treatment indicated for the storage area shall be provided on the bed as well as walls of the drains with 38 MM AR tiles. The underside of the pre-cast slab cover shall be applied with one coat of epoxy primer and two coats of epoxy coating, total DFT 150 microns.</p> <p>Lime tank: Two coats of bitumen paint conforming to IS: 9862, with total DFT 150 microns.</p>		
29.06.00	Walls		
29.06.01	All walls shall be non-load bearing infilled panel walls. All external walls shall be minimum one brick thick masonry wall.		
29.06.02	All external and internal walls shall be with minimum one brick masonry (230 or 250 mm) including toilet walls. Toilet partition low height walls shall be minimum half brick masonry.		
29.06.03	For all air conditioned areas/ rooms, wherever metal cladding is envisaged as cladding material, additional brick masonry wall (230m thick) shall also be provided in addition to metal cladding for effective air conditioning. This brick wall shall be plastered & painted as specified elsewhere in the specification.		
29.06.04	RCC transoms and mullions of size 115x115mm with suitable reinforcement shall be provided wherever necessary to reinforce the brickwork.		
29.06.05	50 mm thick DPC in Cement concrete (M-20) with water proofing compound followed by two layers of bitumen coating 85/ 25 grade as per IS: 702 @ 1.7 kg/ sq.m. shall be provided at plinth level before starting the masonry work.		
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29.06.06	The bricks shall be laid with cement mortar (1:6) for one brick thick walls and (1:4) for half brick thick walls IS: 1905, IS: 2212 and SP -- 20 shall be followed for brick work design and construction.		
29.07.00	Plastering		
29.07.01	<p>External (rough) surface of walls shall be plastered with 18 mm thick cement plaster, consisting first (base) layer of 12 mm thick plaster in cement sand mortar (1:6) and second (finishing) layer of 6 mm thick plaster in cement sand mortar (1:4).</p> <p>The internal (smooth) surface of walls shall have 12 mm thick plaster in cement sand mortar (1:6).</p> <p>All external / internal RCC surfaces including RCC parapet walls shall be provided with minimum 12mm thick plaster in cement sand mortar (1:4) except walls of underground structures like cable trenches / valve pits etc.</p>		
29.07.02	All exposed faces of R.C.C. walls of structures, buildings and facilities shall have minimum 12 mm thick cement sand plaster 1:6.		
29.07.03	All RCC ceilings (except areas provided with false ceilings and cable vault ceiling) shall be provided with 6 mm thick cement sand plaster 1:4.		
29.07.04	All plastering work shall conform to IS: 1661.		
29.08.00	Painting		
29.08.01	All painting on masonry or concrete surface shall preferably be applied by roller. If Applied by brush then same shall be finished off with roller.		
29.08.02	All paints shall be of approved make including chemical resistant chlorinated rubber paint.		
29.08.03	Minimum two finishing coats of paint shall be applied over a coat of primer.		
29.08.04	The thinner shall not be used with textured paint (Sandtex Matt or equivalent) finish.		
29.09.00	Internal Finish		
29.09.01	All Air conditioned areas shall have 2mm of polymer based water resistant putty (wall putty) to given an even and smooth surface.		
29.09.02	Acrylic emulsion paint shall be as per IS: 5411 (Part - 1). Acrylic distemper shall be as per IS: 428. Air - conditioned areas shall be applied with minimum 2 coats of acrylic emulsion paint. All other areas shall be applied with minimum 2 coats of Acrylic distemper.		
29.09.03	Toilet, Pantry / Kitchen areas shall have dado with Designer ceramic tiles, 300x200mw (matt finish) upto 2.2 m height and shall match with floor finish. Above dado, Acrylic distemper shall be applied.		
29.09.04	<p>Areas coming in contact with chlorine fumes or acid / alkali shall have two coats of acid / alkali resistant chlorinated rubber paint over suitable primer on walls above dado & ceiling.</p> <p>The paint shall be of approved colour shade and make.</p>		
29.10.00	<p>External Wall Finish</p> <p>One pack, ready mix and ready to use, resin / polymer bonded granular textured coating finish of 2.5 mm (natural coloured graded stone chips), of approved colour, and shade for all types of plastered and / or exposed concrete surface, in all kinds of works, at all levels, including preparation of surface, preparation of working drawing,</p>		
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	<p>labour, material, equipment, handling, transportation, mixing, laying, applying finishing, testing, curing, making grooves, scaffolding, staging, etc., all complete, as per specifications, drawings and instructions of the Engineer-in-charge.</p> <p>Toe wall of chain link fencing shall be provided with two coats of Acrylic Smooth Exterior Paint</p> <p>The finish shall be of approved colour shade and make.</p>		
29.11.00	<p>Ceiling Finish</p> <p>Ceiling shall have min. two (2) coats of Acrylic distemper except AC areas & Battery room.</p>		
29.11.01	<p>For painting on concrete, masonry and plastered & surface, IS: 2395 shall be followed. For painting on steel work and ferrous metals, IS: 1477 shall be followed.</p>		
29.11.02	<p>Fire resistant transparent paint (confirming to IS: 162) shall be provided on all wood work, over French police or flat oil paint. French polish shall confirm to IS : 348. Flat oil paint shall confirm to IS: 1237.</p>		
29.12.00	<p>Doors, Windows, Ventilators, Louvers, Rolling Shutters & Glazing</p>		
29.12.01	<p>Adequate Doors, Windows, Louvers and Ventilators shall be provided for proper lighting and ventilation of all buildings. The area of windows shall be at least 10% of the floor area of the respective building. In addition to the above, wherever room height is more than 3.5 m, a band of ventilators of 600 mm height (minimum) shall be provided at the top.</p>		
29.12.02	<p>Unless specified all doors, of air conditioned areas, entrance lobby of all buildings shall have electro colour coated (anodised) aluminium frame work with glazing. Windows, ventilators & partitions of all buildings shall have electro colour coated (anodised) aluminium frame work with glazing. All doors of toilet, kitchen, pantry & store areas shall be of factory made pre - laminated solid core flush door shutters, as per IS: 2202 (Part-II) with pressed steel door frame. Control room shall have Aluminium glazed door & partitions. All other doors (unless otherwise specified) shall be of steel.</p>		
29.12.03	<p>All steel doors shall consist of double plate flush door shutters. The door shutter shall be 45 mm thick with two outer sheets of 18 G rigidly connected with continuous vertical 20 G stiffeners at the rate of 150 mm centre to centre. Side, top and bottom edges of shutters shall be reinforced by continuous pressed steel channel with minimum 18 G. The door shall be sound deadened by filling the inside void with mineral wool. Doors shall be complete with all hardware and fixtures like door closer, tower bolts, handles, stoppers, aldrops, etc.</p>		
29.12.04	<p>Wherever functionally required, rolling shutters of suitable size approved by the Owner, with suitable operating arrangement manual/ electric shall be provided to facilitate smooth operations. Rolling shutters shall conform to IS: 6248.</p>		
29.12.05	<p>All windows and ventilators at ground floor level shall be provided with suitable anodised aluminum grill.</p>		
29.12.06	<p>Fire proof doors with panic devices shall be provided at all fire exit points as per the requirements. However minimum Fire rating shall be 2 hours. These doors shall be double cover plated type with mineral wool insulation.</p>		
29.12.07	<p>Hollow excluded Section of minimum 2 mm wall thickness as manufactured by INDAL, Jindal, Hindalco or equivalent shall be used for all Aluminium doors, windows, ventilators and Partitions.</p>		
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29.12.08	The doors, Windows & ventilators frame shall be of suitable size & thickness for fixing the glazing. The Glazing thickness shall be minimum 6 mm thk clear toughened glass for all glazed doors, windows, ventilators & partitions. Windows in air conditioned areas shall be provided with 24mm thick hermetically sealed composite double glazing.												
29.12.09	Doors and windows on external walls shall be provided with sunshade over the openings with width 600 mm more than the opening width. The projection from the finished face of the wall for sunshade shall generally be 450 mm over window openings, 750 mm over door openings and 900 over Rolling shutters, or as decided and approved by the Engineer.												
29.12.10	Float glass or flat transparent sheet glass shall conform to IS: 2835.												
29.12.11	All glazing work shall conform to IS: 3548.												
29.12.12	Windows in conveyor gallery shall be provided with welded wire fabric of 1.6mm thick wire as per IS: 4948 and 12mm x 30mm mesh size.												
30.00.00	WATER SUPPLY, DRAINAGE AND SANITATION												
30.01.00	Polyethylene water storage tank conforming to IS: 12701 shall be provided (for the use of toilet, pantry and kitchen) over the roof, with adequate capacity depending on the number of users and 8 hours requirement complete with all fittings including float valve, stop cock etc. The capacity of tank shall be calculated minimum 500 liters, per toilet, pantry and kitchen												
30.02.00	Galvanised MS pipe of medium class conforming to IS: 1239 shall be used for internal piping works for potable water supply.												
30.03.00	Sand C.I. pipes with lead joints conforming to IS: 1729 shall be used for sanitary works above ground level.												
30.04.00	The facilities provided in the toilet block shall depend on the number of users. However, minimum facilities to be provided shall be as stipulated below. IS: 1172 shall be followed for working out the basic requirements for water supply, drainage and sanitation. In addition, IS: 2064 and IS: 2065 shall be also be followed.												
30.05.00	<p>Each toilet block shall have the following minimum facilities. Unless specified all the fittings shall be of chromium plated brass (fancy type).</p> <p>The common toilet area shall have finished floor level at 15 mm below the finished floor level of surrounding area.</p> <p>Following minimum fittings & fixtures together with associated plumbing works shall be provided as specified below.</p> <table border="1"> <thead> <tr> <th>Sl. No.</th> <th>Type of Fitting / Fixtures</th> <th>Gents Toilet</th> </tr> </thead> <tbody> <tr> <td>i)</td> <td>1 no wall mounted coloured glazed vitreous china European water closet with flush valve.</td> <td>1 No.</td> </tr> <tr> <td>ii)</td> <td>Coloured glazed vitreous china flat back lipped urinals with photo voltaic controlled automatic flushing system including all requisite fittings and fixtures</td> <td>1</td> </tr> <tr> <td>iii)</td> <td>Wash Basin (oval shape) with photo voltaic control system and all requisite fittings and fixtures to be fixed on concrete platform finished with 18mm thick first</td> <td>1 No.</td> </tr> </tbody> </table>	Sl. No.	Type of Fitting / Fixtures	Gents Toilet	i)	1 no wall mounted coloured glazed vitreous china European water closet with flush valve.	1 No.	ii)	Coloured glazed vitreous china flat back lipped urinals with photo voltaic controlled automatic flushing system including all requisite fittings and fixtures	1	iii)	Wash Basin (oval shape) with photo voltaic control system and all requisite fittings and fixtures to be fixed on concrete platform finished with 18mm thick first	1 No.
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	<p>One No. drinking water connection with C.P. brass valve for fixing water cooler by Owner.</p> <p>Required plumbing work from Owner's service water terminal point to the service water tank and from tank to the toilet accessories mentioned above.</p> <p>Required plumbing work from Owner's potable water terminal point to the drinking water tank and from tank up to the water coolers.</p> <p>Janitor room. Adequate space shall be provided.</p> <p>Provision for installation of water cooler.</p>																			
30.06.00	All structures, buildings, facilities, liquid storage tanks shall be provided with peripheral surface brick drains of all around periphery and suitably connected to nearest Owner's drain. Overflow and drains from storage tanks shall be laid to and suitably connected to Owner's open surface drains.																			
30.07.00	The sewerage and waste water disposal system shall consist of providing all associated plumbing and underground pipe works together with all fittings and fixtures and inclusive of ancillary works such as connections, manholes and inspection chambers, including connection to Owner's nearest main sewer line or as directed by Engineer. If required, R.C.C. septic tank and soak pit of required capacity shall be provided by the Bidder.																			
30.08.00	<p>Miscellaneous Architectural Items</p> <p>(a.) In all buildings suitable arrangement with provision of floor traps for draining the water collected from leakage, floor washing, fire fighting etc. shall be provided on all floors which shall be connected to rain water down comers.</p> <p>(b.) Wherever required minimum 1000 high hand railing with 32 NB M.S. pipes medium class as per IS : 1239 shall be provided, with toe & knee rail and toe guard plate, around all floor / roof openings, around periphery of Neutralisation Pit, projections of balconies, walkways, platforms, steel staircase etc.</p> <p>(c.) However for RCC staircases in structures, buildings and facilities, railings with 20 mm square MS bar balustrades with suitable anti corrosive paint of approved colour MS flats for knee & toe guard with 50mm Ø NB MS pipe hand rail at top shall be provided.</p> <p>(d.) All air conditioned areas / common corridors shall be provided with false ceiling constructed from 15 mm mineral Fibre Board in tile form of</p>																			
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	<p>600x600mm with supporting system as per manufacture guidelines. 50 mm thick mineral wool insulation (conforming to IS : 8183) shall be provided with as under deck insulation). Additional hangers and height adjustment clips shall be provided for return air grills, light fixtures, Air conditioning ducts etc. Minimum headroom below false ceiling shall be 3.0 m.</p> <p>(e.) Under - deck insulation shall be provided on the ceiling (underside of roof slab) and underside of floor slab of air - conditioned areas depending upon the functional / air - conditioning requirements. The under - deck insulation shall consist of 50 mm thick mineral wool insulation conforming to IS : 8183 backed with 0.05 mm thick aluminium foil & 24 G x 25 mm mesh wire netting and shall be fixed to ceiling with 24 G wire ties and suitable fixing arrangements.</p> <p>(f.) Parapets, chajjas, window / door heads, architectural facias, fins etc., shall be provided with drip course in cement mortar (1 : 3).</p> <p>(g.) 150mm thick fillets at junction of roof slab / chajja slab and parapet / vertical walls shall be provided with cast - in - situ cement concrete 1 : 2 : 4 nominal mix, followed by 12 mm thick cement sand plaster (1 : 4).</p> <p>(h.) Suitable provision shall be made for fixing of ceiling fans in office areas of different structures, buildings and facilities.</p>		
31.00.00	CORROSION PROTECTION		
31.01.00	<p>GENERAL</p> <p>(a) All Steel structures shall be provided with painting as given in the specification. Further, painting system shall also meet the requirements of Corrosivity category C3 (durability High) as per ISO 12944.</p> <p>Painting system for steel surfaces embedded in Concrete is given separately.</p> <p>(b) All Painting shall be done as per technical specification. Painting scheme shall be submitted by the bidder for approval of employer.</p> <p>(c) All steel structures shall be designed by following basic design criteria in ISO 12944 Part 3. However, where it is not feasible to follow the design criteria given in ISO 12944 Part 3 where the steel surface are inaccessible for application of protective coating, corrosion allowance of 1.5 mm shall be kept in thickness(over the design thickness) of structural steel members.</p> <p>d) Painting scheme shall be resubmitted by the Bidder for approval of employer.</p>		
31.02.00	<p>PAINTING OF STEEL SURFACES EMBEDDED IN CONCRETE:</p> <p>a) For the portion of Steel surfaces embedded in Concrete, the surface shall be prepared by Manual Cleaning and provided with Primer Coat of Chlorinated Rubber based Zinc Phosphate Primer of Minimum 50 Micron Dry Film Thickness (DFT).</p> <p>b) All threaded and other surfaces of foundation bolts and its materials, insulation pins, Anchor channels, sleeves, etc. shall be coated with temporary rust preventive fluid and during execution of civil works, the dried film of coating shall be removed using organic solvents.</p>		
31.03.00	PAINTING OF STEEL SURFACES (OTHER THAN THOSE EMBEDDED IN CONCRETE)		
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
31.04.00	<p>a) All steel surfaces shall be provided with two component moisture curing zinc (ethyl) silicate primer coat (having minimum 80% of metallic Zinc content in dry film, solid by volume minimum 60% \pm2%) of minimum 70 micron DFT to be applied over blast cleaned surface conforming to Sa 2 ½ finish of ISO 8501-1 with surface profile 40-60 Micron. The primer coat shall be applied in shop immediately after blast cleaning by airless spray technique. Zinc dust composition and properties shall be Type-II as per ASTM D520-00.</p> <p>b) Primer coat shall be followed with the application of Intermediate coat of two component polyamide cured epoxy with MIO Content (containing lamellar MIO minimum 30% on pigment, solid by volume minimum 80% \pm2%) of minimum 100 micron DFT. This coat shall be applied in shop after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.</p> <p>c) Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% \pm2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This coat shall be applied shop after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer.</p> <p>Notes:</p> <ol style="list-style-type: none"> 1. For Primer, high quality surface preparation is necessary and good amount of moisture is required for proper curing. Below 70 % relative humidity, curing time may go up to 7 days or more. In such a case additional water sprinkling may be ensured for completion of curing. Additionally Inorganic zinc silicate cannot be recoated; even with itself. Typically it should be used when coating bare steel surface for first time. 2. The most frequent problem associated when top coating Primer is bubbling/pin holing especially with non-weathered zinc silicate coatings. To a great extent, this bubbling of finish paint can be eliminated by applying a mist coat of intermediate/topcoat as the first pass of the product, allow the bubbles to subside and then apply a full coat, as required. 3. In case top coating of zinc silicate with epoxy/polyurethane coatings, is expected to be delayed, it is advisable to use a suitable tie coat to avoid formation of white rust. However, if white rust forms then clean the surface with high pressure water, dry and apply the subsequent coats as required. 4. Touch up paintings on damaged areas: Surface preparation by manual tools, wire brush/ emery paper etc. Minimum 6 inches peripheral area, adjoining to damaged area to be covered. If metal surface is exposed, it is to be painted with Zinc rich epoxy (70 micron) or suitable primer with existing paint scheme. If primer is intact, intermediate & top coat to be done with specified DFT in scheme. <p>COATING FOR MILD STEEL PARTS IN CONTACT WITH WATER.</p> <p>a) All mild Steel parts coming in contact with water or water vapour shall be hot dip galvanised. The Minimum Coating of Zinc shall be 610 Gms / 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.</p>		
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	<p>b) The galvanising shall be followed by the application of an etching Primer and dipping in black bitumen in accordance with BS: 3416, unless otherwise specified.</p>		
31.05.00	<p>Gratings</p> <p>All gratings shall be blast cleaned to Sa 2 ½ finish or cleaned by acid pickling as per ISO 8501-1 and shall be hot dip galvanized at the rate of 610 Gms / Sq. M.</p>		
31.06.00	<p>Hand Railings and Ladders</p> <p>All Mild steel handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. as per IS: 4736. However, Stainless steel handrails shall be provided as specified in General Architectural Specification clause 9.0.0.</p>		
31.07.00	<p>Sea Worthiness</p> <p>All Steel Sections and fabricated Structures, which are required to be transported on sea, shall be provided with anti corrosive Paint before shipment to take care of sea worthiness.</p>		
31.08.00	<p>For Reinforced Concrete Work.</p> <p>i) The protection for concrete sub-structure shall be provided based on aggressiveness of the soil, chemical analysis of soil/sub-soil water and presence of harmful chemicals/salts.</p> <p>ii) The protection to super structure shall depend on exposure condition and degree of atmospheric corrosion.</p> <p>This shall require use of dense and durable concrete, control of water cement ratio, increase in clear cover, use of special type of cement and reinforcement, etc., coating of concrete surface, etc.,</p> <p>Bidder shall furnish the details of corrosion protection measures.</p>		
32.00.00	<p>Miscellaneous</p>		
32.01.00	<p>Ordinary form work shall be used in roofs and floor slabs in transfer houses, footings, pedestals, cable trenches, pits etc., Plywood form work shall be used for all over ground exposed work like columns, beams, floors and ceilings in control room and M. C. C. buildings.</p>		
32.02.00	<p>Monorail girders and fixtures shall be provided for monorails at the locations as required and as described elsewhere in these specifications or drawings. Monorail openings in the walls shall be provided with steel frame doors preferably sliding type or otherwise open able inside, access platforms and ladders.</p>		
32.03.00	<p>Steel frame around openings in roof and on external walls for mounting of exhaust fans shall be provided.</p>		
32.04.00	<p>Ready mix non - shrink cementitious grout of reputed manufacturer as approved by the Employer shall be used for grouting of block outs and foundation bolts, underpinning of base plates and machine bases. Crushing strength of grout shall be one grade higher than the foundation concrete. Minimum crushing strength shall be 30 N / mm² unless higher strength requirement is specified by the equipment supplier or the grout manufacturers.</p>		
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32.05.00	The bottom of steel in case of cable / pipe galleries and trestles shall be generally 3m above the ground except for rail / road crossing where it shall be 8m above the rail top / road crest/ground. Further in bunker areas it shall be 8 m above the ground.		
32.06.00	Polysulphide Sealing Compound shall be two-part polysulphide sealant and shall be from approved manufacturer, conforming to IS : 12118. Materials shall consist of polysulphide polymer and a curing agent. Gun grade material shall be used unless otherwise specified. The application of the sealant shall be strictly followed as per manufacturer's guidelines.		
33.00.00	SHOTCRETING		
33.01.00	General Requirements		
33.01.01	Generally, shotcreting shall be done in accordance with IS : 9012.		
33.01.02	Reinforcement for shotcreting shall be as detailed below, unless specified otherwise. Reinforcement in one direction consisting of 6 mm M. S. bars at 750 mm c / c shall be connected to the lugs for fastening of the wire fabric. This shall be used in case of 50 mm or above thick shotcreting.		
33.01.03	Wire fabric conforming to IS : 1566 shall be used as reinforcement and shall consist of wire, 3 mm diameter, spaced 50 mm both ways and shall be electrically cross welded. Wire fabric shall be securely tied to 6 mm bars for 50 mm thickness. Adjacent sheet of wire fabric shall be lapped at least 100 mm and tied.		
33.01.04	Clear cover to reinforcement mesh shall not be less than 15 mm.		
33.01.05	Minimum thickness of shotcreting shall be 50 mm. for abrasion resistant work and 25 mm for ordinary surface protection work.		
33.02.00	Material Generally, the materials shall be in accordance with aggregates specification given hereunder.		
33.02.01	Fine aggregate shall consist of natural sand or crushed stone from a known source and shall be strong, hard, coarse, sharp, chemically inert, clean and free from any coating. It shall be free from clay, coal or coal residue, organic or any other impurities that may impair the strength or durability of the concrete and shall conform to IS : 383.		
33.02.02	Fine aggregate (Sand) shall be well graded and particles shall range in size within the following limits. The Engineer, may approved the use of any other grading as per requirement or as per IS : 9012.		
33.02.03	The fineness modulus shall be preferably between 2.5 and 3.3. Any other value can be used, with prior approval of the Engineer.		
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33.03.00	Application		
33.03.01	After the placement of reinforcement and / or welded mesh and not more than six hours prior to the application of shotcrete, the surface shall be thoroughly cleaned of all loose materials and dirt. The Contractor shall properly prepare the surfaces, reinforcement and / or welded mesh to receive the shotcrete. Cleaned surfaces shall be wetted not more than hour prior to shotcreting.		
33.03.02	The mix as placed on surface shall be one part cement to three parts approved sand by mass. Cement and sand shall be dry mixed; not water shall be added after mixing and before using in the gun. The quantity of water when added shall be only that which is sufficient to hydrate the cement. For average atmospheric conditions, the water cement ratio for shotcrete in place shall be between 0.35 and 0.5 by mass. Suitable admixture shall be used wherever required.		
33.03.03	A uniform pressure of not less than 3 Kg/cm ² at the nozzle shall be maintained. Necessary adjustments shall be made to ensure this pressure, taking into account the length of hose and height of the place to be shotcreted, above location of the machine.		
33.03.04	The application shall proceed in an upward direction. Beams, stiffeners and intermediate walls, if any, shall be wrapped with wire fabric and completely covered with shotcreting. All rebound shall be removed from the area of application as the work progresses and such rebound material shall not be reused.		
33.03.05	As soon as the freshly shotcreted surface shows the first dry patches, a fine spray of water shall be applied to keep too moist. After the surface has hardened, it shall be kept continuously moist for minimum seven days. If there is extreme heat, especially when accompanied by hot winds, the shotcreted surface, immediately upon completion, shall be covered with burlap or similar covering, which must be kept continuously moist for 14 days after shotcreting. The temperature of the lining shall not be permitted to exceed 38°C during placing of concrete.		
34.00.00	<p>VIBRATION ISOLATION SYSTEM</p> <p>These specifications are meant for the design, supply and erection of vibration isolation system for supporting crushers.</p>		
34.01.00	Supporting Arrangement		
34.01.01	<p>For Crushers:</p> <p>The crushers shall be supported on vibration isolation system consisting of steel helical springs and viscous dampers. The supporting arrangement for each crusher shall consist of an R. C. C. deck supported on steel helical spring units and viscous damper units which in turn shall be supported on girders. The girders shall be an integral part of the crusher house building.</p> <p>The part of the structure consisting of the R. C. C. deck, springs and viscous dampers shall hitherto be referred to as “spring supported foundation”. The part of the structure, which is below the spring shall hitherto be called “supporting structure”.</p>		
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34.01.02	<p>The Contractor should do the Engineering / design, supply and erection of vibration isolation system consisting of steel helical spring units and viscous dampers supporting the top deck which in turn would support the crushers. The vibrations isolation system supplied shall be of a proven make. The Contractor or his sub - contractor who designs and supplies the system should have designed, supplied and installed such systems for not less than five machines of speeds and unbalance forces comparable to the machine proposed by the vendor. The vibration isolation systems installed by the contractor or his sub - contractor in such machines should have been working satisfactorily for at least five years.</p>		
34.02.00	<p>Scope of Work</p>		
34.02.01	<p>Scope of work shall include the following :</p> <p>(a.) Engineering</p> <p>(1.) Design of the vibration isolation system using steel helical springs and viscous dampers to support an R. C. C. top deck supporting the equipment. This includes the static and dynamic analysis of the vibration isolation system with the R. C. C. top deck and the equipment.</p> <p>(2.) Structural design of the R. C. C. top deck including preparation of General Arrangement drawings, detailed reinforcement drawings, bar - bending schedules etc.</p> <p>(3.) Calculation of loads on the structure supporting the springs and viscous dampers, their points of application and the stiffness requirements of the supporting structure.</p> <p>(4.) Drawings showing embedments and their locations and details on the R. C. C. top deck.</p> <p>(5.) Drawings showing blockouts, recesses etc. on the top deck.</p> <p>(6.) Design of the supporting structure, including preparation of detailed drawings and bill of materials.</p> <p>(b.) Supply including packing and transportation to site</p> <p>(1.) Steel helical spring units and viscous dampers, including associated auxiliaries for installation of the spring units and dampers like steel shims, adhesive pads etc.</p> <p>(2.) Frame (s) for pre-stressing of spring elements.</p> <p>(3.) Suitable hydraulic jacks system including electric pumps, high pressure tubes etc. required for the installation, alignment etc. of the spring units, two extra hydraulic jacks, one hand operated pump and spares for the hydraulic jack system as required.</p>		
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	<p>(c.) Erection and Commissioning</p> <p>(1.) Complete erection and commissioning of the vibration isolation system including :</p> <p>(2.) Pre-stressing of spring elements, placing of spring elements in position, checking clearances on the shuttering of the R. C. C. top deck, construction of the supporting structure and the R. C. C. top deck, releasing to pre-stress in spring elements and making final adjustments and alignments after machine installation etc.</p> <p>(3.) 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 completion of the work for which these specifications are intended.</p> <p>(4.) This part of the specifications is for vibration isolation system. For the construction of the supporting structure for the crusher and the top deck, the relevant parts of the specification should be referred to.</p> <p>(d.) Documentation</p> <p>(1.) Submission of detailed design calculation, analysis (static and dynamic) and drawings for Employer's acceptance and approval.</p> <p>(2.) Furnishing methodology of providing shuttering and its removal as well as concreting of deck slab, installation of springs and dampers and the sequence of operation.</p> <p>(3.) Furnishing installation and maintenance manual indicating equipment, procedure etc., necessary for installation, maintenance of vibration isolation system.</p> <p>(4.) Furnishing a check list for confirming the readiness of the civil fronts for the installation of vibration isolation system and equipment required at each stage installation.</p> <p>(5.) Bill of materials of various elements such as springs, visco-dampers, with their rating, stiffness etc., included in supply.</p> <p>(6.) Detailed specifications of the vibration isolation system and various items included in the supply and the standard (local or international) to which they conform.</p> <p>(7.) Proposed erection strategy of the entire system.</p> <p>34.03.00 Design Requirements for Crusher Foundation</p> <p>34.03.01 Dynamic Analysis</p> <p>Detailed dynamic analysis shall be done for the top deck together with springs and dampers and the natural frequencies and amplitudes of vibration shall be</p>		
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	<p>determined. A mathematical model of the top deck shall be formulated with three - dimensional beam / plate finite elements for the purpose of analysis with the spring idealised with vertical and horizontal stiffnesses. The mass of the machine together with that of the top deck shall be considered for the analysis.</p> <p>Natural frequencies upto at least 10 % above the operating speed shall be determined and these frequencies shall be checked against the design criteria.</p> <p>Forced response dynamic analysis shall be carried out for the operating condition unbalance forces using a sinusoidal forcing function. Unbalance forces as given by this specifications shall be used for his purpose. The amplitudes shall be checked against the design criteria. The dynamic forces from this analysis shall be used for structural design with a suitable fatigue factor.</p>		
34.03.02	<p>Isolation Efficiency</p> <p>The vibration isolation system shall be designed for about 90 % isolation efficiency.</p>		
34.03.03	<p>De-coupling</p> <p>A ratio of the least 10 (ten) shall be ensured between the stiffness of the supporting structure and the stiffness of the spring system in the vertical direction to achieve de-coupling between the two (the stiffness of the spring system being lower). This ensures that dynamic analysis of the supporting structure need not be carried out.</p>		
34.03.04	<p>Frequency Criteria</p> <p>The frequency criterion has already been laid down implicitly by the isolation efficiency criteria and de-coupling required.</p> <p>The first bending mode frequency of the top deck shall be at least 20 % above the operating speed.</p>		
34.03.05	<p>Unbalance Forces for Crushers</p> <p>Unbalance forces arising out of all the following cases shall be considered for checking the design and amplitudes.</p> <p>(a.) Balance quality grade Q 40 as per VDI 2060 - 1966.</p> <p>(b.) One hammer broken condition. The missing hammer shall be assumed to be closest to the crusher non - drive end of the crusher.</p> <p>(c.) Three hammers broken condition. All the three hammers broken shall be assumed to be from the same suspension bar and located at the non - drive end of the crusher.</p>		
34.03.06	<p>Amplitude Criteria for Crushers</p> <p>The calculated amplitudes (mean to peak values) shall not exceed following limits under the specified conditions.</p>		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 62 OF 69</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>1) Operating speed of 750 RPM</p> <p>(a.) 150 microns for an unbalance force arising out of balance quality grade Q 40 as per VDI 2060 - 1966.</p> <p>(b.) 300 microns in case of a one hammer broken condition.</p> <p>(c.) Amplitudes need not be checked for a three hammer broken condition.</p> <p>2) Operating speed of 450 RPM</p> <p>(a.) 200 microns for an imbalance force arising out of balance quality grade Q-40 as per VDI -2060-1966.</p> <p>(b.) 400 microns in case of a one hammers broken condition.</p> <p>(c.) Amplitude need not be checked for a three hammer broken condition.</p> <p>For intermediate operating speed between 450 to 750 RPM the amplitude limits can be linearly interpolated.</p> <p>The amplitude limits mentioned above are in both vertical and horizontal directions. The amplitudes shall be calculated at critical points on the top surface of the R. C. C. deck. The amplitudes shall be checked for the most unfavorable superposition of modes in any direction. However, phase difference between the maximum amplitude occurring in different directions due to the rotating vector may be considered while superimposing the modes.</p> <p>34.03.07 Unbalance force and Amplitude Criteria</p> <p>The unbalance forces and amplitude criteria shall be as per the equipment manufacturer's recommendations or as per VDI 2060/ VDI 2056, whichever is more stringent.</p> <p>34.03.08 Transient Resonance</p> <p>Transient resonance, which may occur during the start - up or coasting down condition of the crusher, shall be checked, and the amplitudes in such a condition should not exceed one - and - half times those at operating speed for each design condition.</p> <p>34.04.00 Strength Criteria</p> <p>The following criteria shall apply for the design of top deck :</p> <p>(a.) Dead loads, live loads, Seismic loads and dynamic loads shall be considered for the design. The most unfavorable combination shall considered for design.</p> <p>(b.) Seismic loads shall be assumed to act together with dynamic loads for a one millimeter eccentricity in the rotor. However, seismic loads and dynamic loads arising out of hammer breakage need not be considered together</p>		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 63 OF 69</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>(c.) Fatigue shall be considered while designing for dynamic forces. A fatigue factor of 2.0 shall be used on all dynamic forces to arrive at the equivalent static force for the purpose of design.</p> <p>(d.) Working stress method shall be used for the design of R. C. C. deck. In survival condition, 10 % overstressing may be permitted.</p> <p>(e.) The R. C. C. top deck shall be at least of M35 grade of concrete as per IS : 456.</p> <p>(f.) Fatigue need not be considered for the three hammer broken condition.</p> <p>(g.) For calculating unbalance forces, the heaviest hammer (plain or toothed) shall be considered.</p>		
34.05.00	<p>Approval of Designs and Drawings</p> <p>All design calculation, drawings and documents shall be in English. All design calculations and drawings shall be submitted to Employer for approval. However, approval of such designs and drawings shall not relieve the contractor of his responsibility regarding the adequacy of the foundation to carry the design forces.</p>		
34.06.00	<p>Standards</p> <p>Latest revisions of the following Codes shall be used for the design of the crusher foundations.</p> <p>(a.) IS : 456 Code of Practice for Plain and Reinforced concrete.</p> <p>(b.) IS : 2974 (Part IV) Code of Practice for Design and Construction of Machine Foundations (Part IV) for rotary type machine of low frequency.</p> <p>(c.) IS : 1893 (Criteria for Earthquake Resistant Design of Structures).</p> <p>(d.) DIN 4024 Machine Foundations :</p> <p>Flexible supporting structures for machines with rotating masses.</p> <p>(e.) DIN 2089</p> <p>Helical Compression Springs out of round wire and rod; calculation and Design.</p> <p>(f.) DIN 2096</p> <p>Helical Compression Springs out of round wire and rod; quality requirements for hot formed compression springs.</p> <p>(g.) VDI 2056 - Criteria for assessing mechanical vibrations of machines.</p> <p>(h.) VDI 2060 - Criteria for assessing the state of balance of rotating rigid bodies. not be permitted to exceed 38°C during placing and curing</p>		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 64 OF 69</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
35.00.00	<p>Packaging and Transportation.</p> <p>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 should be taken into account. The contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing.</p>		
36.00.00	<p>Plant Life</p> <p>The plant shall be designed for a minimum operating life of 30 years under the conditions of operation. Assurance shall be given that plant components are adequate for this lifetime. If there are any exceptional items of the plant on which an assurance of meeting this clause cannot be given, life of such components and the difficulties associated with them shall be stated.</p>		
37.00.00	<p>PTFE (Poly Tetra Fluoroethylene) Bearing</p> <p>The bearing shall be of reputed make and manufacturer as approved by the Engineer, for required vertical load and end displacement/rotation. PTFE bearing shall be sliding against highly polished stainless steel and the coefficient of friction between them shall be less than 0.06 at 55 kg/sq.cm. In order to prevent cold flow in PTFE surface it shall be rigidly bonded by a special high temperature resistance adhesive to the stainless steel substrata. The stainless steel surface that slides against the PTFE is mirror polished. The stainless steel shall be bonded to the top plate by special high strength adhesive. The thickness of stainless steel plate shall be between 1.0 mm to 1.5 mm.</p>		
38.00.00	<p>TESTS FOR MATERIAL / WORKMANSHIP</p> <p>All tests required for all materials, quality of workmanship or any other tests as desired by the Engineer shall be at contractor's cost.</p>		
39.00.00	<p>MATERIALS</p>		
39.01.00	<p>For Civil, Structural and Architectural works</p> <p>Employer will not supply any material. All materials including cement, reinforcement steel and structural steel, whatsoever required for execution and completion of the entire scope of work covered under this specification shall be arranged by the contractor at his own cost. All materials procured by the contractor shall meet the quality requirements specified in this specification.</p> <p>The contractor shall keep sufficient stock of cement and steel at site at any point of time when the work is in progress excluding what has been already incorporated in the works, so that any disruption / delay in availability of these materials during procurement will not affect the progress of work at site. The minimum quantity of such materials in stock at site shall not be less than the Requirement of one (1) month in case of Cement and Requirement of two (2) Consecutive months in case of Steel.</p>		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 65 OF 69</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
39.02.00	<p>Structural steel</p> <p>Structural Steel (including embedded Steel) shall be straight, sound, free from twists, cracks, flaw, laminations and all other defects. Structural steel shall comprise of mild steel, medium strength steel and high tensile steel as specified below.</p>		
39.02.01	<p>Mild Steel</p> <p>a) Rolled sections shall be of grade designation E250, Quality A/BR, Semi-killed/killed conforming to IS 2062. All steel plates shall be of Grade designation E250, Quality BR (fully killed), conforming to IS 2062 and shall be tested for impact resistance at room temperature. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalised and shall also be 100% ultrasonically tested as per ASTM –A578 level B-S2.</p> <p>b) Pipes shall conform to IS 1161.</p> <p>c) Hollow (square and rectangular) steel sections shall be hot formed conforming to IS: 4923 and shall be of minimum Grade Yst 240.</p> <p>d) Chequered plate shall conform to IS 3502 and shall be minimum 6 mm thick excluding projection. Steel for chequered plate shall conform to grade E250A semi killed of IS: 2062 or equivalent grade conforming to ASTM & BS standards only.</p>		
39.02.02	<p>Medium and High Tensile Steel</p> <p>Rolled Sections and plates shall be of grade designation E350 or higher, Quality B0 (Fully killed), conforming to IS 2062. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalised and shall also be 100% ultrasonically tested as per ASTM –A578 level B-S2.</p>		
39.03.00	<p>Fly ash based Portland pozzolona cement conforming to IS: 1489 Part - I shall preferably be used. However, the contractor may use other types of cements conforming to IS: 269, IS: 8112, IS: 12269, & IS: 455.</p>		
39.04.00	<p>Reinforcement steel shall conform to:</p> <p>a) Mild steel bars of grade I of IS: 432 Part – I or grade A of IS: 2062.</p> <p>b) High yield strength deformed TMT steel bars of grade Fe-500 having minimum elongation of 14.5 % or Fe-500D, and conforming to other requirements of IS 1786.</p>		
40.00.00	<p>CODES AND STANDARDS</p> <p>All standards, specifications, acts and code of practice referred to herein shall be the latest editions including all applicable official amendments and revisions. Other Indian, foreign Codes and Standards not listed here but referred to elsewhere within this specification shall also be deemed to be part of this list.</p> <p>In case of conflict between this specification and those (IS standards, codes etc.) referred to herein, the former shall prevail.</p>		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 66 OF 69</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>Some of the relevant Indian standards, Acts and Codes applicable to this section of the specification are listed below</p> <p>IS : 383 Specification for coarse and fine aggregates from natural sources for Concrete.</p> <p>IS : 432 Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.</p> <p>IS : 456 Code of practice for plain and reinforced concrete.</p> <p>IS : 458 Specification for concrete pipes.</p> <p>IS : 516 Method of test for strength of concrete.</p> <p>IS : 800 Code of practice for use of structural steel in general building construction.</p> <p>IS : 814 Specification for covered electrodes for metal arc welding for weld steel.</p> <p>IS : 816 Code of practice for use of metal arc welding for general construction.</p> <p>IS : 817 Code of practice for training and testing of metal arc welders.</p> <p>IS : 875 (Pt. I to V) Code of practice for design loads other than earthquake) for buildings and structures.</p> <p>IS : 1038 Steel doors, windows and ventilators.</p> <p>IS : 1172 Basic requirements for water supply, drainage and sanitation.</p> <p>IS : 1361 Steel windows for industrial buildings.</p> <p>IS : 1786 Specification for high strength deformed steel bars and wires for concrete reinforcement.</p> <p>IS : 1892 Code of practice for subsurface investigation for foundation.</p> <p>IS : 1893 Criteria for earthquake resistant design of structures.</p> <p>IS : 1904 Code of practice for design and construction of foundations in soils; general requirements.</p> <p>IS : 1905 Code of practice for structural safety of buildings - Masonry walls.</p> <p>IS : 1948 Specification for aluminium doors, windows and ventilators.</p> <p>IS : 2062 Steel for general structural purposes.</p>		
<p align="center">LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION-VI, PART-B</p> <p align="center">BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p align="center">SUB-SECTION-IV-D CIVIL WORKS</p>	<p align="center">PAGE 67 OF 69</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>IS : 2131 Method of standard penetration test for soils.</p> <p>IS : 2212 Code of practice for brickwork.</p> <p>IS : 2645 Specification for Integral cement water proofing compounds.</p> <p>IS:2720 (Part-II, IV TO VIII, XIV, XXI, XXIII, XXIV, XXVII TO XXIX, XL) Methods of test for soils - determination for water content etc code of practice for earth work on canals.</p> <p>IS : 2911 Code of practice for design and construction of pile foundations.</p> <p>(Part-1/Sec.1) Driven cast in situ concrete piles.</p> <p>(Part-1/Sec.2) Bored cast-in-situ concrete piles.</p> <p>(Part-IV) Load test on piles.</p> <p>IS : 2974 (Part - I TO V) Code of practice for design and construction of machine foundations.</p> <p>IS : 3370 (Part I to IV) Code of practice for concrete structures for the storage of liquids.</p> <p>IS : 3658 Code of practice for liquid penetrant flaw detection.</p> <p>IS : 3664 Code of practice for ultra sonic testing by pulse echo method.</p> <p>IS : 4326 Code of practice for earthquake resistant design and construction of buildings.</p> <p>IS : 4990 Specification for plywood for concrete shuttering work.</p> <p>IS : 5624 Specification for foundation bolts.</p> <p>IS : 7215 Tolerances for fabrication steel structures.</p> <p>IS : 8112 Specification for 43 grade Ordinary Portland Cement.</p> <p>IS : 9103 Specification for admixtures for concrete.</p> <p>IS : 9595 Code of procedure of manual metal arc welding of mild steel.</p> <p>IS : 10262 Recommended guidelines for concrete mix design.</p> <p>IS : 13311 Method of non - destructive testing of concrete.</p> <p>IS : 13755 Dust pressed ceramic tiles with water absorption of 3%, E6% (Group B11a)</p>		
<p align="center">LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION-VI, PART-B</p> <p align="center">BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p align="center">SUB-SECTION-IV-D CIVIL WORKS</p>	<p align="center">PAGE 68 OF 69</p>


CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>ASTM 898 -89 Standard guide for use of high solid content, cold liquid-applied elastomeric water proofing membrane for use with separate wearing course.</p> <p>AS/NZS 2728 Pre finished / pre painted sheet metal product for interior / exterior building applications – Performance requirements.</p> <p>AS : 1365 Standards for steel manufacturing.</p> <p>AS : 1397 A steel sheet & strip – hot – dipped-zinc-coated or Aluminium-Zinc coated.</p> <p>AS : 3566 Self drilling screws for building and construction industry.</p> <p>IRC : 37 Guidelines for the design of flexible pavements.</p> <p>- Manual on sewerage and sewage treatment (Published by CPH & EEO) As updated.</p> <p>Indian Explosives Act. 1940 as updated.</p> <p>For “Foundation System and Geotechnical Data” refer “Project Information section” of Technical specification.</p>		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 69 OF 69</p>


SUB-SECTION-II-A10

PROJECT INFORMATION- BARH-I 3X660 MW

LOT-IA PROJECTS
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI
BID DOCUMENT NO.: CS-0011-109(1A)-2

CLAUSE NO.	Project Information 		
1.00.00	BACKGROUND Barh Super Thermal Power Project, Stage-I (3x660 MW) & Stage-II (2 x 660MW) coal based is being set up by NTPC near Barh town in Patna district of Bihar.		
1.01.00	LOCATION AND APPROACH The proposed power station is located at the latitude and longitude of 25 deg 29' 10" (N) and 85 deg. 45' 40" (E) respectively. The plant site is situated between National Highway (NH-31) and Patna-Mokama main railway line. The ash disposal area is located on the south of the railway line. Barh, the nearest town, is about 4.0 kms away from the project site. The nearest rail head Barh Railway Station on Patna - Mokama Section of main trunk route, is approximately 3.0 km away from the project site. The nearest airport at Patna is located at a distance of approximately 75 kms from the project site. The Vicinity Plan of the project is enclosed at drawing section at Annexure-I. The nearest airport at Patna is located at a distance of approximately 75 kms. from the project site. The Vicinity Plan of the project is enclosed at ANNEXURE-I. Further to the information's given in this sub-section, Bidders are also advised visit the project site and collect data on local site conditions.		
1.02.00	LAND About 3200 acres of land is acquired/under acquisition under Stage-I of the project. No additional land is envisaged to be acquired under Stage-II. The plant, ash disposal and township shall be accommodated within the land acquired/under acquisition under Stage-I.		
1.03.00	WATER The project site is located near the river Ganges. The make up water requirement for the expansion project is approximately 71 cusecs and the same is proposed to be drawn from river Ganges near village Nawada, at a distance of 2.0 kms. Make-up water pump house is already constructed at the river end in Stage-I with space provision for Stage-II pumps and the plant water requirement will be pumped to the plant through makeup water piping.		
1.04.00	COAL a) Coal requirement for the project shall be met from Amrapali block of North Karanpura Coalfields of CCL. b) The coal quality parameters and Fuel oil characteristics are attached below.		
1.05.00	RAILWAY SIDING For brining the equipment and material to the power house through rail, a permanent railway siding is proposed to be constructed near the project site to provide rail access to unloading bays and transformer yard.		
1.06.00	Steam Generator and ESP data: refer Table-6.		
2.00.00	NOT USED		
LOT-IA PROJECTS FLUE GAS DESHULPURISATION (FGD) PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC. NO.: CS-0011-109 (1A)-2	SUB SECTION II-A10 PROJECT INFORMATION BARH STPP STAGE-I (3X660 MW)	PAGE 1 OF 30

CLAUSE NO.	Project Information 		
3.00.00	<p>Capacity</p> <p>Stage-I : 3 x 660 MW - Under Construction -Present proposal</p> <p>Stage-II : 2 x 660 MW - Under Operation</p>		
4.00.00	<p>METEOROLOGICAL DATA</p> <p>The meteorological data from the nearest observatory at Patna is placed as ANNEXURE-II.</p>		
5.00.00	<p>CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT</p> <p>All structures and equipment shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS:1893 (Part 1 to Part 4). Pending finalization of Part 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for embankments.</p> <p>A site specific seismic study has been conducted for the project site. The peak ground horizontal acceleration for the project site, the site specific acceleration spectral coefficients (in units of gravity acceleration 'g') in the horizontal direction for the various damping values and the multiplying factor (to be used over the spectral coefficients) for evaluating the design acceleration spectra are as given at Appendix-I.</p> <p>Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values.</p> <p>The site specific design acceleration spectra shall be used in place of the response acceleration spectra, given at figure-2 in IS:1893 (Part 1) and Annex B of IS:1893 (Part 4). The site specific acceleration spectra along with multiplying factors specified in Appendix-I includes the effect of the seismic environment of the site, the importance factor related to the structures and the response reduction factor. Hence, the design spectra do not require any further consideration of the zone factor (Z), the importance factor (I) and response reduction factor (R) as used in the IS:1893 (Part 1 to Part 4).</p>		
<p>LOT-IA PROJECTS FLUE GAS DESHULPURISATION (FGD) PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC. NO.: CS-0011-109 (1A)-2</p>	<p>SUB SECTION II-A10 PROJECT INFORMATION BARH STPP STAGE-I (3X660 MW)</p>	<p>PAGE 2 OF 30</p>




CLAUSE NO.


Project Information

Damping in Structures

The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:

a)	Steel structures	:	2%
b)	Reinforced Concrete structures	:	5%
c)	Reinforced Concrete Stacks	:	3%
d)	Steel stacks	:	2%

CLAUSE NO.	Project Information 		
	<p style="text-align: right;">1.01.00</p> <p>Method of Analysis</p> <p>Since most structures in a power plant are irregular in shape and have irregular distribution of mass and stiffness, dynamic analysis for obtaining the design seismic forces shall be carried out using the response spectrum method. The number of vibration modes used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass and shall also meet requirements of IS:1893 (Part 1). Modal combination of the peak response quantities shall be performed as per Complete Quadratic Combination (CQC) method or by an acceptable alternative as per IS:1893 (Part 1).</p> <p>In general, seismic analysis shall be performed for the three orthogonal (two principal horizontal and one vertical) components of earthquake motion. The seismic response from the three components shall be combined as specified in IS:1893 (Part 1).</p> <p>The spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the structure falls to the left of the peak in the spectral acceleration curve.</p> <p>For buildings, if the design base shear (V_B) obtained from modal combination is less than the base shear (\bar{V}_B) computed using the approximate fundamental period (T_a) given in IS:1893:Part 1 and using site specific acceleration spectra with appropriate multiplying factor, the response quantities (e.g. member forces, displacements, storey forces, storey shears and base reactions) shall be enhanced in the ratio of \bar{V}_B / V_B. However, no reduction is permitted if \bar{V}_B is less than V_B.</p> <p>For regular buildings less than 12m in height, design seismic base shear and its distribution to different floor levels along the height of the building may be carried out as specified under clause 7.5, 7.6 & 7.7 of IS:1893 (Part 1) and using site specific design acceleration spectra. The design horizontal acceleration spectrum value (A_h) shall be computed for the fundamental natural period as per clause 7.6 of IS:1893 (Part 1) using site specific spectral acceleration coefficients with appropriate multiplying factor given in Appendix-I.</p> <p>Design/Detailing for Ductility for Structures</p> <p>The site specific design acceleration spectra is a reduced spectra and has an in-built allowance for ductility. Structures shall be engineered and detailed in accordance with relevant Indian/International standards to achieve ductility.</p>		
<p style="text-align: center;">LOT-IA PROJECTS FLUE GAS DESHULPURISATION (FGD) PACKAGE</p>	<p style="text-align: center;">TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC. NO.: CS-0011-109 (1A)-2</p>	<p style="text-align: center;">SUB SECTION II-A10 PROJECT INFORMATION BARH STPP STAGE-I (3X660 MW)</p>	<p style="text-align: center;">PAGE 4 OF 30</p>

CLAUSE NO.	Project Information 		
	<p style="text-align: right;">APPENDIX – I (Contd.)</p> <p><u>SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT</u></p> <p>The various site specific seismic parameters for the project site shall be as follows:</p> <ol style="list-style-type: none"> 1) Peak ground horizontal acceleration : 0.24g 2) Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra <ol style="list-style-type: none"> a) for moment resisting steel frames designed and detailed as per IS:800 : 0.072 b) for braced steel frames designed and detailed as per IS:800 : 0.054 c) for moment resisting RC frames designed and detailed as per IS:456 and IS:13920 : 0.043 d) for RCC Chimney : 0.144 e) for Liquid retaining tanks : 0.087 f) for Steel chimney, Absorber tower : 0.11 g) for design of structures not covered under 2 (a) to 2 (f) above and under 3 below : 0.072 3) Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted : 0.144 <p>Note: g = Acceleration due to gravity</p> <p>The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages.</p>		
<p style="text-align: center;">LOT-IA PROJECTS FLUE GAS DESHULPURISATION (FGD) PACKAGE</p>	<p style="text-align: center;">TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC. NO.: CS-0011-109 (1A)-2</p>	<p style="text-align: center;">SUB SECTION II-A10 PROJECT INFORMATION BARH STPP STAGE-I (3X660 MW)</p>	<p style="text-align: center;">PAGE 5 OF 30</p>

CLAUSE NO.

Project Information



APPENDIX – I (Contd.)

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
In units of 'g' for BARH STPP

Period (Sec)	Damping Factor (as a percentage of critical damping)					
	0.80%	1%	1.60%	2%	3%	5%
0.000	1.000	1.000	1.000	1.000	1.000	1.000
0.030	1.000	1.000	1.000	1.000	1.000	1.000
0.040	1.373	1.361	1.327	1.310	1.275	1.212
0.050	1.755	1.728	1.653	1.615	1.539	1.406
0.058	2.066	2.026	1.913	1.856	1.744	1.552
0.059	2.106	2.063	1.945	1.886	1.770	1.570
0.060	2.145	2.101	1.978	1.916	1.795	1.588
0.061	2.184	2.138	2.010	1.946	1.820	1.605
0.062	2.224	2.176	2.043	1.976	1.845	1.623
0.065	2.343	2.289	2.140	2.065	1.920	1.675
0.070	2.542	2.478	2.302	2.214	2.044	1.760
0.071	2.582	2.516	2.334	2.244	2.069	1.776
0.074	2.702	2.630	2.431	2.332	2.143	1.826
0.084	3.107	3.012	2.754	2.627	2.385	1.987
0.094	3.516	3.398	3.077	2.919	2.622	2.142
0.104	3.930	3.787	3.398	3.210	2.856	2.292
0.114	4.349	4.178	3.720	3.498	3.086	2.436
0.120	4.608	4.414	3.912	3.671	3.222	2.521
0.121	4.608	4.445	3.944	3.699	3.245	2.535
0.123	4.608	4.445	4.018	3.757	3.290	2.563
0.124	4.608	4.445	4.018	3.798	3.313	2.577
0.126	4.608	4.445	4.018	3.798	3.368	2.604
0.133	4.608	4.445	4.018	3.798	3.368	2.708
0.601	4.608	4.445	4.018	3.798	3.368	2.708
0.604	4.586	4.445	4.018	3.798	3.368	2.708
0.617	4.489	4.348	4.018	3.798	3.368	2.708
0.622	4.453	4.314	3.982	3.798	3.368	2.708
0.632	4.383	4.245	3.919	3.739	3.368	2.708
0.667	4.153	4.022	3.714	3.543	3.192	2.708
0.767	3.611	3.498	3.229	3.081	2.776	2.356
0.867	3.195	3.095	2.857	2.725	2.456	2.084
0.967	2.865	2.775	2.562	2.444	2.202	1.869
1.067	2.596	2.515	2.321	2.215	1.995	1.694
1.167	2.374	2.299	2.123	2.025	1.824	1.548
1.267	2.186	2.118	1.955	1.865	1.680	1.426
1.367	2.026	1.963	1.812	1.729	1.557	1.322
1.467	1.888	1.829	1.688	1.611	1.451	1.232
1.567	1.768	1.712	1.581	1.508	1.359	1.153
1.667	1.662	1.609	1.486	1.418	1.277	1.084


CLAUSE NO.

Project Information



HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
In units of 'g' for BARH STPP

Period (Sec)	Damping Factor (as a percentage of critical damping)					
	0.80%	1%	1.60%	2%	3%	5%
1.767	1.568	1.513	1.402	1.337	1.205	1.023
1.867	1.484	1.437	1.327	1.266	1.140	0.968
1.967	1.408	1.364	1.259	1.201	1.082	0.919
2.067	1.340	1.293	1.198	1.143	1.030	0.874
2.167	1.278	1.233	1.143	1.090	0.982	0.834
2.267	1.222	1.184	1.093	1.042	0.939	0.797
2.367	1.170	1.134	1.046	0.998	0.899	0.763
2.467	1.123	1.083	1.004	0.958	0.863	0.732
2.567	1.079	1.045	0.965	0.921	0.829	0.704
2.667	1.039	1.006	0.929	0.886	0.798	0.678
2.767	1.001	0.970	0.895	0.854	0.769	0.653
2.867	0.966	0.936	0.864	0.824	0.743	0.630
2.967	0.934	0.904	0.835	0.796	0.718	0.609
3.067	0.903	0.875	0.808	0.770	0.694	0.589
3.167	0.875	0.847	0.782	0.746	0.672	0.571
3.267	0.848	0.821	0.758	0.723	0.652	0.553
3.367	0.823	0.797	0.736	0.702	0.632	0.537
3.467	0.799	0.774	0.714	0.682	0.614	0.521
3.544	0.782	0.757	0.699	0.667	0.601	0.510
3.559	0.778	0.754	0.696	0.664	0.596	0.508
3.666	0.756	0.732	0.676	0.645	0.561	0.479
3.765	0.736	0.713	0.658	0.611	0.532	0.454
3.865	0.717	0.694	0.624	0.580	0.505	0.431
3.965	0.699	0.677	0.593	0.551	0.480	0.409
4.017	0.690	0.663	0.578	0.537	0.468	0.399

CLAUSE NO.	Project Information																			
6.00.00	<p>CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT</p> <p>All structures shall be designed for wind forces in accordance with IS:875 (Part-3) and as specified in this document. See Annexure – B for site specific information.</p> <p>Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind Speed method as defined in the standard.</p> <p>Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor Method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method.</p> <p>Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than “5” and/or if the fundamental frequency of the structure is less than 1 Hz.</p> <p>Susceptibility of structures to across-wind forces, galloping, flutter, ovalling etc. should be examined and designed/detailed accordingly following the recommendations of IS:875(Part-3) and other relevant Indian standards.</p> <p>It should be estimated if size and relative position of other structures are likely to enhance the wind loading on the structure under consideration. Enhancement factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects.</p> <p>Damping in Structures</p> <p>The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:</p> <table border="1"> <tbody> <tr> <td>a)</td> <td>Welded steel structures</td> <td>:</td> <td>1.0%</td> </tr> <tr> <td>b)</td> <td>Bolted steel structures</td> <td>:</td> <td>2.0%</td> </tr> <tr> <td>c)</td> <td>Reinforced concrete structures</td> <td>:</td> <td>1.6%</td> </tr> <tr> <td>d)</td> <td>Steel stacks</td> <td></td> <td>As per IS:6533 & CICIND Model Code whichever is more critical.</td> </tr> </tbody> </table>			a)	Welded steel structures	:	1.0%	b)	Bolted steel structures	:	2.0%	c)	Reinforced concrete structures	:	1.6%	d)	Steel stacks		As per IS:6533 & CICIND Model Code whichever is more critical.	
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<p>LOT-IA PROJECTS FLUE GAS DESHULPURISATION (FGD) PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC. NO.: CS-0011-109 (1A)-2</p>	<p>SUB SECTION II-A10 PROJECT INFORMATION BARH STPP STAGE-I (3X660 MW)</p>	<p>PAGE 8 OF 30</p>																	




CLAUSE NO.

Project Information

ANNEXURE-B**SITE SPECIFIC DESIGN PARAMETERS**

The various design parameters, as defined in IS: 875 (Part-3), to be adopted for the project site shall be as follows:

a)	The basic wind speed " V_b " at tenmetres above the mean ground level	:	47 metres/second
b)	The risk coefficient " K_1 "	:	1.07
c)	Category of terrain	:	Category-2

CLAUSE NO.	Project Information							
7.00.00	SOIL DATA AND FOUNDATION SYSTEM							
7.01.01	Employer has carried out geotechnical investigation in the areas near to this package. Logs of representative boreholes to be used for bidder's information in the vicinity of proposed area are enclosed with this Annexure-II. The bidder is required to carry out geotechnical investigation as per the clause no. 7.07.00 and ascertain the pile capacity and bearing capacity. The onus of correct assessment / interpretation and understanding of the existing subsoil condition / data is on the Bidder. Ground water table is encountered at a depth of about 0 to 1.0m below natural ground level (NGL) at the time of investigation. Fluctuation may occur in ground water table due to seasonal variation.							
7.01.00	Finished Ground Level (FGL) generally corresponds to RL 46.20 within the plant area as shown in General Layout Plan (GLP). Controlled filling of thickness 3.5 to 4.0 m with soil has been done over Natural Ground Level (NGL) to achieve the FGL as indicated above.							
7.02.00	For excavation depth upto 6.0 m from FGL, contractor shall make arrangements like shoring, strutting or any other method duly approved by the Engineer to retain the sides of excavated area. Contractor may also use sheet piling to protect the sides of excavated area if he so desires. For excavation 6 metres below FGL, sheet piling shall be provided. The design of the sheet pile shall be done by Contractor as per relevant IS codes. The Contractor shall submit the design of sheet piling for Engineers information.							
7.03.00	The natural ground level is varying as per enclosed contour/spot level drawing.							
a)	<p>The foundation system to be adopted for different structures shall be as given in Table – 1 below</p> <p style="text-align: center;">Table – 1: Net Allowable Bearing Pressure</p> <table border="1"> <thead> <tr> <th>STRUCTURE</th> <th>TYPE OF FOUNDATION TO BE ADOPTED</th> </tr> </thead> <tbody> <tr> <td>FGD and related structures</td> <td>Open/Piles</td> </tr> </tbody> </table>				STRUCTURE	TYPE OF FOUNDATION TO BE ADOPTED	FGD and related structures	Open/Piles
STRUCTURE	TYPE OF FOUNDATION TO BE ADOPTED							
FGD and related structures	Open/Piles							
b)	During design the Allowable Bearing Pressure shall be as furnished in Table-2. Bidder is required to carry out geotechnical investigation in this area. The allowable bearing pressure shall be adopted after approval of geotechnical investigation report by owner. However, the maximum allowable bearing pressure shall be as per the approved geotechnical report and shall be limited to the values as furnished in Table-2.							
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC. NO.: CS-0011-109 (1A)-2	SUB SECTION II-A10 PROJECT INFORMATION BARH STPP STAGE-I (3X660 MW)	PAGE 10 OF 30					

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Project Information

Table – 2: Net Allowable Bearing Pressure

Structure	Founding Level in RL	1.02.00 Net Allowable Bearing Pressure		
		1.03.00 T/m ²		Rafts (width > 6m) for 75mm settlement
		Isolated / Strip		
		width upto 6 m for 25mm settlement	Width upto 6m for 40mm settlement	
FGD and related structures	1.5 m below NGL	5.0	5.5	7.0
	2.5 m below NGL	6.0	7.0	8.0

The net allowable bearing pressure higher than above mentioned values shall not be permitted. At intermediate levels the bearing capacity shall be same as the net allowable bearing pressure corresponding to the immediate shallower level mentioned above.

c) Permissible Settlement of Foundations:

For open foundations, the total permissible settlement and differential settlement shall be governed by IS: 1904 and from functional requirements whichever is more stringent. However, total settlement shall be restricted to the following:

Isolated, Strip & Raft (Mill foundations/machine foundation)	25 mm
Isolated & Strip (Other than Mill foundations/machine foundation)	40 mm
Raft (widths greater than 6 m) (Other than Mill foundations/machine foundation)	75 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 after review in consultation with Engineer.



CLAUSE NO.	Project Information					
d)	The diameter of pile, minimum length and maximum allowable capacity of piles shall be as given below:					
	Area/ Location	Pile Diameter (mm)	Minimum Length of Bored Pile Below Cut-off Level (m)	Safe Load Capacity in		
				Vertical Comp. (MT)	Pullout (MT)	Lateral (MT)
	FGD and related	600	26.0	100.0	35.0	5.0
	structures	600*	27.0*	100	35.0	5.0
	Cut off Level (COL) is assumed at 3.0 m below FGL (RL (+) 46.2m). If the COL is shallower than the assumed COL, then the length of the pile shall be increased accordingly.					
	* Cut off Level (COL) is assumed at 1.5 m below FGL (RL (+) 46.2m). If the COL is shallower than the assumed COL, then the length of the pile shall be increased accordingly.					
e)	The criteria for Pile Termination (founding level) shall be as given below: The termination level of the pile shall be decided based on the following criterion					
	i) Minimum length of the pile below COL (cut off level) shall be as specified above					
	ii) The minimum pile length for each group of piles shall be determined based on the nearest borelog. The SPT N value at pile termination level shall not be less than 40. For pile termination, SPT 'N' values shall be used from the nearby borelog data. The boreholes are in the bidder's scope and shall be conducted as per the enclosed scheme.					
	iii) However, in no case the length of pile shall be less than the minimum length determined as in (i) or (ii) above whichever is longer, for that pile group.					
f)	Special Requirements: 1) Chemicals in ground water and subsoil, as observed during investigation are:					
LOT-IA PROJECTS FLUE GAS DESHULPURISATION (FGD) PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-A BID DOC. NO.: CS-0011-109 (1A)-2	SUB SECTION II-A10 PROJECT INFORMATION BARH STPP STAGE-I (3X660 MW)	PAGE 12 OF 30			



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Project Information

Chemical	SO ₃	Chlorides	pH
Ground Water	20 - 56 ppm	34 – 368 ppm	6.8 - 7.2
Sub-soil	0.024 - 0.04 %	0.01 - 0.03 %	6.1 - 7.2

2) In view of the above, the following shall be adopted.

Cement Type	As specified elsewhere in the specifications
Concrete Grade	M25 for piles Minimum cement content for piles shall be 400 kg/cum of concrete. Concrete shall be dense and durable. Admixtures in concrete are not permitted
Type of Reinforcement	As specified elsewhere in the specifications
Cover to Reinforcement	As specified elsewhere in the specifications



CLAUSE NO.	Project Information																																																																							
<p>GEO TECH CONSULTANTS PVT. LTD. NEW DELHI</p> <p>BORING METHOD: Shell and Auger NAME OF WORK : Detailed Geotechnical Investigation for Plant and Township Area for Barh Super Thermal Power Project in Bihar.</p>	<p>PROJECT NO : 2507 BORING SIZE : 150 MM CU-ORDINATES : 900S, 430E WATER TABLE : 0.75 M RECORDED ON : 27/10/2002</p> <p>TABLE NO : 252 BORING HOLE NO. : BH-127 TERMINATION DEPTH : 30.45 M BORING START DATE : 24/10/2002 BORING FINISH DATE : 26/10/2002</p>																																																																							
	<p>Standard Penetration Curve</p>	<table border="1"> <thead> <tr> <th>Elevation in metre</th> <th>Sample Depth Below Reference Level (m)</th> <th>Sample Reference No.</th> <th>SPT Observed N value</th> </tr> </thead> <tbody> <tr> <td>42.281</td> <td>0.50</td> <td>UDS1</td> <td>10</td> </tr> <tr> <td>41.281</td> <td>1.55</td> <td>SPT1</td> <td>12</td> </tr> <tr> <td>39.281</td> <td>3.00</td> <td>UDS2</td> <td>13</td> </tr> <tr> <td></td> <td>4.15</td> <td>SPT2</td> <td>17</td> </tr> <tr> <td></td> <td>6.00</td> <td>UDS3</td> <td>19</td> </tr> <tr> <td></td> <td>7.15</td> <td>SPT3</td> <td>29</td> </tr> <tr> <td></td> <td>9.00</td> <td>UDS4</td> <td>43</td> </tr> <tr> <td></td> <td>10.15</td> <td>SPT4</td> <td></td> </tr> <tr> <td>30.281</td> <td>12.00</td> <td>UDS5</td> <td></td> </tr> <tr> <td></td> <td>13.15</td> <td>SPT5</td> <td></td> </tr> <tr> <td></td> <td>15.00</td> <td>UDS6</td> <td></td> </tr> <tr> <td></td> <td>16.15</td> <td>SPT6</td> <td></td> </tr> <tr> <td></td> <td>18.00</td> <td>UDS7</td> <td></td> </tr> <tr> <td></td> <td>19.15</td> <td>SPT7</td> <td></td> </tr> </tbody> </table>		Elevation in metre	Sample Depth Below Reference Level (m)	Sample Reference No.	SPT Observed N value	42.281	0.50	UDS1	10	41.281	1.55	SPT1	12	39.281	3.00	UDS2	13		4.15	SPT2	17		6.00	UDS3	19		7.15	SPT3	29		9.00	UDS4	43		10.15	SPT4		30.281	12.00	UDS5			13.15	SPT5			15.00	UDS6			16.15	SPT6			18.00	UDS7			19.15	SPT7										
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CLAUSE NO.

Project Information

GEOTECH CONSULTANTS PVT. LTD.
NEW DELHI

BORING METHOD: Shell and Auger

NAME OF WORK : Detailed Geotechnical Investigation for Plant and Township Area for Barh Super Thermal Power Project in Bihar.

PROJECT NO : 2507
 BORING SIZE : 150 MM
 CO-ORDINATES : 900S, 430E
 WATER TABLE : 0.75 M
 RECORDED ON : 27/10/2002

TABLE NO : 253
 BORE HOLE NO. : BH-127
 TERMINATION DEPTH : 30.45 M
 BORING START DATE : 24/10/2002
 BORING FINISH DATE : 26/10/2002

Elevation in metre	Sample Depth Below Reference Level (m)	Sample Reference No.	SPT Observed 'N' value	Standard Penetration Curve	Visual Description of Soil with IS Classification	Depth (m)	IS Symbol	Grain Size Analysis				Shrinkage Limit	Bulk Density (gm/cc)	Dry Density (gm/cc)	Natural Moisture Content (%)	Specific Gravity	Void Ratio (eg)	Type of Test	Cohesion C (kg/cm ²)	Friction Angle φ (Deg.)	Pressure Range (kg/cm ²)	CV X 10 ⁻⁴ (cm ² /sec)	WV X 10 ⁻² (cm ² /kg)	Compression Index (Cc)	Free Swell Index (%)	Swell Pressure (kg/cm ²)		
								Gravel (%)	Sand (%)	Silt (%)	Clay (%)																	
21.281	21.00	IOS8	66		C.L. Hard Silty Sand with Silty Clay	20.00		3	83	6	29	20	2.01	1.70	18.5	.	.	.	.	.	.	.	.	.	.	.	.	.
	22.15	IP78	66						2	78	19	39	22	2.00	1.88	19.2	.	.	.	.	.	.	.	.	.	.	.	.
	24.00	IOS9*	65			C.L. Hard Greyish Clay with Silty Clay	24.00		2	78	19	39	22	2.00	1.88	19.2	.	.	.	.	.	.	.	.	.	.	.	.
	25.15	IP79	65						2	78	19	39	22	2.00	1.88	19.2	.	.	.	.	.	.	.	.	.	.	.	.
15.281	27.00	IOS10	42						2	78	19	39	22	2.00	1.88	19.2	.	.	.	.	.	.	.	.	.	.	.
	28.15	IP110	42						2	78	19	39	22	2.00	1.88	19.2	.	.	.	.	.	.	.	.	.	.	.
	30.15	IP111	40			30.45		2	78	19	39	22	2.00	1.88	19.2	.	.	.	.	.	.	.	.	.	.	.



CLAUSE NO.

Project Information

GEOTECH CONSULTANTS PVT. LTD.
NEW DELHI

BORING METHOD: Shell and Auger

NAME OF WORK : Detailed Geotechnical Investigation for Plant and Township Area for Barh Super Thermal Power Project in Bihar.

PROJECT NO : 2507
BORING SIZE : 150 MM
CO-ORDINATES : 900S, 520E
WATER TABLE : 0.0 M
RECORDED ON : 06/10/2002

TABLE NO : 254
BORING HOLE NO. : BH-128
TERMINATION DEPTH : 30.45 M
BORING START DATE : 03/10/2002
BORING FINISH DATE : 05/10/2002

Depth (m)	Visual Description of Soil with its Classification	SPT Observed N Value	Standard Penetration Curve	Sample Reference No.	Reference Level (m)	Deviation in metre	Grain Size Analysis				Shrinkage Limit	Bulk Density (gm/cc)	Dry Density (gm/cc)	Natural Moisture Content (%)	Specific Gravity	Void Ratio (eg)	Shear Test		Consolidation Test				Free Swell Index (%)	Swell Pressure (kg/cm ²)
							Gravel (%)	Sand (%)	Slit (%)	Clay (%)							Type of Test	Cohesion C (kg/cm ²)	Friction Angle φ (Deg.)	Pressure Range (kg/cm ²)	e _v X 10 ⁻⁴ (cm ² /sec)	M _v X 10 ⁻² (cm ² /kg)			Compression Index (Cc)
0	CH: Stiff Greyish Clayey Silt	10		U051	0.0	42.285	3	75	15	33	20	1.95	1.64	19.1	2.66	0.625	UCT	0.45	0.5-1.0	9.59	1.36	0.090	-	-
0.6	CI: Medium to Stiff Brownish Clayey Silty Medium Plasticity	9		11	U052	0.6	38.795	3	73	20	38	22	1.86	1.49	24.7	-	-	-	-	1.0-2.0	7.71	1.00	-	-
1.2	CL: Stiff to Hard Brownish Clayey Silty Low Plasticity	8		9	U053	1.2	38.795	3	4	73	38	22	1.86	1.49	24.7	-	-	-	-	2.0-4.0	6.27	0.73	-	-
1.8	CL: Stiff to Hard Brownish Clayey Silty Low Plasticity	11		44	U054	1.8	38.795	3	6	75	33	20	1.95	1.64	19.1	2.66	0.625	-	-	4.0-6.0	5.57	0.43	-	-
2.4	CL: Stiff to Hard Brownish Clayey Silty Low Plasticity	44		19	U055	2.4	38.795	3	6	75	33	20	1.95	1.64	19.1	2.66	0.625	-	-	4.0-6.0	5.57	0.43	-	-
3.0	CL: Stiff to Hard Brownish Clayey Silty Low Plasticity	19		31	U056	3.0	38.795	3	6	75	33	20	1.95	1.64	19.1	2.66	0.625	-	-	4.0-6.0	5.57	0.43	-	-
3.6	CL: Stiff to Hard Brownish Clayey Silty Low Plasticity	31		31	U057	3.6	38.795	3	6	75	33	20	1.95	1.64	19.1	2.66	0.625	-	-	4.0-6.0	5.57	0.43	-	-
4.2	CL: Stiff to Hard Brownish Clayey Silty Low Plasticity	31		31	U057	4.2	38.795	3	6	75	33	20	1.95	1.64	19.1	2.66	0.625	-	-	4.0-6.0	5.57	0.43	-	-
4.8	CL: Stiff to Hard Brownish Clayey Silty Low Plasticity	31		31	U057	4.8	38.795	3	6	75	33	20	1.95	1.64	19.1	2.66	0.625	-	-	4.0-6.0	5.57	0.43	-	-
5.4	CL: Stiff to Hard Brownish Clayey Silty Low Plasticity	31		31	U057	5.4	38.795	3	6	75	33	20	1.95	1.64	19.1	2.66	0.625	-	-	4.0-6.0	5.57	0.43	-	-



CLAUSE NO.	Project Information																																																																										
	<p align="center">GEO TECH CONSULTANTS PVT. LTD. NEW DELHI</p> <p>BORING METHOD: Shell and Auger NAME OF WORK: Detailed Geotechnical Investigation for Plant and Township Area for Barh Super Thermal Power Project in Bihar.</p> <p>PROJECT NO : 2507 BORING SIZE : 150 MM CO-ORDINATES : 900S, 520E WATER TABLE : 0.0 M RECORDED ON : 06/10/2002</p> <p>TABLE NO : 255 BORE HOLE NO. : BH-128 TERMINATION DEPTH : 30.45 M BORING START DATE : 03/10/2002 BORING FINISH DATE : 05/10/2002</p>	<table border="1"> <tr> <td rowspan="2">Grain Size Analysis</td> <td>Clay (%)</td> <td>24</td> </tr> <tr> <td>Silt (%)</td> <td>72</td> </tr> <tr> <td rowspan="2">Liquid Limit</td> <td>Liquid Limit</td> <td>44</td> </tr> <tr> <td>Plastic Limit</td> <td>23</td> </tr> <tr> <td rowspan="2">Shrinkage Limit</td> <td>Shrinkage Limit</td> <td>2.03</td> </tr> <tr> <td>Bulk Density (gm/cc)</td> <td>1.70</td> </tr> <tr> <td rowspan="2">Dry Density (gm/cc)</td> <td>Dry Density (gm/cc)</td> <td>19.6</td> </tr> <tr> <td>Specific Gravity</td> <td></td> </tr> <tr> <td rowspan="2">Void Ratio (eg)</td> <td>Void Ratio (eg)</td> <td></td> </tr> <tr> <td>Type of Test</td> <td></td> </tr> <tr> <td rowspan="2">Shear Test</td> <td>Cohesion C (kg/cm²)</td> <td></td> </tr> <tr> <td>Friction Angle φ (Deg)</td> <td></td> </tr> <tr> <td rowspan="4">Consolidation Test</td> <td>Pressure Range (kg/cm²)</td> <td></td> </tr> <tr> <td>C_v X 10⁻⁴ (cm²/sec)</td> <td></td> </tr> <tr> <td>M_v X 10⁻² (cm²/kg)</td> <td></td> </tr> <tr> <td>Compression Index (Cc)</td> <td></td> </tr> <tr> <td rowspan="2">Free Swell Index (%)</td> <td>Free Swell Index (%)</td> <td></td> </tr> <tr> <td>Swell Pressure (kg/cm²)</td> <td></td> </tr> </table> <table border="1"> <tr> <td rowspan="2">Visual Description of Soil with IS Classification</td> <td>Depth (m)</td> <td>20.00</td> </tr> <tr> <td></td> <td>30.45</td> </tr> <tr> <td rowspan="2">Standard Penetration Curve</td> <td>SPT Observed 'N' value</td> <td>38</td> </tr> <tr> <td>Sample Reference No.</td> <td>48</td> </tr> <tr> <td rowspan="2">Sample Depth Below Reference Level (m)</td> <td>Reference Level (m)</td> <td>17.965</td> </tr> <tr> <td></td> <td>34.59</td> </tr> <tr> <td rowspan="2">Elevation in metre</td> <td>Reference Level (m)</td> <td>26.65</td> </tr> <tr> <td></td> <td>27.59</td> </tr> <tr> <td rowspan="2">Sample Reference No.</td> <td></td> <td>61</td> </tr> <tr> <td></td> <td>47</td> </tr> </table> <table border="1"> <tr> <td>IS Symbol</td> <td></td> </tr> <tr> <td>Visual Description of Soil with IS Classification</td> <td>Cl. Hard Coarse Gravelly OR Medium Plasticity</td> </tr> </table>	Grain Size Analysis	Clay (%)	24	Silt (%)	72	Liquid Limit	Liquid Limit	44	Plastic Limit	23	Shrinkage Limit	Shrinkage Limit	2.03	Bulk Density (gm/cc)	1.70	Dry Density (gm/cc)	Dry Density (gm/cc)	19.6	Specific Gravity		Void Ratio (eg)	Void Ratio (eg)		Type of Test		Shear Test	Cohesion C (kg/cm ²)		Friction Angle φ (Deg)		Consolidation Test	Pressure Range (kg/cm ²)		C _v X 10 ⁻⁴ (cm ² /sec)		M _v X 10 ⁻² (cm ² /kg)		Compression Index (Cc)		Free Swell Index (%)	Free Swell Index (%)		Swell Pressure (kg/cm ²)		Visual Description of Soil with IS Classification	Depth (m)	20.00		30.45	Standard Penetration Curve	SPT Observed 'N' value	38	Sample Reference No.	48	Sample Depth Below Reference Level (m)	Reference Level (m)	17.965		34.59	Elevation in metre	Reference Level (m)	26.65		27.59	Sample Reference No.		61		47	IS Symbol		Visual Description of Soil with IS Classification	Cl. Hard Coarse Gravelly OR Medium Plasticity
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CLAUSE NO.

Project Information

COOLING WATER ANALYSIS

Sl. No.	Constituent	as	mg per litre
1.	Calcium	CaCO ₃	493
2.	Magnesium	CaCO ₃	212
3.	Sodium	CaCO ₃	250
4.	Potassium	CaCO ₃	28
5.	Total Cations	CaCO ₃	983
6.	Total Alkalinity	CaCO ₃	643
7.	P-Alkalinity	CaCO ₃	Nil
8.	Chloride	CaCO ₃	233
9.	Sulphate	CaCO ₃	107
9.	Total Anions	CaCO ₃	983
11.	Silica (Reactive)	SiO ₂	15
12.	Iron	Fe	1
13.	pH Value	-	8.6-9
14.	Turbidity	NTU	50

Note : The C.W system is expected to operate at about 2.5 Cycles of Concentration. As CW blow down water (Service Water) is tapped from discharge of CW pumps, the water quality of CW Blow down water shall be same as that above.



CLAUSE NO.

Project Information

**ANALYSIS OF DM WATER TO BE USED FOR
MAKE-UP WATER TO CONDENSER**

Sl.No.	Characteristics	Value
1.	Silica (Max.)	0.02 ppm as SiO ₂
2.	Iron as Fe	Nil
3.	Total hardness	Nil
4.	pH value	6.8 -7.2
5.	Conductivity	Not more than 0.1 excluding the effects of free CO ₂



CLAUSE NO.

Project Information

ANNEXURE-I



LOT-IA PROJECTS
FLUE GAS DESULPHURISATION (FGD)
PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI, PART-A
BID DOC. NO: CS-0011-109 (1A)-2

SUB SECTION II-A10
PROJECT INFORMATION
BARH STPP STAGE-I
(3X660 MW)

PAGE 20 OF 30



CLAUSE NO.

Project Information

ANNEXURE-II

CLIMATOLOGICAL TABLE

1555 मी. उचाय पर स्थित बांधी वारुंडी
BASED ON OBSERVATIONS FROM 1981 TO 2010

MONTH	TEMPERATURE		WIND		HUMIDITY		EXTREMES		CLOUD		RAINFALL		TOTAL IN PRECIPITATION FALLING PER YEAR	PERCENT RELATIVE HUMIDITY PER YEAR	NO. OF WINDY DAYS TOTAL	PERCENT WINDY DAYS		
	MAX	MIN	MAX	DIR	RELATIVE HUMIDITY	WIND SPEED	HIGHEST TEMP	LOWEST TEMP	DATE OF ONSET	DATE OF CESSATION	NO. OF DAYS	PERCENT						
JAN	23.5	15.3	2.5	18.8	47.5	6.8	20.5	5.2	19.6	5.2	8.8	15.2	185.2	8.3	45.4	23	13	
FEB	26.1	18.0	3.1	22.2	32.9	8.7	25.1	2.2	19.2	6.5	10.5	16.4	181.4	8.0	48.8	34	17	
MAR	30.5	21.9	4.0	28.2	27.5	12.4	32.4	2.4	18.4	10.8	11.8	17.6	162.2	6.1	64.1	45	24	
APR	34.8	25.8	4.8	35.3	25.8	16.4	38.5	2.8	16.8	12.5	12.5	15.5	132.2	5.2	81.1	58	30	
MAY	39.2	30.8	5.8	42.9	23.0	20.0	43.3	3.1	16.0	15.5	13.5	13.5	102.2	4.3	97.5	72	37	
JUN	43.5	35.2	6.8	48.7	22.1	23.1	45.5	3.5	15.2	18.5	14.5	13.5	82.2	3.0	103.2	85	44	
JUL	47.8	40.2	7.8	55.8	23.4	26.4	46.5	4.0	14.4	22.5	15.5	14.5	62.2	2.0	107.2	98	51	
AUG	51.2	45.8	8.8	62.9	24.8	28.4	47.5	4.5	13.8	26.5	16.5	15.5	42.2	1.0	108.2	111	56	
SEP	48.5	41.8	9.8	68.9	26.8	30.4	48.5	5.0	13.2	30.5	17.5	16.5	22.2	0.5	107.2	124	63	
OCT	44.8	37.8	10.8	75.9	28.8	32.4	49.5	5.5	12.8	34.5	18.5	17.5	12.2	0.2	106.2	137	70	
NOV	40.2	33.8	11.8	82.9	30.8	34.4	50.5	6.0	12.2	38.5	19.5	18.5	6.2	0.1	105.2	150	77	
DEC	35.8	29.8	12.8	89.9	32.8	36.4	51.5	6.5	11.8	42.5	20.5	19.5	2.2	0.0	104.2	163	84	
YEARLY																		
MEAN	27.9	19.4	3.9	31.9	32.4	18.4	35.2	2.8	17.8	16.5	16.5	16.5	112.4	6.2	72.2	102.4	54.2	
MAX	49.2	41.8	10.8	68.9	32.8	36.4	51.5	6.5	11.8	42.5	20.5	19.5	162.2	0.5	104.2	163	84	
MIN	2.5	18.8	47.5	6.8	20.5	5.2	19.6	5.2	19.6	5.2	8.8	15.2	185.2	8.3	45.4	23	13	
PERCENT																		
WINDY	11	19	17	13	11	59												
RELATIVE	8.3	45.4	23	13	17	17	17	17	17	17	17	17	17	17	17	17	17	17



CLAUSE NO.

Project Information

CLIMATOLOGICAL TABLE

STATION	STATION DATA		ELEVATION		LONGITUDE		LATITUDE		AREA		WIND		MOON		RELATIVE HUMIDITY		CLOUDS		TOTAL ANNUAL RAINFALL	
	NAME	NO.	FT	M	LONGITUDE	LONGITUDE	LATITUDE	LATITUDE	AREA	AREA	DIRECTION	SPEED	MOON	MOON	RELATIVE HUMIDITY	RELATIVE HUMIDITY	RELATIVE HUMIDITY	RELATIVE HUMIDITY	RELATIVE HUMIDITY	RELATIVE HUMIDITY
197	BARH		1011	1011	85° 11'	85° 11'	24° 31'	24° 31'	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000



CLAUSE NO.

Project Information

TABLE - 1

COAL CHARACTERISTICS

Sl. No.	Description	Symbol	Design Coal	Worst Coal	Best Coal	Range of Adequacy Coal
1	2	3	4	5	6	7
A. PROXIMATE ANALYSIS (As received basis)						
1.	Total Moisture	%	15.00	17.00	12.00	10 - 20
2.	Ash	%	40.00	42.00	34.00	30 - 46
3.	Volatile matter	%	19.00	18.00	22.00	24 - 16
4.	Fixed carbon	%	26.00	23.00	32.00	38 - 18
B. ULTIMATE ANALYSIS (As received basis)						
1.	Carbon	C%	31.37	28.93	40.08	48 - 24.75
2.	Hydrogen	H2%	3.40	2.40	3.50	3.6 - 2.2
3.	Nitrogen	N2%	1.5	1.45	1.78	1.8 - 0.4
4.	Oxygen (By difference)	O2%	7.75	7.26	8.03	8.1 - 5.5
5.	Sulphur	S%	0.40	0.5	0.36	0.30 - 0.5
6.	Carbonates	CO3%	0.3	0.26	0.15	0.10 - 0.35
7.	Phosphorous	P2%	0.28	0.20	0.10	0.1 - 0.3
8.	Total Moisture	H2O%	15.0	17.0	12.0	10 - 20
9.	Ash	%	40.0	42.0	34.0	30.0 - 46.0
10.	Total	%	100	100	100	
11.	Gross Calorific Value	KCal/Kg	3300	2800	4000	4500 - 2500
12.	Hard grove index		55	50	60	45 - 65



CLAUSE NO.

Project Information

Sl. No.	Description	Symbol	Design Coal	Worst Coal	Best Coal	Range of Adequacy Coal
1	2	3	4	5	6	7

C. ASH ANALYSIS

1.	Silica	(SiO ₂)%	59.79	61.3	56.7	62.0 - 56.0
2.	Alumina	(Al ₂ O ₃)%	25.36	28.0	23.5	28.0 - 23.0
3.	Iron Oxide	(Fe ₂ O ₃)%	7.2	6.0	10.0	6.0 - 10.0
4.	Titania	(TiO ₂)%	1.2	1.0	1.5	1.0 - 1.7
5.	Phosphoric Anhydride	(P ₂ O ₅)%	2.6	1.5	3.0	1.0 - 3.0
6.	Lime	(CaO)%	0.88	0.5	1.5	0.5 - 1.7
7.	Magnesia	(MgO)%	0.55	0.4	1.0	0.4 - 1.1
8.	Sulphuric Anhydride	(SO ₃)%	1.2	0.5	1.4	0.5 - 1.7
9.	Alkalies (Na ₂ O+K ₂ O) (%) (by difference)		1.22	0.8	1.4	0.6 - 1.8

NOTE: Na₂O content in the above shall not be more than 0.1%

D. ASH FUSION RANGE
(Under reducing atmosphere)

a)	Initial Deformation Temperature (IDT) °C	1100	1100	1100	1100 - 1150
b)	Hemispherical temperature °C	1300	1250	1350	1250 - 1400
c)	Flow temperature °C	1400	1350	1400	1400 - 1450



CLAUSE NO.

Project Information

TABLE-2

LIGHT DIESEL OIL CHARACTERISTICS

AS PER IS 1460-2000

Characteristics	LDO
1. Pour Point (max)	21 deg.C & 12°C for Summer and Winter respectively
2. Kinematic viscosity in centistokes at 40 deg.C	2.5 to 15
3. Sediment percent by mass (max)	0.10
4. Total sulphur percent by mass (max)	1.5
5. Ash percentage by mass (max)	0.02
6. Carbon residue (Rans bottom) percent by pass (max.)	1.50
7. Acidity in organic	Nil
8. Flash point(Min.) - Pensky Martens	66 deg.C
9. Copper strip corrosion for 3 hours at 100°C	Not worse than No. 2
10. Water content, % by volume(max)	0.25
11. GCV (Kcal/kg)	10,000



CLAUSE NO.

Project Information

**TABLE -3
FUEL OIL CHARACTERISTICS**

Sl. No.	Characteristics	Heavy Furnace Oil IS-1593 1971 Grade HV	Low Sulphur Heavy Stock (LSHS)	Heavy Petroleum Stock (HPS)
1.	Total sulphur content	4.5% Max.	1.0% Max.	4.5% Max.
2.	Gross calorific value (KCal/kg)	of the order of 11,000	of the order of 11,000	9,500 (min)
3.	Flash Point (Min)	66 deg C	75 deg C	75 deg C
4.	Water content by volume (Max)	1.0%	1.0%	1.0%
5.	Sediment by weight (Max)	0.25%	0.25%	0.25%
6.	Asphaltene content by weight (Max.)	2.5%	2.5%	2.5%
7.	Kinematic viscosity in Centistokes at - 50deg C (Max)	370	180	500
8.	Ash Content by weight (Max.)	0.1%	0.05%	0.1%
9.	Acidity (inorganic)	Nil	Nil	Nil
10.	Pour Point (Max.)	57 deg C	72 deg C	
11.	Sodium content	—	—	100 ppm
12.	Vanadium content	25 ppm	25 ppm	25 ppm
13.	Specific heat below pour point (KCal/Kg °C)		0.65	



CLAUSE NO.

Project Information

Table-4

S.No	Constituent	As	mg/l (except pH & turbidity)
1.	Calcium	CaCO ₃	200.5
2.	Magnesium	CaCO ₃	92
3.	Sodium + Potassium	CaCO ₃	96
4.	Total Cations	CaCO ₃	388.50
5.	Chloride	CaCO ₃	106
6.	Sulphate	CaCO ₃	58.5
7.	Alkalinity	CaCO ₃	224
8.	Total Anions	CaCO ₃	388.50
9.	Iron(total)	Fe	0.3
10.	Silica	SiO ₂	10
11.	pH value	---	7.0-8.5
12.	Turbidity	NTU	10

Note: Clarified water is used for CW system as make up & the CW system is expected to operate at about 5.0 – 5.5 Cycles of Concentration (COC) with suitable chemical treatment program using acid, scale & corrosion inhibitor dosing. As CW blow down water is tapped from CW system, the water quality of CW blow down shall accordingly be arrived by the bidder.

Table-5

ANALYSIS OF DM WATER

Sl.No.	Characteristics	Value
1.	Silica (Max.)	0.02 ppm as SiO ₂
2.	Iron as Fe	Nil
3.	Total hardness	Nil
4.	pH value	6.8 to 7.2
5.	Conductivity	Not more than 0.1 µs/cm



CLAUSE NO.

Project Information

Table-6

1.00.00


STEAM GENERATOR DATA

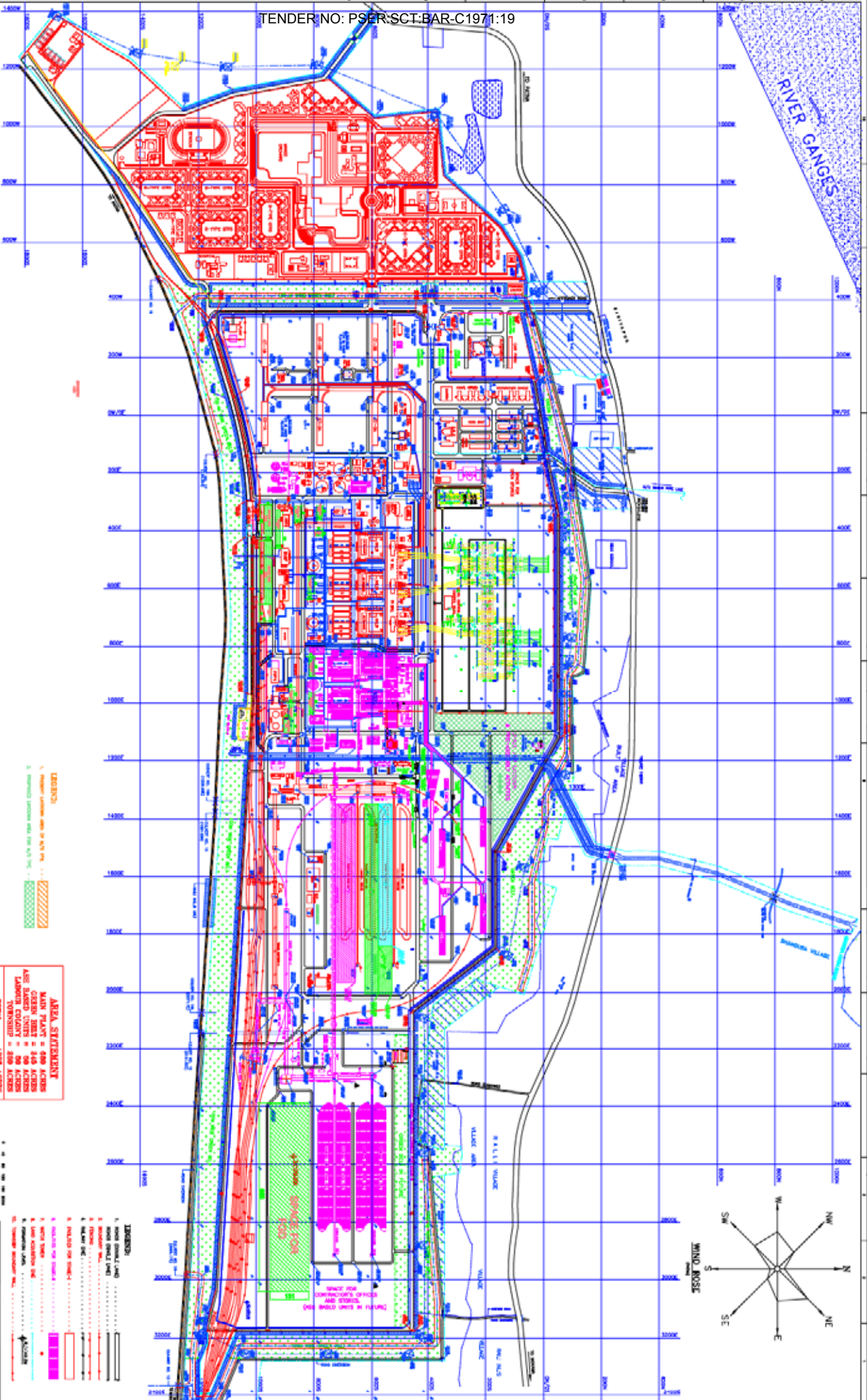
1.	Location	Outdoor
2.	Operation	Base load
3.	Type	Pulverised coal fired
4.	Maximum Continuous Rating	2225 Tonns/hr.
5.	Steam pressure at SH outlet	256 Kg/cm ² (a)
6.	Steam temperature at SH outlet	540°C
7.	Oil for start up and flame stabilisation	LDO/HFO
8.	Fuel oil system sizing	30% of Boiler MCR for HFO
9.	Pulverised coal size	Minimum 70% through 200 Mesh and 99% thru 50 mesh
10.	Type of pulveriser	Vertical spindle mills
11.	Type of oil burners	Air/Steam atomised for LDO/ HFO
12.	No. of air heaters	2 Nos PAPH, 2 Nos SAPH
13.	No. of ID Fans	Two (Axial Type, both working)

2.00.00

ESP DATA

1.	Location:	Downstream side of Air preheaters
2.	Operation:	Base load
3.	Type:	Rigid Discharge frame
4.	Rapping:	Intermittent

CLAUSE NO.	Project Information																																										
	<p>List of Drawings placed below in this sub section:</p> <table border="1"> <thead> <tr> <th>Sl.no.</th> <th>Drawing description</th> <th>Drawing no.</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>General Layout Plan</td> <td>9562-999-POC-F-001</td> </tr> <tr> <td>2.</td> <td>Topographical Survey</td> <td>9562-999-POC-F-002</td> </tr> <tr> <td>3.</td> <td>Equipment Layout Plan</td> <td>9562-999-POM-A-001</td> </tr> <tr> <td>4.</td> <td>ID system-Elevation & Plan</td> <td>(a) 9562-102-PVM-F-009 (b) 9562-102-PVM-F-008</td> </tr> <tr> <td>5.</td> <td>Chimney foundation</td> <td>Refer details below</td> </tr> </tbody> </table> <p style="text-align: center;">Chimney Details</p> <table border="1"> <thead> <tr> <th>Sl. No.</th> <th>Project</th> <th>Chimney shell outer diameter at ground level (m)</th> <th>Chimney foundation outer diameter (m)</th> <th>Type of foundation</th> <th>Level of Top of foundation (m)</th> <th>Level of Bottom of foundation (m)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Barh-I Unit#3</td> <td>32</td> <td>48.94</td> <td>Raft supported on piles</td> <td>RL(+) 45.70</td> <td>RL(+) 41.45</td> </tr> <tr> <td>2</td> <td>Barh-I Unit#1 & 2</td> <td>34.5</td> <td>55.78</td> <td>Raft supported on piles</td> <td>RL(+) 45.70</td> <td>RL(+) 40.95</td> </tr> </tbody> </table>			Sl.no.	Drawing description	Drawing no.	1.	General Layout Plan	9562-999-POC-F-001	2.	Topographical Survey	9562-999-POC-F-002	3.	Equipment Layout Plan	9562-999-POM-A-001	4.	ID system-Elevation & Plan	(a) 9562-102-PVM-F-009 (b) 9562-102-PVM-F-008	5.	Chimney foundation	Refer details below	Sl. No.	Project	Chimney shell outer diameter at ground level (m)	Chimney foundation outer diameter (m)	Type of foundation	Level of Top of foundation (m)	Level of Bottom of foundation (m)	1	Barh-I Unit#3	32	48.94	Raft supported on piles	RL(+) 45.70	RL(+) 41.45	2	Barh-I Unit#1 & 2	34.5	55.78	Raft supported on piles	RL(+) 45.70	RL(+) 40.95	
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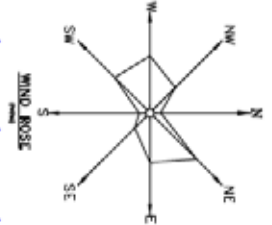
- LEGEND**
- 1. Proposed layout with 40% P.C.
 - 2. Proposed layout with 75% P.C.

AREA STATEMENT

MAIN PLANT	= 640 ACRES
STEAM HEAT	= 845 ACRES
LANDSCAPE	= 50 ACRES
CONCRETE	= 289 ACRES
TOTAL	= 1824 ACRES



- LEGEND**
- 1. ROAD (SOLID LINE)
 - 2. ROAD (DOTTED LINE)
 - 3. RAILWAY TRACK
 - 4. FENCE
 - 5. WATER CANAL
 - 6. FLOODING ZONE
 - 7. WET ZONE
 - 8. LAND ACQUISITION
 - 9. PROPOSED LAYOUT
 - 10. EXISTING LAYOUT

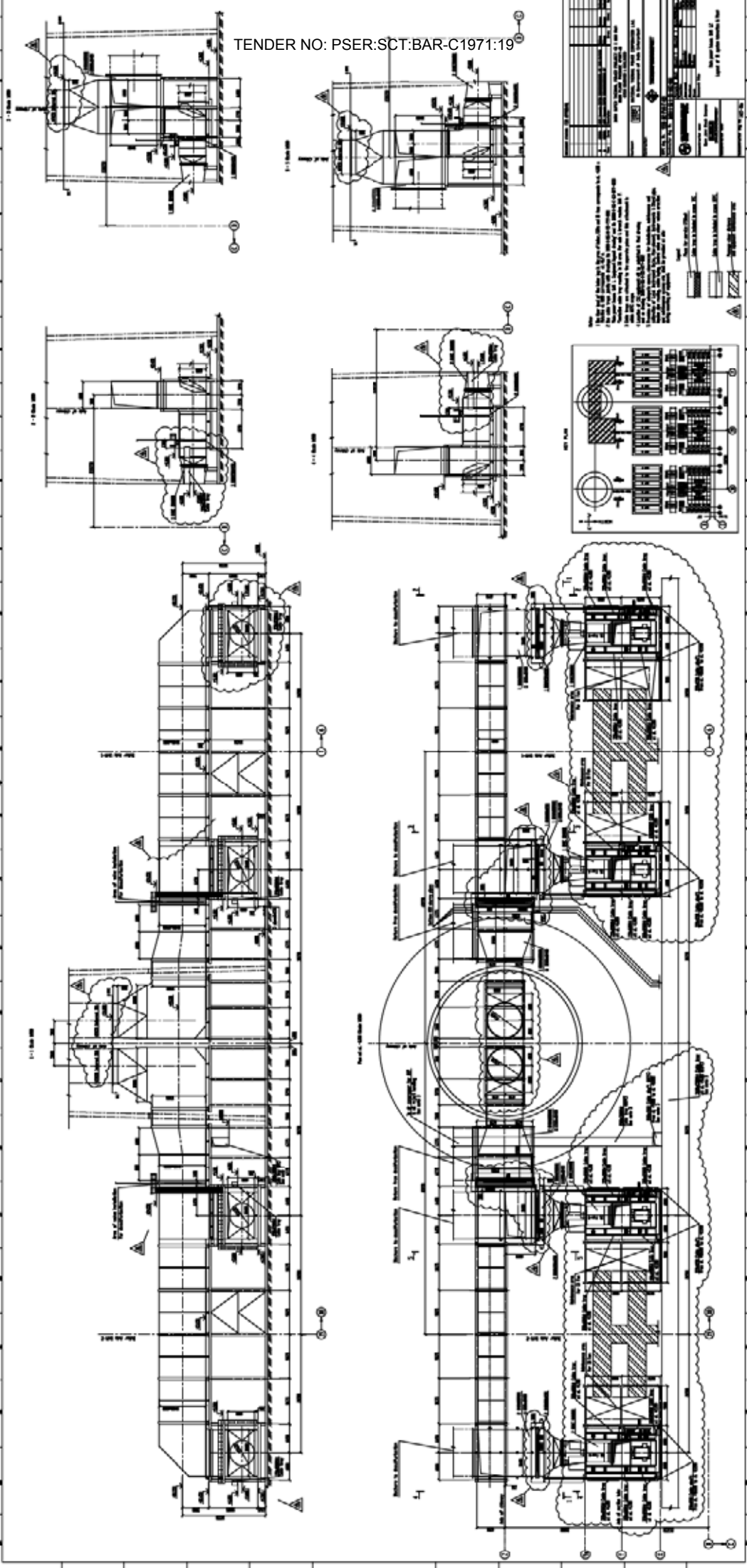


- NOTES**
1. ALL DIMENSIONS ARE GIVEN IN METERS.
 2. THE PROPOSED LAYOUT IS SUBJECT TO THE APPROVAL OF THE COMPETENT AUTHORITY.
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NO.	REVISION	DATE	BY	CHECKED	APPROVED
1	ISSUED FOR TENDER	10/10/2019			
2	REVISED	10/10/2019			
3	REVISED	10/10/2019			
4	REVISED	10/10/2019			
5	REVISED	10/10/2019			
6	REVISED	10/10/2019			
7	REVISED	10/10/2019			
8	REVISED	10/10/2019			
9	REVISED	10/10/2019			
10	REVISED	10/10/2019			

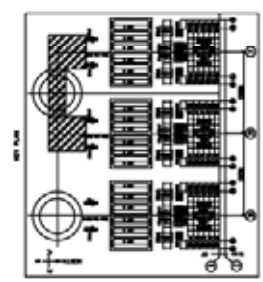
NTPC Limited
RAJESH SINGH THERMAL POWER PROJECT
GENERAL LAYOUT PLAN
 Scale: 1:1000
 Date: 10/10/2019
 Drawing No: 8950


TENDER NO: PSER:SCT:BAR-C1971:19





NO.	DESCRIPTION	QUANTITY	UNIT	REMARKS
1
2
3
4
5
6
7
8
9
10


THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROVISION OF ALL MATERIALS AND LABOUR REQUIRED FOR THE EXECUTION OF THE WORK. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROVISION OF ALL MATERIALS AND LABOUR REQUIRED FOR THE EXECUTION OF THE WORK. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROVISION OF ALL MATERIALS AND LABOUR REQUIRED FOR THE EXECUTION OF THE WORK.




CLAUSE NO.	Project Information 		
1.00.00	<p>BACKGROUND</p> <p>Barh Super Thermal Power Project, Stage-I (3x660 MW) & Stage-II (2 x 660MW) coal based is being set up by NTPC near Barh town in Patna district of Bihar.</p>		
1.01.00	<p>LOCATION AND APPROACH</p> <p>The proposed power station is located at the latitude and longitude of 25 deg 29' 10" (N) and 85 deg. 45' 40" (E) respectively. The plant site is situated between National Highway (NH-31) and Patna-Mokama main railway line. The ash disposal area is located on the south of the railway line. Barh, the nearest town, is about 4.0 kms away from the project site. The nearest rail head Barh Railway Station on Patna - Mokama Section of main trunk route, is approximately 3.0 km away from the project site. The nearest airport at Patna is located at a distance of approximately 75 kms from the project site. The Vicinity Plan of the project is enclosed at drawing section at Annexure-I. The nearest airport at Patna is located at a distance of approximately 75 kms. from the project site. The Vicinity Plan of the project is enclosed at ANNEXURE-I. Further to the information's given in this sub-section, Bidders are also advised visit the project site and collect data on local site conditions.</p>		
1.02.00	<p>LAND</p> <p>About 3200 acres of land is acquired/under acquisition under Stage-I of the project. No additional land is envisaged to be acquired under Stage-II. The plant, ash disposal and township shall be accommodated within the land acquired/under acquisition under Stage-I.</p>		
1.03.00	<p>WATER</p> <p>The project site is located near the river Ganges. The make up water requirement for the expansion project is approximately 71 cusecs and the same is proposed to be drawn from river Ganges near village Nawada, at a distance of 2.0 kms. Make-up water pump house is already constructed at the river end in Stage-I with space provision for Stage-II pumps and the plant water requirement will be pumped to the plant through makeup water piping.</p>		
1.04.00	<p>COAL</p> <p>a) Coal requirement for the project shall be met from Amrapali block of North Karanpura Coalfields of CCL.</p> <p>b) The coal quality parameters and Fuel oil characteristics are attached at Sub-section-V / Part-A.</p>		
1.05.00	<p>RAILWAY SIDING</p> <p>For brining the equipment and material to the power house through rail, a permanent railway siding is proposed to be constructed near the project site to provide rail access to unloading bays and transformer yard.</p>		
1.06.00	<p>Steam Generator and ESP data: refer Table-6.</p>		
2.01.00	<p>Limestone linkage:</p>		
2.02.00	<p>Gypsum Evacuation:</p>		
<p>LOT-IB PROJECTS FLUE GAS DESHULPURISATION (FGD) PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (1B)-2</p>	<p>PART-A PROJECT INFORM. BARH STPP STAGE-2 (2X660 MW)</p>	<p>PAGE 1 OF 33</p>

CLAUSE NO.	Project Information 		
3.00.00	<p>Capacity</p> <p>Stage-I : 3 x 660 MW - Under Construction -Present proposal</p> <p>Stage-II : 2 x 660 MW - Under Operation</p>		
4.00.00	<p>METEOROLOGICAL DATA</p> <p>The meteorological data from the nearest observatory at Patna is placed as ANNEXURE-II.</p>		
5.00.00	<p>CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT</p> <p>All structures and equipment shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS:1893 (Part 1 to Part 4). Pending finalization of Part 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for embankments.</p> <p>A site specific seismic study has been conducted for the project site. The peak ground horizontal acceleration for the project site, the site specific acceleration spectral coefficients (in units of gravity acceleration 'g') in the horizontal direction for the various damping values and the multiplying factor (to be used over the spectral coefficients) for evaluating the design acceleration spectra are as given at Appendix-I.</p> <p>Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values.</p> <p>The site specific design acceleration spectra shall be used in place of the response acceleration spectra, given at figure-2 in IS:1893 (Part 1) and Annex B of IS:1893 (Part 4). The site specific acceleration spectra along with multiplying factors specified in Appendix-I includes the effect of the seismic environment of the site, the importance factor related to the structures and the response reduction factor. Hence, the design spectra do not require any further consideration of the zone factor (Z), the importance factor (I) and response reduction factor (R) as used in the IS:1893 (Part 1 to Part 4).</p>		
<p>LOT-IB PROJECTS FLUE GAS DESHULPURISATION (FGD) PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (1B)-2</p>	<p>PART-A PROJECT INFORM. BARH STPP STAGE-2 (2X660 MW)</p>	<p>PAGE 2 OF 33</p>

CLAUSE NO.	Project Information																			
	<p>Damping in Structures</p> <p>The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:</p> <table border="1"> <tbody> <tr> <td>a)</td> <td>Steel structures</td> <td>:</td> <td>2%</td> </tr> <tr> <td>b)</td> <td>Reinforced Concrete structures</td> <td>:</td> <td>5%</td> </tr> <tr> <td>c)</td> <td>Reinforced Concrete Stacks</td> <td>:</td> <td>3%</td> </tr> <tr> <td>d)</td> <td>Steel stacks</td> <td>:</td> <td>2%</td> </tr> </tbody> </table>			a)	Steel structures	:	2%	b)	Reinforced Concrete structures	:	5%	c)	Reinforced Concrete Stacks	:	3%	d)	Steel stacks	:	2%	
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CLAUSE NO.	Project Information 		
	<p style="text-align: right;">1.01.00</p> <p>Method of Analysis</p> <p>Since most structures in a power plant are irregular in shape and have irregular distribution of mass and stiffness, dynamic analysis for obtaining the design seismic forces shall be carried out using the response spectrum method. The number of vibration modes used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass and shall also meet requirements of IS:1893 (Part 1). Modal combination of the peak response quantities shall be performed as per Complete Quadratic Combination (CQC) method or by an acceptable alternative as per IS:1893 (Part 1).</p> <p>In general, seismic analysis shall be performed for the three orthogonal (two principal horizontal and one vertical) components of earthquake motion. The seismic response from the three components shall be combined as specified in IS:1893 (Part 1).</p> <p>The spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the structure falls to the left of the peak in the spectral acceleration curve.</p> <p>For buildings, if the design base shear (V_B) obtained from modal combination is less than the base shear (\bar{V}_B) computed using the approximate fundamental period (T_a) given in IS:1893:Part 1 and using site specific acceleration spectra with appropriate multiplying factor, the response quantities (e.g. member forces, displacements, storey forces, storey shears and base reactions) shall be enhanced in the ratio of \bar{V}_B / V_B. However, no reduction is permitted if \bar{V}_B is less than V_B.</p> <p>Design/Detailing for Ductility for Structures</p> <p>The site specific design acceleration spectra is a reduced spectra and has an in-built allowance for ductility. Structures shall be engineered and detailed in accordance with relevant Indian/International standards to achieve ductility.</p>		
<p style="text-align: center;">LOT-IB PROJECTS FLUE GAS DESHULPURISATION (FGD) PACKAGE</p>	<p style="text-align: center;">TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (1B)-2</p>	<p style="text-align: center;">PART-A PROJECT INFORM. BARH STPP STAGE-2 (2X660 MW)</p>	<p style="text-align: center;">PAGE 4 OF 33</p>

CLAUSE NO.	Project Information 		
	<p style="text-align: center;">APPENDIX – I (Contd.)</p> <p><u>SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT</u></p> <p>The various site specific seismic parameters for the project site shall be as follows:</p> <ol style="list-style-type: none"> 1) Peak ground horizontal acceleration : 0.24g 2) Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra <ol style="list-style-type: none"> a) for moment resisting steel frames designed and detailed as per IS:800 : 0.06 b) for braced steel frames designed and detailed as per IS:800 : 0.045 c) for moment resisting RC frames designed and detailed as per IS:456 and IS:13920 : 0.036 d) for RCC Chimney : 0.12 e) for Liquid retaining tanks : 0.072 f) for Steel chimney, Absorber tower : 0.09 g) for design of structures not covered under 2 (a) to 2 (f) above and under 3 below : 0.06 3) Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted : 0.12 <p>Note: g = Acceleration due to gravity</p> <p>The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages.</p>		
<p style="text-align: center;">LOT-IB PROJECTS FLUE GAS DESHULPURISATION (FGD) PACKAGE</p>	<p style="text-align: center;">TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (1B)-2</p>	<p style="text-align: center;">PART-A PROJECT INFORM. BARH STPP STAGE-2 (2X660 MW)</p>	<p style="text-align: center;">PAGE 5 OF 33</p>

CLAUSE NO.

Project Information



APPENDIX – I (Contd.)

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
In units of 'g' for BARH STPP

Period (Sec)	Damping Factor (as a percentage of critical damping)					
	0.80%	1%	1.60%	2%	3%	5%
0.000	1.000	1.000	1.000	1.000	1.000	1.000
0.030	1.000	1.000	1.000	1.000	1.000	1.000
0.040	1.373	1.361	1.327	1.310	1.275	1.212
0.050	1.755	1.728	1.653	1.615	1.539	1.406
0.058	2.066	2.026	1.913	1.856	1.744	1.552
0.059	2.106	2.063	1.945	1.886	1.770	1.570
0.060	2.145	2.101	1.978	1.916	1.795	1.588
0.061	2.184	2.138	2.010	1.946	1.820	1.605
0.062	2.224	2.176	2.043	1.976	1.845	1.623
0.065	2.343	2.289	2.140	2.065	1.920	1.675
0.070	2.542	2.478	2.302	2.214	2.044	1.760
0.071	2.582	2.516	2.334	2.244	2.069	1.776
0.074	2.702	2.630	2.431	2.332	2.143	1.826
0.084	3.107	3.012	2.754	2.627	2.385	1.987
0.094	3.516	3.398	3.077	2.919	2.622	2.142
0.104	3.930	3.787	3.398	3.210	2.856	2.292
0.114	4.349	4.178	3.720	3.498	3.086	2.436
0.120	4.608	4.414	3.912	3.671	3.222	2.521
0.121	4.608	4.445	3.944	3.699	3.245	2.535
0.123	4.608	4.445	4.018	3.757	3.290	2.563
0.124	4.608	4.445	4.018	3.798	3.313	2.577
0.126	4.608	4.445	4.018	3.798	3.368	2.604
0.133	4.608	4.445	4.018	3.798	3.368	2.708
0.601	4.608	4.445	4.018	3.798	3.368	2.708
0.604	4.586	4.445	4.018	3.798	3.368	2.708
0.617	4.489	4.348	4.018	3.798	3.368	2.708
0.622	4.453	4.314	3.982	3.798	3.368	2.708
0.632	4.383	4.245	3.919	3.739	3.368	2.708
0.667	4.153	4.022	3.714	3.543	3.192	2.708
0.767	3.611	3.498	3.229	3.081	2.776	2.356
0.867	3.195	3.095	2.857	2.725	2.456	2.084
0.967	2.865	2.775	2.562	2.444	2.202	1.869
1.067	2.596	2.515	2.321	2.215	1.995	1.694
1.167	2.374	2.299	2.123	2.025	1.824	1.548
1.267	2.186	2.118	1.955	1.865	1.680	1.426
1.367	2.026	1.963	1.812	1.729	1.557	1.322
1.467	1.888	1.829	1.688	1.611	1.451	1.232
1.567	1.768	1.712	1.581	1.508	1.359	1.153
1.667	1.662	1.609	1.486	1.418	1.277	1.084


CLAUSE NO.


Project Information





HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
In units of 'g' for BARH STPP


Period (Sec)	Damping Factor (as a percentage of critical damping)					
	0.80%	1%	1.60%	2%	3%	5%
1.767	1.568	1.518	1.402	1.337	1.205	1.023
1.867	1.484	1.437	1.327	1.266	1.140	0.968
1.967	1.408	1.364	1.259	1.201	1.082	0.919
2.067	1.340	1.298	1.198	1.143	1.030	0.874
2.167	1.278	1.238	1.143	1.090	0.982	0.834
2.267	1.222	1.184	1.093	1.042	0.939	0.797
2.367	1.170	1.134	1.046	0.998	0.899	0.763
2.467	1.123	1.088	1.004	0.958	0.863	0.732
2.567	1.079	1.045	0.965	0.921	0.829	0.704
2.667	1.039	1.006	0.929	0.886	0.798	0.678
2.767	1.001	0.970	0.895	0.854	0.769	0.653
2.867	0.966	0.936	0.864	0.824	0.743	0.630
2.967	0.934	0.904	0.835	0.796	0.718	0.609
3.067	0.903	0.875	0.808	0.770	0.694	0.589
3.167	0.875	0.847	0.782	0.746	0.672	0.571
3.267	0.848	0.821	0.758	0.723	0.652	0.553
3.367	0.823	0.797	0.736	0.702	0.632	0.537
3.467	0.799	0.774	0.714	0.682	0.614	0.521
3.544	0.782	0.757	0.699	0.667	0.601	0.510
3.559	0.778	0.754	0.696	0.664	0.596	0.508
3.666	0.756	0.732	0.676	0.645	0.561	0.479
3.765	0.736	0.713	0.658	0.611	0.532	0.454
3.865	0.717	0.694	0.624	0.580	0.505	0.431
3.965	0.699	0.677	0.593	0.551	0.480	0.409
4.017	0.690	0.668	0.578	0.537	0.468	0.399


CLAUSE NO.	Project Information																			
6.00.00	<p>CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT</p> <p>All structures shall be designed for wind forces in accordance with IS:875 (Part-3) and as specified in this document. See Annexure – B for site specific information.</p> <p>Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind Speed method as defined in the standard.</p> <p>Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor Method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method.</p> <p>Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than “5” and/or if the fundamental frequency of the structure is less than 1 Hz.</p> <p>Susceptibility of structures to across-wind forces, galloping, flutter, ovalling etc. should be examined and designed/detailed accordingly following the recommendations of IS:875(Part-3) and other relevant Indian standards.</p> <p>It should be estimated if size and relative position of other structures are likely to enhance the wind loading on the structure under consideration. Enhancement factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects.</p> <p>Damping in Structures</p> <p>The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:</p> <table border="1"> <tbody> <tr> <td>a)</td> <td>Welded steel structures</td> <td>:</td> <td>1.0%</td> </tr> <tr> <td>b)</td> <td>Bolted steel structures</td> <td>:</td> <td>2.0%</td> </tr> <tr> <td>c)</td> <td>Reinforced concrete structures</td> <td>:</td> <td>1.6%</td> </tr> <tr> <td>d)</td> <td>Steel stacks</td> <td></td> <td>As per IS:6533 & CICIND Model Code whichever is more critical.</td> </tr> </tbody> </table>			a)	Welded steel structures	:	1.0%	b)	Bolted steel structures	:	2.0%	c)	Reinforced concrete structures	:	1.6%	d)	Steel stacks		As per IS:6533 & CICIND Model Code whichever is more critical.	
a)	Welded steel structures	:	1.0%																	
b)	Bolted steel structures	:	2.0%																	
c)	Reinforced concrete structures	:	1.6%																	
d)	Steel stacks		As per IS:6533 & CICIND Model Code whichever is more critical.																	
<p>LOT-IB PROJECTS FLUE GAS DESHULPURISATION (FGD) PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (1B)-2</p>	<p>PART-A PROJECT INFORM. BARH STPP STAGE-2 (2X660 MW)</p>	<p>PAGE 8 OF 33</p>																	

CLAUSE NO.	Project Information															
	<p style="text-align: right;">ANNEXURE-B</p> <p>SITE SPECIFIC DESIGN PARAMETERS</p> <p>The various design parameters, as defined in IS: 875 (Part-3), to be adopted for the project site shall be as follows:</p> <table border="1"> <tbody> <tr> <td>a)</td> <td>The basic wind speed "V_b" at tenmetres above the mean ground level</td> <td>:</td> <td>47 metres/second</td> </tr> <tr> <td>b)</td> <td>The risk coefficient "K_1"</td> <td>:</td> <td>1.07</td> </tr> <tr> <td>c)</td> <td>Category of terrain</td> <td>:</td> <td>Category-2</td> </tr> </tbody> </table>			a)	The basic wind speed " V_b " at tenmetres above the mean ground level	:	47 metres/second	b)	The risk coefficient " K_1 "	:	1.07	c)	Category of terrain	:	Category-2	
a)	The basic wind speed " V_b " at tenmetres above the mean ground level	:	47 metres/second													
b)	The risk coefficient " K_1 "	:	1.07													
c)	Category of terrain	:	Category-2													
<p style="text-align: center;">LOT-IB PROJECTS FLUE GAS DESHULPURISATION (FGD) PACKAGE</p>	<p style="text-align: center;">TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (1B)-2</p>	<p style="text-align: center;">PART-A PROJECT INFORM. BARH STPP STAGE-2 (2X660 MW)</p>	<p style="text-align: center;">PAGE 9 OF 33</p>													

CLAUSE NO.	Project Information						
<p>7.00.00</p> <p>7.01.01</p> <p>7.01.00</p> <p>7.02.00</p> <p>7.03.00</p> <p>a)</p> <p>b)</p>	<p>SOIL DATA AND FOUNDATION SYSTEM</p> <p>Employer has carried out geotechnical investigation in the areas near to this package. Logs of representative boreholes to be used for bidder's information in the vicinity of proposed area are enclosed with this Annexure-II. The bidder is required to carry out geotechnical investigation as per the clause no. 7.07.00 and ascertain the pile capacity and bearing capacity. The onus of correct assessment / interpretation and understanding of the existing subsoil condition / data is on the Bidder. Ground water table is encountered at a depth of about 0 to 1.0m below natural ground level (NGL) at the time of investigation. Fluctuation may occur in ground water table due to seasonal variation.</p> <p>Finished Ground Level (FGL) generally corresponds to RL 46.20 within the plant area as shown in General Layout Plan (GLP). Controlled filling of thickness 3.5 to 4.0 m with soil has been done over Natural Ground Level (NGL) to achieve the FGL as indicated above.</p> <p>For excavation depth upto 6.0 m from FGL, contractor shall make arrangements like shoring, strutting or any other method duly approved by the Engineer to retain the sides of excavated area. Contractor may also use sheet piling to protect the sides of excavated area if he so desires. For excavation 6 metres below FGL, sheet piling shall be provided. The design of the sheet pile shall be done by Contractor as per relevant IS codes. The Contractor shall submit the design of sheet piling for Engineers information.</p> <p>The natural ground level is varying as per enclosed contour/spot level drawing.</p> <p>The foundation system to be adopted for different structures shall be as given in Table – 1 below</p> <p style="text-align: center;">Table – 1: Net Allowable Bearing Pressure</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>STRUCTURE</th> <th>TYPE OF FOUNDATION TO BE ADOPTED</th> </tr> </thead> <tbody> <tr> <td>FGD and related structures</td> <td>Open/Piles</td> </tr> </tbody> </table> <p>During design the Allowable Bearing Pressure shall be as furnished in Table-2. Bidder is required to carry out geotechnical investigation in this area. The allowable bearing pressure shall be adopted after approval of geotechnical investigation report by owner. However, the maximum allowable bearing pressure shall be as per the approved geotechnical report and shall be limited to the values as furnished in Table-2.</p>			STRUCTURE	TYPE OF FOUNDATION TO BE ADOPTED	FGD and related structures	Open/Piles
STRUCTURE	TYPE OF FOUNDATION TO BE ADOPTED						
FGD and related structures	Open/Piles						
<p>LOT-IB PROJECTS FLUE GAS DESHULPURISATION (FGD) PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (1B)-2</p>	<p>PART-A PROJECT INFORM. BARH STPP STAGE-2 (2X660 MW)</p>	<p>PAGE 10 OF 33</p>				

CLAUSE NO.	Project Information 																											
	Table – 2: Net Allowable Bearing Pressure																											
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="3" style="width: 15%;">Structure</th> <th rowspan="3" style="width: 10%;">Founding Level in RL</th> <th colspan="3" style="text-align: center;">1.02.00 Net Allowable Bearing Pressure</th> </tr> <tr> <th colspan="2" style="text-align: center;">1.03.00 T/m²</th> <th rowspan="2" style="text-align: center;">Rafts (width > 6m) for 75mm settlement</th> </tr> <tr> <th colspan="2" style="text-align: center;">Isolated / Strip</th> </tr> <tr> <td></td> <td></td> <th style="text-align: center;">width upto 6 m for 25mm settlement</th> <th style="text-align: center;">Width upto 6m for 40mm settlement</th> <td></td> </tr> </thead> <tbody> <tr> <td rowspan="2" style="text-align: center;">FGD and related structures</td> <td style="text-align: center;">1.5 m below NGL</td> <td style="text-align: center;">5.0</td> <td style="text-align: center;">5.5</td> <td style="text-align: center;">7.0</td> </tr> <tr> <td style="text-align: center;">2.5 m below NGL</td> <td style="text-align: center;">6.0</td> <td style="text-align: center;">7.0</td> <td style="text-align: center;">8.0</td> </tr> </tbody> </table>				Structure	Founding Level in RL	1.02.00 Net Allowable Bearing Pressure			1.03.00 T/m ²		Rafts (width > 6m) for 75mm settlement	Isolated / Strip				width upto 6 m for 25mm settlement	Width upto 6m for 40mm settlement		FGD and related structures	1.5 m below NGL	5.0	5.5	7.0	2.5 m below NGL	6.0	7.0	8.0
Structure	Founding Level in RL	1.02.00 Net Allowable Bearing Pressure																										
		1.03.00 T/m ²		Rafts (width > 6m) for 75mm settlement																								
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FGD and related structures	1.5 m below NGL	5.0	5.5	7.0																								
	2.5 m below NGL	6.0	7.0	8.0																								
	<p>The net allowable bearing pressure higher than above mentioned values shall not be permitted. At intermediate levels the bearing capacity shall be same as the net allowable bearing pressure corresponding to the immediate shallower level mentioned above.</p>																											
c)	<p>Permissible Settlement of Foundations:</p> <p>For open foundations, the total permissible settlement and differential settlement shall be governed by IS: 1904 and from functional requirements whichever is more stringent. However, total settlement shall be restricted to the following:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td style="width: 70%;">Isolated, Strip & Raft (Mill foundations/machine foundation)</td> <td style="text-align: center;">25 mm</td> </tr> <tr> <td>Isolated & Strip (Other than Mill foundations/machine foundation)</td> <td style="text-align: center;">40 mm</td> </tr> <tr> <td>Raft (widths greater than 6 m) (Other than Mill foundations/machine foundation)</td> <td style="text-align: center;">75 mm</td> </tr> </tbody> </table> <p>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 after review in consultation with Engineer.</p>				Isolated, Strip & Raft (Mill foundations/machine foundation)	25 mm	Isolated & Strip (Other than Mill foundations/machine foundation)	40 mm	Raft (widths greater than 6 m) (Other than Mill foundations/machine foundation)	75 mm																		
Isolated, Strip & Raft (Mill foundations/machine foundation)	25 mm																											
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Raft (widths greater than 6 m) (Other than Mill foundations/machine foundation)	75 mm																											
d)	<p>The diameter of pile, minimum length and maximum allowable capacity of piles shall be as given below:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Area/</th> <th style="width: 15%;">Pile</th> <th style="width: 30%;">Minimum Length of</th> <th style="width: 40%;">Safe Load Capacity in</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>				Area/	Pile	Minimum Length of	Safe Load Capacity in																				
Area/	Pile	Minimum Length of	Safe Load Capacity in																									
LOT-IB PROJECTS FLUE GAS DESHULPURISATION (FGD) PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (1B)-2	PART-A PROJECT INFORM. BARH STPP STAGE-2 (2X660 MW)	PAGE 11 OF 33																									

CLAUSE NO.	Project Information					
	Location	Diameter (mm)	Bored Pile Below Cut-off Level (m)	Vertical Comp. (MT)	Pullout (MT)	Lateral (MT)
	FGD and related	600	26.0	100.0	35.0	5.0
	structures	600*	27.0*	100	35.0	5.0
	<p>Cut off Level (COL) is assumed at 3.0 m below FGL (RL (+) 46.2m). If the COL is shallower than the assumed COL, then the length of the pile shall be increased accordingly.</p> <p>* Cut off Level (COL) is assumed at 1.5 m below FGL (RL (+) 46.2m). If the COL is shallower than the assumed COL, then the length of the pile shall be increased accordingly.</p>					
e)	<p>The criteria for Pile Termination (founding level) shall be as given below: The termination level of the pile shall be decided based on the following criterion</p> <ol style="list-style-type: none"> i) Minimum length of the pile below COL (cut off level) shall be as specified above ii) The minimum pile length for each group of piles shall be determined based on the nearest borelog. The SPT N value at pile termination level shall not be less than 40. For pile termination, SPT 'N' values shall be used from the nearby borelog data. The boreholes are in the bidder's scope and shall be conducted as per the enclosed scheme. iii) However, in no case the length of pile shall be less than the minimum length determined as in (i) or (ii) above whichever is longer, for that pile group. 					
<p>LOT-IB PROJECTS FLUE GAS DESHULPURISATION (FGD) PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (1B)-2</p>	<p>PART-A PROJECT INFORM. BARH STPP STAGE-2 (2X660 MW)</p>	<p>PAGE 12 OF 33</p>			

CLAUSE NO.	Project Information			
<p align="center"> LOT-IB PROJECTS FLUE GAS DESHULPURISATION (FGD) PACKAGE </p>	<p align="center"> TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (1B)-2 </p>	<p align="center"> PART-A PROJECT INFORM. BARH STPP STAGE-2 (2X660 MW) </p>	<p align="center"> PAGE 13 OF 33 </p>	

CLAUSE NO.

Project Information



CLIENT : NTPC LIMITED													
PROJECT : Geotechnical Investigation for 2 X 800 MW Barh STPP at Barh in Bihar													
BORE HOLE NO. : BH-36				SHEET NO. : 1 OF 4									
LOCATION : -				DATE : 25/12/06 TO 30/12/06									
CO-ORDINATE : E=812.00 S =736.00				METHOD : ROTARY DRILLING.									
GROUND R. L. : 46.65m				CASING : 150mm.Ø upto 2.10m. Below G.L.									
GROUND W. T. : 2.70m Below G.L.													
DEPTH (M.)	DIA. OF BORE HOLE	LOG.	STRATA DESCRIPTION	SAMPLE		BLOWS/15cm			SPT N	C R %	RQD %	CORRECTED SPT 'N'	
				DEPTH (M.)	TYPE	15	15	15					
0.00			Filled up Soil									N=06	
1.50													
2.10				SPT1	02	03	03	04	06				
3.00													
3.60				SPT2	05	06	07	09	13				
4.00	150 mm Ø		Stiff to very stiff blackish silty CLAY										
6.10													
6.60				SPT3	07	10	13	17	23				
7.50													
8.00			Stiff reddish yellow clayey SILT	8.00	UDS1								
9.00													
9.60				SPT4	04	05	05	06	10				
10.00													
SPT N = STANDARD PENETRATION TEST VALUE				RQD = ROCK QUALITY DESIGNATION				UDS = UNDISTURBED SOIL SAMPLE					
CR = CORE RECOVERY				DS = DISTURBED SOIL SAMPLE				VST = VANE SHEAR TEST					
REMARKS : CONTINUED ON NEXT PAGE.								SCALE : 1:50	Checked By : Ms. SAVITRI	Drawn By: SANJAY			
DBM GEOTECHNICS AND CONSTRUCTIONS PVT. LTD. MUMBAI.								JOB NO. : 1701					

LOT-IB PROJECTS
FLUE GAS DESHULPURISATION (FGD)
PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI
BID DOC. NO.: CS-0011-109 (1B)-2

PART-A
PROJECT INFORM.
BARH STPP STAGE-2
(2X660 MW)

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CLAUSE NO.

Project Information



CLIENT : NTPC LIMITED													
PROJECT : Geotechnical Investigation for 2 X 800 MW Barh STPP at Barh in Bihar													
BORE HOLE NO. : BH-36						SHEET NO. : 2 OF 4							
DEPTH (M.)	DIA. OF BORE HOLE	LOG.	STRATA DESCRIPTION	SAMPLE		BLOWN/15cm			SPT N	C.R. %	ROQ %	CORRECTED SPT N	
				DEPTH (m)	TYPE	15	15	15					15
11.00	150 mm Ø		Stiff reddish yellow clayey SILT	10.00/									
				10.50/									
				11.00	UDS2								
12.00					Stiff to very stiff yellowish grey clayey SILT	12.00/							
			12.80	SPT5		05	04	07	08	11			
			13.50/										
			14.00	UDS3		SLIPPED							
			15.00/										
			15.80	SPT6		05	07	09	11	16			
			16.50/										
17.00			Hard yellowish grey clayey SILT	17.00	UDS4								
	18.00/												
	18.60	SPT7		09	22	18	16	40					
	19.50/												
20.00				19.70	UDS5	SLIPPED							
21.00													

SPT N = STANDARD PENETRATION TEST VALUE ROQ = ROCK QUALITY DESIGNATION UDS = UNDISTURBED SOIL SAMPLE
CR = CORE RECOVERY DS = DISTURBED SOIL SAMPLE VST = VANE SHEAR TEST

REMARKS : CONTINUED ON NEXT PAGE

DBM GEOTECHNICS AND CONSTRUCTIONS PVT. LTD. MUMBAI. SCALE : 1:50 Checked By : Ms. SAVITRI Drawn By : SANJAY
JOB NO. : 1701

LOT-IB PROJECTS
FLUE GAS DESHULPURISATION (FGD)
PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI
BID DOC. NO.: CS-0011-109 (1B)-2

PART-A
PROJECT INFORM.
BARH STPP STAGE-2
(2X660 MW)

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CLAUSE NO.

Project Information



CLIENT : NTPC LIMITED																
PROJECT : Geotechnical Investigation for 2 X 800 MW Barh STPP at Barh in Bihar																
BORE HOLE NO. : BH-36						SHEET NO. : 3 OF 4										
DEPTH (m.)	DIA. OF BORE HOLE	LOG	STRATA DESCRIPTION	SAMPLE		BLOWN/STROKES				SPT N	CR %	RQD %	CORRECTED SPT N'			
				DEPTH (m.)	TYPE	15	15	15	15							
21.00	150 mm Ø		Dense greyish fine SAND	21.00/									N=22			
21.60				SPT6	09	16	21	30	37							
22.00																
24.00						24.00/										
24.60			SPT9	10	13	18	22	31								
25.50/					Hard yellowish grey silty CLAY	25.50/										
26.00			UDS6													
27.00						27.00/										
27.60			SPT10	12	29	36	41	65								
28.50/					Hard yellowish grey clayey SILT with gravel	28.50/										
28.78	UDS7															
31.00																

SPT N = STANDARD PENETRATION TEST VALUE RQD = ROCK QUALITY DESIGNATION UDS = UNDISTURBED SOIL SAMPLE
CR = CORE RECOVERY DS = DISTURBED SOIL SAMPLE VST = VANE SHEAR TEST

REMARKS : CONTINUED ON NEXT PAGE. SCALE : 1:50 Checked By : Ms. SAVITRI Drawn By : SANJAY

DBM GEOTECHNICS AND CONSTRUCTIONS PVT. LTD. MUMBAI. JOB NO. : 1701

CLAUSE NO.

Project Information



CLIENT : NTPC LIMITED													
PROJECT : Geotechnical Investigation for 2 X 800 MW Barh STPP at Barh in Bihar													
BORE HOLE NO. : BH- 36						SHEET NO. : 4 OF 4							
DEPTH (M.)	DIA. OF BORE HOLE	LOG.	STRATA DESCRIPTION	SAMPLE		BLOWS/15cm			SPT N	C/R %	RQD %	CORRECTED SPT 'N'	
				DEPTH (M.)	TYPE	15	15	15					
30.00	150 mm Ø		Dense yellowish grey fine silty SAND with gravel	30.00/	SPT11	12	19	26	30	45		N=23	
30.60													
31.00													
32.00													
33.00					Hard yellowish grey clayey SILT with gravel	33.00/							
33.60				SPT12		09	16	22	31	40			
34.00													
35.00						34.50/							
36.00						34.70	UDSs						
36.00						36.00/							
37.00					Hard grey clayey SILT with gravel	38.60	SPT13	10	16	20	26	36	
38.00						38.00/							
39.00				38.75	UDSs	SLIPPED							
40.00				40.00/									
40.60				40.60	SPT14	20	22	27	34	49			
41.00													

SPT N = STANDARD PENETRATION TEST VALUE
 CR = CORE RECOVERY
 RQD = ROCK QUALITY DESIGNATION
 DS = DISTURBED SOIL SAMPLE
 UDS = UNDISTURBED SOIL SAMPLE
 VST = VANE SHEAR TEST

REMARKS : BORE HOLE TERMINATED AT DEPTH OF 40.60m BELOW GL.

DBM GEOTECHNICS AND CONSTRUCTIONS PVT. LTD. MUMBAI.

SCALE : 1:50
 JOB NO. : 1701
 Checked By : Ms. SAVITRI
 Drawn By : SANJAY

CLAUSE NO.

Project Information



CLIENT : NTPC LIMITED													
PROJECT : Geotechnical Investigation for 2 X 800 MW Barh STPP at Barh in Bihar													
BORE HOLE NO. : BH-40				SHEET NO. : 1 OF 4									
LOCATION : -				DATE : 24/12/06 to 29/12/07									
CO-ORDINATE : E-810.00 S -785.50				METHOD : ROTARY DRILLING.									
GROUND R. L. : 46.72m				CASING : 150mm.Ø upto 2.40m. Below G.L.									
GROUND W. T. : 2.60m Below G.L.													
DEPTH (m)	DIA. OF BORE HOLE	LOG	STRATA DESCRIPTION	SAMPLE			BLOWS/15cm			SPT N	CR %	RQD %	CORRECTED SPT N'
				DEPTH (m)	TYPE	15	15	15	15				
1.50/			Filled up Soil									N=11	
2.10/		SPT1		03	03	05	06	08					
3.00/													
3.60/		SPT2		02	03	04	05	07					
4.20/	150 mm Ø		Medium stiff to stiff blackish silty CLAY										
4.50/													
5.00/		UDS1											
6.00/													
6.60/		SPT3	05	07	08	11	15						
7.50/			Stiff reddish yellow clayey SILT										
8.00/		UDS2											
9.00/													
9.60/		SPT4		03	04	05	05	09					
10.00/													
SPT N = STANDARD PENETRATION TEST VALUE CR = CORE RECOVERY				RQD = ROCK QUALITY DESIGNATION DS = DISTURBED SOIL SAMPLE				UDS = UNDISTURBED SOIL SAMPLE VST = VANE SHEAR TEST					
REMARKS : CONTINUED ON NEXT PAGE.								SCALE : 1:50		Checked By : Ms. SAVITRI		Drawn By: SANJAY	
DBM GEOTECHNICS AND CONSTRUCTIONS PVT. LTD. MUMBAI.											JOB NO. : 1701		

CLAUSE NO.

Project Information



CLIENT : NTPC LIMITED													
PROJECT : Geotechnical investigation for 2 X 800 MW Barh STPP at Barh in Bihar													
BORE HOLE NO. : BH-40						SHEET NO. : 2 OF 4							
DEPTH (m.)	DIA. OF BORE HOLE	LOG	STRATA DESCRIPTION	SAMPLE		BLOWS/15cm				SPT N	CR %	RQD %	CORRECTED SPT N
				DEPTH (m)	TYPE	15	15	15	15				
11.00			Stiff reddish yellow silty CLAY	10.00									
				10.50									
				11.00	UDS3								
12.00				12.00									
				12.80	SPT5	06	08	09	11	17			
14.00			Very stiff reddish silty CLAY	13.50									
				14.00	UDS4	SLIPPED							
15.00	150 mm Ø			15.00									
				15.80	SPT6	08	08	10	14	18			
17.00				16.50									
				17.00	UDS5								
18.00				18.00									
				18.80	SPT7	15	20	22	27	42			
19.00			Hard reddish fine sandy SILT	19.50									
				20.00	UDS6	SLIPPED							
21.00													

SPT N = STANDARD PENETRATION TEST VALUE RQD = ROCK QUALITY DESIGNATION UDS = UNDISTURBED SOIL SAMPLE
 CR = CORE RECOVERY DS = DISTURBED SOIL SAMPLE VST = VANE SHEAR TEST

REMARKS : CONTINUED ON NEXT PAGE

DBM GEOTECHNICS AND CONSTRUCTIONS PVT. LTD. MUMBAI. SCALE : 1:50 Checked By : Ms. SAVITRI Drawn By: SANJAY
 JOB NO. : 1701

CLAUSE NO.

Project Information



CLIENT : NTPC LIMITED													
PROJECT : Geotechnical Investigation for 2 X 800 MW Barh STPP at Barh in Bihar													
BORE HOLE NO. : BH-40					SHEET NO. : 3 OF 4								
DEPTH (m.)	DIA. OF BORE HOLE	LOG	STRATA DESCRIPTION	SAMPLE		BLOWS/15cm			SPT N	CR %	RQD %	CORRECTED SPT N	
				DEPTH (m)	TYPE	15	15	15					
21.00	150 mm Ø		Hard greyish yellow sandy silty with gravel	21.00/								N=20	
21.60				SPT8	10	13	18	21	31				
22.50/													
23.00				UDS7	SLIPPED								
24.00/													
24.60			SPT9	12	16	19	24	35					
25.50/													
26.00			UDS8										
27.00/													
27.60			SPT10	13	17	24	34	41					
28.50/													
28.88	UDS9												
29.00													
30.00													
31.00													
SPT N = STANDARD PENETRATION TEST VALUE CR = CORE RECOVERY				RQD = ROCK QUALITY DESIGNATION DS = DISTURBED SOIL SAMPLE				UDS = UNDISTURBED SOIL SAMPLE VST = VANE SHEAR TEST					
REMARKS : CONTINUED ON NEXT PAGE.							SCALE : 1:50	Checked By : Ms. SAVITRI	Drawn By : SANJAY				
DBM GEOTECHNICS AND CONSTRUCTIONS PVT. LTD. MUMBAI.							JOB NO. : 1701						

CLAUSE NO.

Project Information



CLIENT : NTPC LIMITED															
PROJECT : Geotechnical Investigation for 2 X 800 MW Barh STPP at Barh in Bihar															
BORE HOLE NO. : BH- 4D						SHEET NO. : 4 OF 4									
DEPTH (m.)	DIA. OF BORE HOLE	LOG	STRATA DESCRIPTION	SAMPLE		BLOWS/15cm				SPT N	CR %	RQD %	CORRECTED SPT 'N'		
				DEPTH (m)	TYPE	15	15	15	15						
30.00	150 mm Ø		Hard yellowish grey sandy SILT with gravel	30.00	SPT11	10	16	21	27	37			N=20		
30.60															
31.00															
32.00															
33.00															
33.00						Hard yellowish brown clayey SILT	33.00								
33.60					33.60		SPT12	11	14	17	22	31			
34.00															
34.50							34.50								
34.85							34.85	UDS10							
35.00															
36.00						36.00									
36.00			Hard grey sandy SILT with gravel	36.00	SPT13	12	17	22	26	39			N=20		
37.00															
38.00					38.00										
38.40					38.40	UDS11									
39.00															
40.00					40.00										
40.00				40.00											
40.60				40.60	SPT14	15	18	26	31	44			N=21		
41.00															

SPT N = STANDARD PENETRATION TEST VALUE RQD = ROCK QUALITY DESIGNATION UDS = UNDISTURBED SOIL SAMPLE
CR = CORE RECOVERY DS = DISTURBED SOIL SAMPLE VST = VANE SHEAR TEST

REMARKS : BORE HOLE TERMINATED AT DEPTH OF 40.60m BELOW GL


DBM GEOTECHNICS AND CONSTRUCTIONS PVT. LTD. MUMBAI. SCALE : 1: 50 Checked By : Ms. SAVITRI Drawn By: SANJAY
JOB NO. : 1701

LOT-IB PROJECTS
FLUE GAS DESHULPURISATION (FGD)
PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI
BID DOC. NO.: CS-0011-109 (1B)-2

PART-A
PROJECT INFORM.
BARH STPP STAGE-2
(2X660 MW)

PAGE 21 OF 33

CLAUSE NO.	Project Information			
<p align="center">LOT-IB PROJECTS FLUE GAS DESHULPURISATION (FGD) PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (1B)-2</p>	<p align="center">PART-A PROJECT INFORM. BARH STPP STAGE-2 (2X660 MW)</p>	<p align="center">PAGE 22 OF 33</p>	

CLAUSE NO.

Project Information



ANNEXURE-I



LOT-IB PROJECTS
FLUE GAS DESHULPURISATION (FGD)
PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI
BID DOC. NO.: CS-0011-109 (1B)-2

PART-A
PROJECT INFORM.
BARH STPP STAGE-2
(2X660 MW)

CLAUSE NO.

Project Information



ANNEXURE-II

महाराष्ट्र विद्युत निगम
CLIMATOLOGICAL TABLE
आधार पर वर्षा का वितरण
BASED ON OBSERVATIONS FROM 1981 TO 1990

STATION NAME: **BARH**
STATION CODE: **1000**
ELEVATION: **1000** M
LATITUDE: **19° 00' N**
LONGITUDE: **75° 00' E**

STATION NAME	WIND SPEED (km/hr)		WIND DIRECTION		WIND VELOCITY (km/hr)		WIND FORCE		WIND DIRECTION		WIND VELOCITY (km/hr)		WIND FORCE		WIND DIRECTION		WIND VELOCITY (km/hr)		WIND FORCE					
	MAX	AVERAGE	NO. OF DAYS	PERCENT	NO. OF DAYS	PERCENT	NO. OF DAYS	PERCENT	NO. OF DAYS	PERCENT	NO. OF DAYS	PERCENT	NO. OF DAYS	PERCENT	NO. OF DAYS	PERCENT	NO. OF DAYS	PERCENT	NO. OF DAYS	PERCENT				
1. 1981	14.3	11.2	318	100	375	0.8	30.3	12	2.8	180	12	22	8.8	22	8.8	1.8	0.8	25	1.2	1557	9.8	874	23	8.8
2. 1982	14.3	11.2	318	100	375	0.8	30.3	12	2.8	180	12	22	8.8	22	8.8	1.8	0.8	25	1.2	1557	9.8	874	23	8.8
3. 1983	14.3	11.2	318	100	375	0.8	30.3	12	2.8	180	12	22	8.8	22	8.8	1.8	0.8	25	1.2	1557	9.8	874	23	8.8
4. 1984	14.3	11.2	318	100	375	0.8	30.3	12	2.8	180	12	22	8.8	22	8.8	1.8	0.8	25	1.2	1557	9.8	874	23	8.8
5. 1985	14.3	11.2	318	100	375	0.8	30.3	12	2.8	180	12	22	8.8	22	8.8	1.8	0.8	25	1.2	1557	9.8	874	23	8.8
6. 1986	14.3	11.2	318	100	375	0.8	30.3	12	2.8	180	12	22	8.8	22	8.8	1.8	0.8	25	1.2	1557	9.8	874	23	8.8
7. 1987	14.3	11.2	318	100	375	0.8	30.3	12	2.8	180	12	22	8.8	22	8.8	1.8	0.8	25	1.2	1557	9.8	874	23	8.8
8. 1988	14.3	11.2	318	100	375	0.8	30.3	12	2.8	180	12	22	8.8	22	8.8	1.8	0.8	25	1.2	1557	9.8	874	23	8.8
9. 1989	14.3	11.2	318	100	375	0.8	30.3	12	2.8	180	12	22	8.8	22	8.8	1.8	0.8	25	1.2	1557	9.8	874	23	8.8
10. 1990	14.3	11.2	318	100	375	0.8	30.3	12	2.8	180	12	22	8.8	22	8.8	1.8	0.8	25	1.2	1557	9.8	874	23	8.8
TOTAL	14.3	11.2	318	100	375	0.8	30.3	12	2.8	180	12	22	8.8	22	8.8	1.8	0.8	25	1.2	1557	9.8	874	23	8.8

CLAUSE NO.


Project Information





वैश्वविद्यालय सारणी
CLIMATOLOGICAL TABLE


STATION: BARH
STATION PHONO: 147 2337 N. 000 17' 10" E
STATION NAME: BARH STATION
STATION ALTITUDE: 53 METRES
BASED ON OBSERVATIONS FROM 1981 TO 1987


MONTH	WIND		TEMPERATURE		HUMIDITY		EXTREMES		RAINFALL	
	Direction	Speed	Max	Min	Rel. Humidity	Abs. Humidity	Date	Value	Month	Amount
JAN	14.5	12.0	25.6	15.6	77.5	6.8	36.3	19	5.4	185.0
FEB	16.0	13.5	27.2	17.4	82.0	7.7	55.1	22	2.2	187.7
MAR	18.5	16.0	32.0	22.0	85.0	10.4	65.0	27	7.4	187.7
APR	22.0	19.5	35.0	25.0	87.0	13.4	74.0	31	11	187.7
MAY	26.0	23.0	38.0	28.0	89.0	16.4	82.0	35	15	187.7
JUN	30.0	27.0	41.0	31.0	91.0	19.4	88.0	39	19	187.7
JUL	34.0	31.0	44.0	34.0	93.0	22.4	94.0	43	23	187.7
AUG	38.0	35.0	47.0	37.0	95.0	25.4	98.0	47	27	187.7
SEP	42.0	39.0	50.0	40.0	97.0	28.4	100.0	51	31	187.7
OCT	46.0	43.0	53.0	43.0	99.0	31.4	102.0	55	35	187.7
NOV	50.0	47.0	56.0	46.0	100.0	34.4	104.0	59	39	187.7
DEC	54.0	51.0	59.0	49.0	101.0	37.4	106.0	63	43	187.7
ANNUAL	31.5	28.5	37.5	27.5	87.5	21.5	87.5	36.5	21.5	187.7
WIND	31.5		27.5		87.5		87.5		21.5	
TEMPERATURE	31.5		27.5		87.5		87.5		21.5	
HUMIDITY	31.5		27.5		87.5		87.5		21.5	
EXTREMES	31.5		27.5		87.5		87.5		21.5	
RAINFALL	31.5		27.5		87.5		87.5		21.5	


CLAUSE NO.	Project Information					
						
TABLE – 1						
COAL CHARACTERISTICS						
Sl. No.	Description	Symbol	Design Coal	Worst Coal	Best Coal	Range of Adequacy Coal
1	2	3	4	5	6	7
A. PROXIMATE ANALYSIS						
(As received basis)						
1.	Total Moisture	%	15.00	17.00	12.00	10 - 20
2.	Ash	%	40.00	42.00	34.00	30 - 46
3.	Volatile matter	%	19.00	18.00	22.00	24 - 16
4.	Fixed carbon	%	26.00	23.00	32.00	36 - 18
B. ULTIMATE ANALYSIS						
(As received basis)						
1.	Carbon	C%	31.37	28.93	40.08	48 - 24.75
2.	Hydrogen	H2%	3.40	2.40	3.50	3.6 - 2.2
3.	Nitrogen	N2%	1.5	1.45	1.78	1.8 - 0.4
4.	Oxygen (By difference)	O2%	7.75	7.26	8.03	8.1 - 5.5
5.	Sulphur	S%	0.40	0.5	0.36	0.30 - 0.5
6.	Carbonates	CO3%	0.3	0.26	0.15	0.10 - 0.35
7.	Phosphorous	P2%	0.28	0.20	0.10	0.1 - 0.3
8.	Total Moisture	H2O%	15.0	17.0	12.0	10 - 20
9.	Ash	%	40.0	42.0	34.0	30.0 - 46.0
10.	Total	%	100	100	100	
11.	Gross Calorific Value	KCal/Kg	3300	2800	4000	4500 - 2500
12.	Hard grove index		55	50	60	45 - 65
LOT-IB PROJECTS FLUE GAS DESHULPURISATION (FGD) PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (1B)-2	PART-A PROJECT INFORM. BARH STPP STAGE-2 (2X660 MW)	PAGE 27 OF 33			


CLAUSE NO.	Project Information						
Sl. No.	Description	Symbol	Design Coal	Worst Coal	Best Coal	Range of Adequacy Coal	
1	2	3	4	5	6	7	
C. ASH ANALYSIS							
1.	Silica	(SiO ₂)%	59.79	61.3	56.7	62.0 - 56.0	
2.	Alumina	(Al ₂ O ₃)%	25.36	28.0	23.5	28.0 - 23.0	
3.	Iron Oxide	(Fe ₂ O ₃)%	7.2	6.0	10.0	6.0 - 10.0	
4.	Titania	(TiO ₂)%	1.2	1.0	1.5	1.0 - 1.7	
5.	Phosphoric Anhydride	(P ₂ O ₅)%	2.6	1.5	3.0	1.0 - 3.0	
6.	Lime	(CaO)%	0.88	0.5	1.5	0.5 - 1.7	
7.	Magnesia	(MgO)%	0.55	0.4	1.0	0.4 - 1.1	
8.	Sulphuric Anhydride	(SO ₃)%	1.2	0.5	1.4	0.5 - 1.7	
9.	Alkalies (Na ₂ O+K ₂ O) (%) (by difference)		1.22	0.8	1.4	0.6 - 1.8	
NOTE: Na ₂ O content in the above shall not be more than 0.1%							
D. ASH FUSION RANGE							
(Under reducing atmosphere)							
a)	Initial Deformation Temperature (IDT) °C		1100	1100	1100	1100 - 1150	
b)	Hemispherical temperature °C		1300	1250	1350	1250 - 1400	
c)	Flow temperature °C		1400	1350	1400	1400 - 1450	
LOT-IB PROJECTS FLUE GAS DESHULPURISATION (FGD) PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (1B)-2		PART-A PROJECT INFORM. BARH STPP STAGE-2 (2X660 MW)		PAGE 28 OF 33	

CLAUSE NO.	Project Information																										
<p>TABLE-2</p> <p>LIGHT DIESEL OIL CHARACTERISTICS</p> <p>AS PER IS 1460-2000</p> <table border="1"> <thead> <tr> <th>Characteristics</th> <th>LDO</th> </tr> </thead> <tbody> <tr> <td>1. Pour Point (max)</td> <td>21 deg.C & 12°C for Summer and Winter respectively</td> </tr> <tr> <td>2. Kinematic viscosity in centistokes at 40 deg.C</td> <td>2.5 to 15</td> </tr> <tr> <td>3. Sediment percent by mass (max)</td> <td>0.10</td> </tr> <tr> <td>4. Total sulphur percent by mass (max)</td> <td>1.5</td> </tr> <tr> <td>5. Ash percentage by mass (max)</td> <td>0.02</td> </tr> <tr> <td>6. Carbon residue (Rans bottom) percent by pass (max.)</td> <td>1.50</td> </tr> <tr> <td>7. Acidity in organic</td> <td>Nil</td> </tr> <tr> <td>8. Flash point(Min.) - Pensky Martens</td> <td>66 deg.C</td> </tr> <tr> <td>9. Copper strip corrosion for 3 hours at 100°C</td> <td>Not worse than No. 2</td> </tr> <tr> <td>10. Water content, % by volume(max)</td> <td>0.25</td> </tr> <tr> <td>11. GCV (Kcal/kg)</td> <td>10,000</td> </tr> </tbody> </table>				Characteristics	LDO	1. Pour Point (max)	21 deg.C & 12°C for Summer and Winter respectively	2. Kinematic viscosity in centistokes at 40 deg.C	2.5 to 15	3. Sediment percent by mass (max)	0.10	4. Total sulphur percent by mass (max)	1.5	5. Ash percentage by mass (max)	0.02	6. Carbon residue (Rans bottom) percent by pass (max.)	1.50	7. Acidity in organic	Nil	8. Flash point(Min.) - Pensky Martens	66 deg.C	9. Copper strip corrosion for 3 hours at 100°C	Not worse than No. 2	10. Water content, % by volume(max)	0.25	11. GCV (Kcal/kg)	10,000
Characteristics	LDO																										
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<p>LOT-1B PROJECTS FLUE GAS DESHULPURISATION (FGD) PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (1B)-2</p>	<p>PART-A PROJECT INFORM. BARH STPP STAGE-2 (2X660 MW)</p>	<p>PAGE 29 OF 33</p>																								

CLAUSE NO.	Project Information																																																																									
																																																																										
TABLE -3 FUEL OIL CHARACTERISTICS																																																																										
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Sl. No.</th> <th style="text-align: left;">Characteristics</th> <th style="text-align: left;">Heavy Furnace Oil IS-1593 1971 Grade HV</th> <th style="text-align: left;">Low Sulphur Heavy Stock (LSHS)</th> <th style="text-align: left;">Heavy Petroleum Stock (HPS)</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Total sulphur content</td> <td>4.5% Max.</td> <td>1.0% Max.</td> <td>4.5% Max.</td> </tr> <tr> <td>2.</td> <td>Gross calorific value (KCal/kg)</td> <td>of the order of 11,000</td> <td>of the order of 11,000</td> <td>9,500 (min)</td> </tr> <tr> <td>3.</td> <td>Flash Point (Min)</td> <td>66 deg C</td> <td>75 deg C</td> <td>75 deg C</td> </tr> <tr> <td>4.</td> <td>Water content by volume (Max)</td> <td>1.0%</td> <td>1.0%</td> <td>1.0%</td> </tr> <tr> <td>5.</td> <td>Sediment by weight (Max)</td> <td>0.25%</td> <td>0.25%</td> <td>0.25%</td> </tr> <tr> <td>6.</td> <td>Asphaltene content by weight (Max.)</td> <td>2.5%</td> <td>2.5%</td> <td>2.5%</td> </tr> <tr> <td>7.</td> <td>Kinematic viscosity in Centistokes at - 50deg C (Max)</td> <td>370</td> <td>180</td> <td>500</td> </tr> <tr> <td>8.</td> <td>Ash Content by weight (Max.)</td> <td>0.1%</td> <td>0.05%</td> <td>0.1%</td> </tr> <tr> <td>9.</td> <td>Acidity (inorganic)</td> <td>Nil</td> <td>Nil</td> <td>Nil</td> </tr> <tr> <td>10.</td> <td>Pour Point (Max.)</td> <td>57 deg C</td> <td>72 deg C</td> <td></td> </tr> <tr> <td>11.</td> <td>Sodium content</td> <td>—</td> <td>—</td> <td>100 ppm</td> </tr> <tr> <td>12.</td> <td>Vanadium content</td> <td>25 ppm</td> <td>25 ppm</td> <td>25 ppm</td> </tr> <tr> <td>13.</td> <td>Specific heat below pour point (KCal/Kg °C)</td> <td></td> <td>0.65</td> <td></td> </tr> </tbody> </table>	Sl. No.	Characteristics	Heavy Furnace Oil IS-1593 1971 Grade HV	Low Sulphur Heavy Stock (LSHS)	Heavy Petroleum Stock (HPS)	1.	Total sulphur content	4.5% Max.	1.0% Max.	4.5% Max.	2.	Gross calorific value (KCal/kg)	of the order of 11,000	of the order of 11,000	9,500 (min)	3.	Flash Point (Min)	66 deg C	75 deg C	75 deg C	4.	Water content by volume (Max)	1.0%	1.0%	1.0%	5.	Sediment by weight (Max)	0.25%	0.25%	0.25%	6.	Asphaltene content by weight (Max.)	2.5%	2.5%	2.5%	7.	Kinematic viscosity in Centistokes at - 50deg C (Max)	370	180	500	8.	Ash Content by weight (Max.)	0.1%	0.05%	0.1%	9.	Acidity (inorganic)	Nil	Nil	Nil	10.	Pour Point (Max.)	57 deg C	72 deg C		11.	Sodium content	—	—	100 ppm	12.	Vanadium content	25 ppm	25 ppm	25 ppm	13.	Specific heat below pour point (KCal/Kg °C)		0.65				
Sl. No.	Characteristics	Heavy Furnace Oil IS-1593 1971 Grade HV	Low Sulphur Heavy Stock (LSHS)	Heavy Petroleum Stock (HPS)																																																																						
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7.	Kinematic viscosity in Centistokes at - 50deg C (Max)	370	180	500																																																																						
8.	Ash Content by weight (Max.)	0.1%	0.05%	0.1%																																																																						
9.	Acidity (inorganic)	Nil	Nil	Nil																																																																						
10.	Pour Point (Max.)	57 deg C	72 deg C																																																																							
11.	Sodium content	—	—	100 ppm																																																																						
12.	Vanadium content	25 ppm	25 ppm	25 ppm																																																																						
13.	Specific heat below pour point (KCal/Kg °C)		0.65																																																																							
LOT-IB PROJECTS FLUE GAS DESHULPURISATION (FGD) PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109 (1B)-2	PART-A PROJECT INFORM. BARH STPP STAGE-2 (2X660 MW)	PAGE 30 OF 33																																																																							

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	<p style="text-align: center;">Table-4 DESIGN CLARIFIED WATER ANALYSIS (Barh Stage-II)</p> <table border="1"> <thead> <tr> <th>S.No</th> <th>Constituent</th> <th>As</th> <th>mg/l (except pH & turbidity)</th> </tr> </thead> <tbody> <tr><td>1.</td><td>Calcium</td><td>CaCO₃</td><td>200.5</td></tr> <tr><td>2.</td><td>Magnesium</td><td>CaCO₃</td><td>92</td></tr> <tr><td>3.</td><td>Sodium + Potassium</td><td>CaCO₃</td><td>96</td></tr> <tr><td>4.</td><td>Total Cations</td><td>CaCO₃</td><td>388.50</td></tr> <tr><td>5.</td><td>Chloride</td><td>CaCO₃</td><td>106</td></tr> <tr><td>6.</td><td>Sulphate</td><td>CaCO₃</td><td>58.5</td></tr> <tr><td>7.</td><td>Alkalinity</td><td>CaCO₃</td><td>224</td></tr> <tr><td>8.</td><td>Total Anions</td><td>CaCO₃</td><td>388.50</td></tr> <tr><td>9.</td><td>Iron(total)</td><td>Fe</td><td>0.3</td></tr> <tr><td>10.</td><td>Silica</td><td>SiO₂</td><td>10</td></tr> <tr><td>11.</td><td>pH value</td><td>---</td><td>7.0-8.5</td></tr> <tr><td>12.</td><td>Turbidity</td><td>NTU</td><td>10</td></tr> </tbody> </table> <p>Note: Clarified water is used for CW system as make up & the CW system is expected to operate at about 5.0 – 5.5 Cycles of Concentration (COC) with suitable chemical treatment program using acid, scale & corrosion inhibitor dosing. As CW blow down water is tapped from CW system, the water quality of CW blow down shall accordingly be arrived by the bidder.</p> <p style="text-align: center;">Table-5 ANALYSIS OF DM WATER</p> <p style="text-align: center;">ANALYSIS OF DM WATER TO BE USED FOR MAKE-UP WATER TO CONDENSER</p> <table border="1"> <thead> <tr> <th>S.No.</th> <th>Characteristics</th> <th>Value</th> </tr> </thead> <tbody> <tr><td>i)</td><td>Silica (Max.)</td><td>0.02 ppm as SiO₂</td></tr> <tr><td>ii)</td><td>Iron as Fe</td><td>Nil</td></tr> <tr><td>iii)</td><td>Total hardness</td><td>Nil</td></tr> <tr><td>iv)</td><td>pH value</td><td>6.8 to 7.2</td></tr> <tr><td>v)</td><td>Conductivity</td><td>Not more than 0.1 excluding the effects of free CO₂</td></tr> </tbody> </table>				S.No	Constituent	As	mg/l (except pH & turbidity)	1.	Calcium	CaCO ₃	200.5	2.	Magnesium	CaCO ₃	92	3.	Sodium + Potassium	CaCO ₃	96	4.	Total Cations	CaCO ₃	388.50	5.	Chloride	CaCO ₃	106	6.	Sulphate	CaCO ₃	58.5	7.	Alkalinity	CaCO ₃	224	8.	Total Anions	CaCO ₃	388.50	9.	Iron(total)	Fe	0.3	10.	Silica	SiO ₂	10	11.	pH value	---	7.0-8.5	12.	Turbidity	NTU	10	S.No.	Characteristics	Value	i)	Silica (Max.)	0.02 ppm as SiO ₂	ii)	Iron as Fe	Nil	iii)	Total hardness	Nil	iv)	pH value	6.8 to 7.2	v)	Conductivity	Not more than 0.1 excluding the effects of free CO ₂
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CLAUSE NO.	Project Information																													
1.00.00	<p style="text-align: center;">Table-6</p> <p>STEAM GENERATOR DATA</p> <table border="0"> <tr> <td style="padding-left: 20px;">1. Location</td> <td style="padding-left: 100px;">Outdoor</td> </tr> <tr> <td>2. Operation</td> <td>Base load</td> </tr> <tr> <td>3. Type</td> <td>Pulverised coal fired</td> </tr> <tr> <td>4. Maximum Continuous Rating</td> <td>2120 Tonns/hr.</td> </tr> <tr> <td>5. Steam pressure at SH outlet</td> <td>256 Kg/cm²(a)</td> </tr> <tr> <td>6. Steam temperature at SH outlet</td> <td>568°C</td> </tr> <tr> <td>7. Oil for start up and flame stabilisation</td> <td>LDO/HFO</td> </tr> <tr> <td>8. Fuel oil system sizing</td> <td>30% of Boiler MCR for HFO</td> </tr> <tr> <td>9. Pulverised coal size</td> <td>Minimum 70% through 200 Mesh and 99% thru 50 mesh</td> </tr> <tr> <td>10. Type of pulveriser</td> <td>Vertical spindle mills</td> </tr> <tr> <td>11. Type of oil burners</td> <td>Air/Steam atomised for LDO/ HFO</td> </tr> <tr> <td>12. No. of air heaters</td> <td>2 Nos PAPH, 2 Nos SAPH</td> </tr> <tr> <td>13. No. of ID Fans</td> <td>Two (Axial Type, both working)</td> </tr> </table>			1. Location	Outdoor	2. Operation	Base load	3. Type	Pulverised coal fired	4. Maximum Continuous Rating	2120 Tonns/hr.	5. Steam pressure at SH outlet	256 Kg/cm ² (a)	6. Steam temperature at SH outlet	568°C	7. Oil for start up and flame stabilisation	LDO/HFO	8. Fuel oil system sizing	30% of Boiler MCR for HFO	9. Pulverised coal size	Minimum 70% through 200 Mesh and 99% thru 50 mesh	10. Type of pulveriser	Vertical spindle mills	11. Type of oil burners	Air/Steam atomised for LDO/ HFO	12. No. of air heaters	2 Nos PAPH, 2 Nos SAPH	13. No. of ID Fans	Two (Axial Type, both working)	
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CLAUSE NO.	Project Information																																				
	<p>List of Drawings placed below in this sub section:</p> <table border="1"> <thead> <tr> <th>Sl.no.</th> <th>Drawing description</th> <th>Drawing no.</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>General Layout Plan</td> <td>9560-999-POC-F-001</td> </tr> <tr> <td>2.</td> <td>Topographical Survey</td> <td>9560-999-POC-F-002</td> </tr> <tr> <td>3.</td> <td>Equipment Layout Plan</td> <td>9560-999-POM-A-001</td> </tr> <tr> <td>4.</td> <td>ID system-Elevation & Plan</td> <td>(a) 9560-102-01TR-PVM-F-005 SH1 (b) 9560-102-01TR-PVM-F-005 SH2</td> </tr> <tr> <td>5.</td> <td>Chimney foundation</td> <td>Refer details below</td> </tr> </tbody> </table> <p style="text-align: center;">Chimney Details</p> <table border="1"> <thead> <tr> <th>Sl. No.</th> <th>Project</th> <th>Chimney shell outer diameter at ground level (m)</th> <th>Chimney foundation outer diameter (m)</th> <th>Type of foundation</th> <th>Level of Top of foundation (m)</th> <th>Level of Bottom of foundation (m)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Barh-II</td> <td>34.5</td> <td>55.78</td> <td>Raft supported on piles</td> <td>RL(+) 45.70</td> <td>RL(+) 40.95</td> </tr> </tbody> </table>					Sl.no.	Drawing description	Drawing no.	1.	General Layout Plan	9560-999-POC-F-001	2.	Topographical Survey	9560-999-POC-F-002	3.	Equipment Layout Plan	9560-999-POM-A-001	4.	ID system-Elevation & Plan	(a) 9560-102-01TR-PVM-F-005 SH1 (b) 9560-102-01TR-PVM-F-005 SH2	5.	Chimney foundation	Refer details below	Sl. No.	Project	Chimney shell outer diameter at ground level (m)	Chimney foundation outer diameter (m)	Type of foundation	Level of Top of foundation (m)	Level of Bottom of foundation (m)	1	Barh-II	34.5	55.78	Raft supported on piles	RL(+) 45.70	RL(+) 40.95
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NTPC Limited

(A Government of India Enterprise)



LOT 1A PROJECTS

**PART – B
(DETAILED TECHNICAL SPECIFICATION)**

**SUB-SECTION-IV-D
(CIVIL WORKS)**

SECTION – VI

TECHNICAL SPECIFICATION

FOR

FLUE GAS DESULPHURISATION (FGD)

SYSTEM PACKAGE



PART - B (DETAILED TECHNICAL SPECIFICATION)

SUB-SECTION-IV-D (CIVIL WORKS)

LOT-IA PROJECTS
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI
BID DOCUMENT NO.: CS-0011-109(1A)-2



SUB-SECTION-IV-D

CIVIL WORKS

**LOT-IA PROJECTS
FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION
SECTION-VI
BID DOCUMENT NO.: CS-0011-109(1A)-2**

CLAUSE NO.	TECHNICAL REQUIREMENTS		
1.00.00	GENERAL		
1.01.00	<p>This section of the bidding document deals mainly with the technical specification for the design and preparation of detailed drawings, getting the design and drawings approved by the Employer, fabrication, erection and construction of the necessary civil, structural and architectural works associated with the FGD package for Lot-1A. The work shall have to be carried out both below and above ground level and shall be involving, basements, equipment foundations, slabs, beams, columns, footings, rafts, walls, steel frames, brick walls, stairs, trenches, pits, access roads, culverts, trestles, silos, sumps, Limestone storage hopper & shed, Crusher House, Transfer points, Conveyor Galleries, Tunnels, Gypsum storage shed, Chimney, Gypsum dewatering building, Ball Mill building, FGD control room building, Tank Foundations, absorber tower foundation, transformer foundation, MCC Building, finishes, complete architectural aspects, drainage, sanitation, water supply (from terminal points to various buildings/facilities) and all other civil, structural and architectural works associated with the complete FGD package.</p>		
1.02.00	<p>The specifications are intended for the general description of the work, quality and workmanship. The specifications are not, however, intended to cover minutest details and the work shall be executed according to the relevant latest Indian Standard Codes / I. R. S. / I. R. C. specifications. In absence of the above, the work shall be executed according to the best prevailing local Public Works Department practices or to the recommendations of relevant American and British Standards or to the instructions of the Engineer. Some of the relevant I. S. Codes to be followed is mentioned in the Technical Specifications. The Contractor is expected to get clarified on any doubts about the specifications, etc. before bidding, in writing with the Employer in respect of interpretation of any portions of this document.</p>		
1.03.00	<p>Bidder or his agencies engaged as detailer for fabrication drawings should have the experience of detailing for power plant structures or steel plant or Industrial structures like Petro/ Chemical/ Refinery/ Cement/FGD Plant/Coal Handling Plant/Ash Handling Plant etc.</p> <p>The designer responsible for preparation of scope drawings shall review and approve the fabrication drawings prepared by the detailer before releasing them for fabrication.</p>		
2.00.00	Sub QR for Civil Works:		
2.01.00	<p>Bidder or its agency should have in past executed civil and structural works for 500 MW or higher capacity coal based/Lignite based power plant including earthwork in filling involving mechanical compaction and cutting in hard rock, foundations, Bulk material handling plant involving underground storage hopper and underground tunnels.</p>		
2.02.00	<p>Bidder can engage more than one agency, in case the Bidder itself is not able to meet the requirement at 2.01.00. The agency being engaged for a particular work should have in the past executed such works of 500 MW or higher capacity plant.</p>		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 1 OF 69</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.03.00	For Chimney, Bidder or its agency should have in the past built at least one (1) reinforced concrete chimney of minimum 100m height.		
2.04.00	<p>In case Bidder or its agency do not meet the requirements at 2.01.00 and the Bidder proposes to engage agency (ies) for civil & structural works on work volume basis (except for Chimney), Bidder or its agency (ies) should have executed such works in the past and the annual rate of execution in the reference works should not be less than eighty percent (80%) of the asking rate of such works, (structural steel fabrication & erection, RCC, earthwork in filling involving mechanical compaction and cutting in hard rock, RCC in underground storage hopper and underground tunnels) for which it is being engaged.</p> <p>Successful Bidder shall finalize the agency (ies) for each work in consultation with Engineer-in-charge at site before engaging them.</p>		
2.05.00	<p>Design agency for Civil & Steel Structural Works:</p> <p>Bidder or its agency (ies) should have carried out the design and detailed engineering of following works:</p> <ul style="list-style-type: none"> (i) Civil & Structural works associated with at least one bulk material handling plant for 500 MW or higher capacity coal based/Lignite based power plant. (ii) For Chimney, Bidder or its design agency (ies) should have carried out design & detailed engineering of at least one reinforced concrete chimney with steel flues, of minimum 100m height. (iii) Machine foundations such as Mill foundations/ Block foundations. 		
2.06.00	<p>Bidder can engage more than one agency (of repute), in case the Bidder itself is not able to meet the requirement at 2.05.00.</p> <p>The design agency (ies) proposed by the Bidder shall be subject to Employer's approval.</p>		
3.00.00	Work Description		
3.01.00	<p>Truck Hopper, Limestone Storage hopper and Underground Tunnel</p> <p>Truck Hopper shall consist of underground portion, which shall be of R. C. C. with structural steel shed covered with permanently Colour coated profiled steel sheets.</p> <p>Limestone storage hopper shall be of RCC with structural steel shed covered with permanently Colour coated profiled steel sheets.</p> <p>The structural arrangement to be adopted for the design and construction of Limestone Storage hopper shall essentially consist of R. C. C. frames spaced at approx. 3.0M centers with R. C. C. wall panels on the sides and R. C. C. raft at the bottom, fixed to the frames. Minimum thickness of R. C. C. raft at bottom shall be 600</p>		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 2 OF 69</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>mm. Minimum thickness of RCC side walls shall be 600 mm at bottom and 300 mm at top.</p> <p>The vertical and inclined portion of hopper shall be provided with 50 mm thick guniting (shotcreting). Details of shotcreting have been given elsewhere in this specification.</p> <p>Expansion joints shall be provided at a maximum distance of 40m. 600 mm wide water stop fabricated with 22G copper plate with bitumen board fillers and polysulphide sealing compound as specified elsewhere shall be used as expansion joint material.</p> <p>Floor shall be provided with cross slope not flatter than 1 in 50 towards side drains. Side drains shall be sloped towards sump where sump pumps as specified elsewhere, shall be provided. The slope of side drains shall not be flatter than 1 in 400. Side drains and sump shall have removable type steel grating cover.</p> <p>Water proofing / Damp proofing of under ground Truck hopper, Limestone Storage hopper, tunnels and underground (i. e. basement) portion of transfer houses shall be done by providing the following treatments:</p> <p>Chemical injection grouting for inner faces (details as specified elsewhere).</p> <p>Polymer modified cementitious coating on earth side face as per the following :</p> <ol style="list-style-type: none"> (1) On the outer surface of walls, frames and roof slabs coming in contact with earth, polymer modified cementitious coating in two layers as specified and as per manufacturer's specifications shall be provided directly on the concrete surface. (2) 50 mm thick P. C. C. (1 : 2 : 4 with 10 mm nominal size stone aggregates) shall be provided under the raft i.e. over the lean concrete, followed by polymer modified cementitious coating in two layers (slurry mix application) as per manufacturer's specification. 50 mm thick P. C. C. (1 : 2 : 4) with 10 mm nominal size stone aggregates shall then be laid over the polymer modified cementitious coating before laying the raft. <p>Truck hopper and its gratings shall be designed for movement of front end loader/ bulldozer over them. Bull dozer weight shall be considered as about 35T. The gratings shall be built of min. 200x28mm thick flats in main direction and min.100mm x 20mm thick in secondary direction. No painting/galvanization shall be provided in gratings. However, two coats of Red oxide Primer to be provided immediately after fabrication.</p> <p>Plinth protection along with drains shall be provided along the Hopper complex. However, 5m wide paving shall also be provided around machinery hatches.</p> <p>Earth pressure to be considered for design shall be due to earth pressure at rest (Ko) condition only. Earth pressure due to surcharge intensity of Uniformly Distributed Load (U. D. L) of intensity 2 T / Sq. M. shall be considered in the design.</p> <p>A minimum safety factor of 1.2 against uplift due to ground water shall be ensured during execution and after execution, considering dead weight of the structure to be</p>		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 3 OF 69</p>

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<p>3.02.00</p>	<p>0.9 times only, ground water table to be taken at adjoining formation level and soil wedge angle of not more than 15 degrees.</p> <p>Also, FOS against uplift, to be taken as 1.0, considering the dead wt. of structure and soil resting on side projections if any in the vertical plane. Inclined wedge action of soil shall not be considered in this case.</p> <p>Wherever, slope of tunnel exceeds 10°, R. C. C. steps shall be provided for the entire width of each walkway.</p> <p>Overhead / Ground Conveyor Galleries and Trestles</p> <p>Overhead conveyors shall be located in a suitably enclosed gallery of structural steel. The overhead gallery shall consist of two vertical latticed girders having rigid jointed portal frame at both ends. Cross beams at floor level supporting conveyor stringer beams shall be made of single rolled steel beam or single channel section (ISMB or ISMC) or plate girder. Horizontal bracings are to be provided at top & bottom plan of the gallery (latticed girders shall be braced together in plan at the top and bottom). Common end portal frame shall not be used for adjacent conveyor spans. Roof truss shall be provided at upper node points of latticed girders to form an enclosure. Contractor can also use tubular steel sections for roof truss only of conveyor galleries. The tubular steel section shall be of circular/rectangular/square shape. The circular steel tube shall conform to IS 1161 and rectangular/square steel sections shall conform to IS 4923. The steel structures using tubular sections shall be designed and fabricated as per IS 806 – “Code of Practice for use of steel tubes in general building construction.” and EN 1993-1-8:2005. The maximum span of overhead gallery shall be limited to 25 meters unless higher span is required due to site conditions, which shall be subject to approval of the Engineer. The gallery should as far as possible be erected as a box section keeping all the vertical and horizontal bracing tied in proper position. The gallery should be checked for all erection stresses that are likely to develop during handling and erection and if required, temporary strengthening of gallery members during erection shall be made.</p> <p>Seal plates under the conveyor galleries shall be provided in such a way that complete gallery bottom shall form a leak proof floor.</p> <p>The ground conveyors shall be located in suitably enclosed gallery of structural steel consisting of rigid portal frames spaced at regular intervals and suitably braced. Plinth protection along with drains shall be routed along the ground conveyors.</p> <p>For double stream conveyor gallery, two side and one central walkway of width 800 mm and 1100 mm respectively shall be provided. The width of two side walkways for single stream conveyor gallery shall be 800 mm and 1100 mm respectively. Both sides of central and side walkways shall be provided with pipe handrails all along the conveyor gallery. Hand railing should not be supported on conveyor supporting stringers. The walkways shall be chequered plate construction with anti - skid arrangement. The anti - skid arrangement will consist of welding of 10 mm square steel bars at a maximum spacing of 500 mm along the length of the gallery. Where the slope of walkway is more than 10°, chequered plate steps with nosing and toe guard shall be provided. The floor of conveyor gallery all along the gallery length, shall be provided with minimum 12 gauge thick seal plates and other drainage arrangements as specified elsewhere</p>		
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	<p>Conveyor gallery shall have permanently colour coated steel sheet covers on roof and both sides. However in roof, a panel of minimum 1.5 m x 1.5 m area at about 6.0 m center shall be provided with translucent sheets of polycarbonate material for natural lighting. A continuous slit opening of 500 mm shall be provided on both sides just below the roof sheeting. Adequate provision of windows shall be kept on both sides of conveyor gallery as appended in Mechanical Section (Belt conveyor system). Windows shall be provided with wire mesh as specified elsewhere in this specification.</p> <p>Cross - over with chequered plate platform and ladder for crossing over the conveyors shall be provided at approximately every 100 M intervals of conveyor. Crossover shall preferably be located over four-legged rigid trestle location.</p> <p>For railway tracks passing below overhead conveyor gallery and along conveyors, the railway clearances both underground as well as over ground shall have to be adhered to for design, execution and erection of foundations, trestles, galleries etc., so that movement of locomotives and wagons is not hampered in any way during execution and afterwards. However at the location where the overhead conveyor gallery crosses road / rail line, minimum clearance of 8.0m above the road crest / rail top shall be provided.</p> <p>For calculation of material load on moving conveyor, a multiplication factor 1.6 shall be used to take care of inertia force, casual over burden and impact factor etc.</p> <p>Thus material load per unit length of each moving conveyor shall be</p> $1.6 \quad \times \quad \frac{\text{Rated capacity of conveyor system}}{\text{Conveyor Belt Speed}} \quad \times \quad F$ <p>Where, F = 1700/1400 for lime & 1250/900 for gypsum</p> <p>It should be noted that for structural design, unit weight of lime shall be assumed as 1700 Kgs. / Cu. M. instead of 1400 Kgs. / Cu. M., unit weight of gypsum shall be assumed as 1250 Kgs. / Cu. M. instead of 900 Kgs. / Cu. M. considered for system sizing purpose. Conveyor Gallery structure shall be designed considering both conveyors operating simultaneously.</p> <p>Conveyor gallery and supporting trestles located between transfer houses / buildings shall be arranged in any one of the following ways.</p> <p>a) All gallery supporting trestles shall be four legged type only. One end of each gallery span shall be hinged to the supporting trestle and the other end shall be slide type. Slide type support shall be with P. T. F. E. bearings to allow both rotation & longitudinal movements.</p>		
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<p>3.03.00</p>	<p>b) In between transfer houses / buildings, four legged trestles shall be placed at a maximum interval of 90 metres. The arrangement shall be such so as to ensure that force in the longitudinal direction (i. e. along the conveyor length) of conveyor gallery of length not more than 90 m is transferred to any four legged trestle. In the space between each successive four legged trestles, two legged trestles shall be provided at regular intervals. The end supports resting on the four-legged trestle can have either ends hinged or one hinge and the other on slide type depending on the arrangements. Slide type support shall be with P. T. F. E. bearings to allow both rotation & longitudinal movements.</p> <p>End of conveyor gallery which will be supported over transfer house, shall be so detailed that only vertical reaction is transferred from conveyor gallery and no horizontal force in longitudinal direction is transferred from conveyor gallery to transfer house structure and vice - versa.</p> <p>For trestles and trestle foundations for conveyor galleries located adjacent to existing structures, over ground and under ground facilities, location and details of these trestles and foundations shall have to be decided such that there is no interference both underground as well as over ground with existing structures and facilities. Trestle columns / ground conveyor portal column base shall be kept 300 mm higher than the existing ground level.</p> <p>Transfer Houses</p> <p>The over ground portion of the transfer house shall be framed structure of structural steel work with permanently colour coated profiled steel sheet side cladding (from lowest working floor level till top) and R. C. C. floors comprising of RCC slab over profiled metal deck sheets (to be used as permanent shuttering) over structural beams. Shear anchor studs shall be provided through metal deck at regular interval on all top flange/flange plate of structural beams. However, the lower portion of side cladding, at ground, for a minimum height of 0.9 m above the finished floor level shall be one brick thick wall plastered on both side. In some areas like MCC floors etc., one brick thick wall cladding shall be provided. Brick wall cladding shall be supported on encased wall beams and suitably anchored to adjoining columns and beams. Contractor shall have option to use tubular steel sections for roof truss only. Vertical bracings shall be provided only on four sides along the periphery. Grade slab with 0.9m height one brick thick wall plastered on both side at periphery shall be provided for all transfer houses.</p> <p>Adequate steel doors and windows for proper natural lighting and ventilation shall be provided. In addition to steel windows, panels of suitable size to suit the architectural treatment and made of translucent sheets of polycarbonate material shall also be provided on the side cladding for natural lighting.</p> <p>The roof of Transfer points shall be provided with pre-fabricated insulated metal sandwich panels. Composition of Insulated Metal Sandwich Panels shall be as described elsewhere in the Technical Specification. Adequate slope shall be provided for quick drainage of rain water.</p>		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 6 OF 69</p>

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<p>3.04.00</p>	<p>Crusher House</p> <p>The crusher house shall be framed structure of structural steel work with permanently colour coated profiled steel sheet side cladding. However, panels of suitable size to suit the architectural treatment and made of translucent sheets of polycarbonate material shall also be provided on the side cladding for natural lighting. The lower portion of side cladding, at ground, for a height of minimum 0.9m above the finished floor level shall be of one brick thick wall plastered on both faces. Floors shall be of R. C. C. slab over profiled metal deck sheets (to be used as permanent shuttering) over structural beams. Shear anchor studs shall be provided through metal deck at regular interval on all top flange/flange plate of structural beams. Within this building cubicles are to be provided for resting room of operators and these shall be constructed with one brick thick brickwork having both sides plastered and roof slab. Adequate steel doors and windows for natural lighting and ventilation shall be provided. Contractor shall have option to use tubular steel sections for roof truss only . Vertical bracings shall be provided only on four sides along the periphery.</p> <p>The roof of Crusher house shall be provided with pre-fabricated insulated metal sandwich panels. Composition of Insulated Metal Sandwich Panels shall be as described elsewhere in the Technical Specification. Adequate slope shall be provided for quick drainage of rain water.</p> <p>Crushers shall be supported on R. C. C. deck, which in turn will rest on suitable vibration isolation system consisting of springs and dampers. This R. C. C. deck shall be isolated from the floor. However, the vibration isolation system consisting of springs and dampers may rest on main building framework. Detailed specification of vibration isolation system including the unbalanced force, frequency and amplitude criteria and other design requirements are appended elsewhere in this specification</p>		
<p>3.05.00</p>	<p>Control building, M. C. C. Buildings</p> <p>These shall be steel or RCC framed building with R. C. C. roof and floor. For steel framed building roof /floor shall comprise of RCC slab over profiled metal deck sheets (to be used as permanent shuttering only) over structural beams. Cladding shall be of brickwork/concrete blockwork with plastering on both sides. Roof shall be provided with roof water proofing treatment, as specified elsewhere in the Technical specification. Suitable arrangement shall be provided so as to prevent ingress of water into the cable trenches inside the building from cable entry locations.</p> <p>All air - conditioned areas, shall be provided with the suspended permanently colour coated aluminium false ceiling system (details specified elsewhere) with under deck insulation.</p> <p>Adequate aluminium doors and windows shall be provided for natural lighting, ventilation and view. All windows in air conditioned rooms shall have hermetically sealed double glazing.</p>		
<p>3.06.00</p>	<p>Pent House</p> <p>These shall be of R. C. C. framed structures with columns, beams, slabs and foundations etc. Cladding shall be of brickwork with plastering on both sides. Roof</p>		
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	<p>shall be provided with roof water proofing treatment as specified elsewhere. Adequate nos. of steel doors and windows shall be provided for natural lighting and ventilation.</p>		
<p>3.07.00</p>	<p>Gypsum Storage Shed</p> <p>The Gypsum storage shed shall be RCC framed structure with structural steel work shed with permanently colour coated profiled steel sheet roof and side cladding, grade slab and RCC foundations etc. Roof shall be provided with troughed profile permanently colour coated sheet with adequate slope for quick drainage of rain water.</p>		
<p>3.08.00</p>	<p>Toilets</p> <p>Toilet with potable water line facilities shall be provided in each of the following locations:</p> <p>(a.) In all M. C. C. Rooms</p> <p>(b.) Control Building</p>		
<p>3.09.00</p>	<p>Staircases, Gratings, Handrails</p> <p>All floors of transfer points/crusher houses and other facility buildings shall be accessible through staircase. All staircases of Transfer points and crusher house shall be of steel. Cage ladders (min. 450mm wide) shall be provided for access to roof of penthouses, single storey mcc rooms & mumty. All Stairs shall be minimum 1200 mm wide, maximum rise should not be more than 180 mm and minimum tread with 250 mm. Numbers and arrangement (including enclosures etc.) of stair cases shall be such as to meet the fire safety requirement as per guide lines of statutory regulatory bodies. For steel staircases , Stringers shall be of rolled steel channel (minimum ISMC 250) and tread shall be of steel gratings. Out side stairs to transfer points/crusher house shall be open type. Minimum 50 x 50 x 6 mm size angles with lugs shall be provided as edge protection for treads of stairs in underground TP's</p> <p>All gratings shall be electro forged types. Minimum thickness of the grating shall be 40 mm for indoor installation and 32 mm for outdoor installation. However, at entry or road crossing point's minimum thickness of grating shall be 40 mm. The opening size shall not be more than 30mmx100mm. The minimum thickness of the main bearing bar shall be 6 mm or as per design requirement whichever is higher. All gratings shall be designed for minimum imposed load of 500Kgs. / Sq. M. If actual expected load is more than the specified load, then actual load is to be considered. All gratings shall be hot dip galvanized at the rate of 610 g. per sq.m. after surface preparation by means of blast cleaning/ acid pickling.</p> <p>Minimum 1000 mm high hand railing shall be provided around all openings, projections / balconies, walkways, platforms, Stairs, etc. All handrails and ladder Pipes shall be 32 mm nominal bore MS Pipes (medium class) as per IS:1161. Handrails shall have top and middle rails at a height of 1000 mm and 500 mm and the vertical post spacing shall not exceed 1.50 M, with provision of kick Plates (100</p>		
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<p>3.10.00</p>	<p>mm high and 6 mm thick). All handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. M as per IS:4736.</p> <p>Trenches</p> <p>All trenches for cables or any other underground facility as detailed out elsewhere shall be of R. C. C. Cable trenches shall be provided with pre - cast R. C. C. covers / chequered plate cover. Cable trenches as well as pre - cast covers shall be provided with edge protection angles and lifting hooks. All embedments / block outs as required and specified elsewhere in these specifications shall be provided. Proper drainage arrangement shall be provided. Trench pre - cast cover weight shall not be more than 65 Kgs. Trench covers near entry or at road crossings shall be designed for 10 T wheel load at centre. Pre - cast covers shall be designed for central point load of 75 Kgs. R. C. C. cable trenches shall be filled with sand after erection of cables, up to top level and covered with pre - cast R. C. C. covers. For cable trenches outside buildings, top level shall be 200 mm above G. L and sand filling shall be overlaid with 50 thk. PCC.</p> <p>Minimum 50 x 50 x 6 mm size angles with lugs shall be provided as edge protection all around cut outs / openings in floor slabs, edges of drains supporting grating/precast RCC covers, edges of R. C. C. trenches supporting pre - cast covers, supported edges of pre - cast cover</p> <p>3.11.00</p> <p>Cable gallery/trestles</p> <p>Cable galleries/trestles shall be made of structural steel. The contractor can use either rolled sections or tubular steel sections. The tubular steel section shall be of circular/rectangular/square shape. The circular steel tube shall conform to IS:1161 and rectangular/square steel sections shall confirm to IS:4923. The steel structures using tubular sections shall be designed and fabricated as per IS:806 – “Code of Practice for use of steel tubes in general building construction.” and EN 1993-1-8:2005.</p> <p>3.12.00</p> <p>Transformer Foundation</p> <p>3.12.01</p> <p>Foundations of transformers shall be designed for seismic and wind loads in addition to other applicable loads. Block foundations shall be provided for the main transformer block.</p> <p>The oil soak pit, if provided, shall be filled with gravel of size 40mm. The volume of the soak pit shall be sufficient to store complete oil of the transformer/reactor along with 10 minutes of fire water considering only 40% of the volume as available voids between gravel filling. However, in case a separate oil collection tank is provided for the transformer/reactor, oil soak pit of volume equivalent to one-third (1/3) the oil volume of transformer/reactor shall be provided around transformer/reactor. The oil collection tank, in such cases, shall be designed for an effective capacity of complete oil of the transformer along with 10 minutes of fire water. The oil soak pit shall also be provided with a sump at the corner to allow drainage of water/oil from the soak pit.</p> <p>Arrangement for moving the transformer into place using rail cum road, jacking pads and pulling blocks including inserts, as required, shall be provided along with the transformer/ reactor foundations.</p>		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 9 OF 69</p>

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	<p>RCC Firewall shall also be provided between the transformers wherever required.</p> <p>300 mm thick PCC M20 encasement all around the Pylon supports inside soak pit for fire fighting system shall be provided up to top of gravel filling. Coarse aggregate filling inside the transformer oil soak pit shall be carried out only after construction/erection of Pylon supports and PCC encasement.</p> <p>3.12.02 Fencing</p> <p>Fencing with toe wall and steel gates shall be provided around the transformers. Fencing shall comprise of PVC coated GI chain link fencing of minimum 8G (including PVC coating) of mesh size 75 mm and of height 2.4 m above the toe wall. The diameter of the steel wire for chain link fence (excluding PVC coating) shall not be less than 12G. Fence posts shall be of pre – cast R. C. C. of minimum M20 grade. All corner posts will have two stay posts and every tenth post will have transverse stay post. Suitable R. C. C. foundation for the post and stays shall be provided based on prevailing soil conditions. Gates shall be sturdy with locking provisions.</p> <p>Toe walls of brick masonry shall be provided between fence posts all along the run of the fence with suitable foundation. Toe wall shall be minimum 200 mm above the formation level with 50 mm thick P. C. C. coping (1: 1. 5: 3) and shall extend minimum 300 mm below the formation level. Toe wall shall be plastered on both sides and painted with two coats of cement paint of approved colour and shade. Toe wall shall be provided with weep holes at suitable spacing</p> <p>3.13.00 Booster Fan Foundation</p> <p>Booster Fan foundations shall be RCC block foundation directly resting on virgin soil/ pile below Ground level. The vertical faces of this block foundation shall be isolated from adjacent footings by providing minimum 100mm thick polystyrene board of type-1 conforming to IS: 4671 with density 20 Kg/cum sandwiched between the vertical face of block foundation and 230 thick brick wall all round.</p> <p>3.14.00 CHIMNEY</p> <p>3.14.01 Salient Features</p> <p>Single-flue or multi-flue chimney(s) shall be provided. Chimney shall be of reinforced concrete construction. There shall be one flue (liner) for each unit. The flue gas emission point shall be minimum 150 meters above the plant grade level.</p> <p>The chimney shell (windshield) shall be constructed using slip form shuttering. Internal platforms of steel structure shall be provided for enabling access to various elevations of the chimney and to provide support to the flue liners. Spacing of internal platforms shall not exceed 45.0 M. The platform beams shall be supported on concrete shell using suitable load bearing arrangement in the recesses provided for the purpose. The platform beams getting supported in the chimney shell shall have complete bearing support within the thickness of shell at that location and shall in no case be supported completely/partially on corbels/ brackets from the shell. "Through openings" in shell if provided to facilitate erection of platform beams shall be closed with cast-in-situ RCC closure wall on the external face of the shell. Necessary dowel</p>		
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	<p>bars shall be provided in the shell during construction for this purpose. Openings in the concrete shell for flue duct entry, access door & truck entry door at ground level, air ventilation etc shall be provided. Hand railing shall be provided all around internal staircase & around the ventilation voids in the internal platform using min. 32 mm nominal bore MS pipes of medium class conforming to IS:1161. Spacing of railing posts shall not be more than 1500 mm centre to centre with a minimum height of 1200 mm. The handrail shall have three rows of horizontal members between the railing posts including the top member. Kick plate of min. size 100x6 thick shall be provided in the hand railing.</p> <p>The flue duct outside the chimney shall be suitably connected to the flue liner inside the chimney through a transition duct. The transition duct shall be bottom supported and shall be profiled into a circular shape to connect to the flue liner. The flue duct shall be so designed that no load is transferred on the chimney shell due to the duct. The interface between the flue liner and the transition ducting shall be provided with non-metallic fluoroelastomeric fabric expansion joint.</p> <p>The expansion joint in the flue liner shall comprise of non-metallic fluoroelastomeric material suitable to withstand a temperature of 300 Deg C, shall be acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification and shall also prevent dust accumulation. The space between the expansion joint material and the liner shall be packed and sealed by providing a bolster made up of light weight compressible material suitable to withstand a temperature of 300 Deg C and acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification. The bolster shall be confined in texturized glass fabric having a final covering of stainless steel wire mesh.</p> <p>Chimney roof shall be of RCC slab over a grid of structural steel beams and provided with rainwater drainage system. An internal structural steel staircase supported from chimney shell with chequered plate floor panels and pipe handrails, shall be provided for full height of the chimney and an internal cage ladder for a small height, over last staircase landing to access the chimney roof through a roof access hatch.</p> <p>The other components of the chimney include liner test ports (for continuous pollution monitoring), liner hatches, grade level slab of RCC with metallic hardener floor finish, acid resistant treatment on roof slab, a large electrically operated grill type roll-up door and personnel access metallic door at grade level, roof drain basin, rain water down comer pipe (150 mm diameter galvanized pipe), connection to plant drains, louvers with bird screens for ventilation and all other openings in the wind shield, mild steel wind strakes (if required), all finishing works, electrical power distribution boards, lighting panels, power & control cabling and wiring systems, stair and platforms lighting, socket outlet, lightning protection and grounding system, aviation obstruction lighting with photoelectric controller etc, communication system, a rack and pinion elevator and other items, though not specifically mentioned but reasonably implied and necessary to complete the job in all respects.</p> <p>Aviation Warning Lights (AWL) shall be mounted on door panel of required size (open able from interior of chimney shell) fixed to openings in the chimney shell at locations and levels specified elsewhere. Suitable provision for approach to the AWL shall be provided at the platform level. AWL shall be located at about 1-1.5 metre above the top of platform to enable easy handling for maintenance.</p> <p>The size of roll-up door shall be determined based on minimum requirement for ventilation and transportation & erection of flue segments.</p>		
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<p>3.14.02</p>	<p>Design Concept</p> <p>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 Indian Standard, reference shall be made to ACI, BS, CICIND and other international standards.</p> <p>In case of any conflict between this document and the Indian and International Standards, the stipulations of this document shall prevail.</p> <p>Imposed loading for design of all chimney components shall not be less than 5 kN/Sq.m. An additional 25% of liner load shall be taken as impact loading for liner erection in addition to the liner load.</p> <p>The min. thickness of web for plate girders shall be kept as 12 mm.</p> <p>Seismic forces on the chimney system shall be determined based on site specific seismic information provided elsewhere in this document.</p> <p>Wind forces on the chimney system shall be determined based on site specific wind design criteria provided elsewhere in this document.</p> <p>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.</p>		
<p>3.14.03</p>	<p>Wind Shield</p> <p>The wind shield shall be designed for vertical loading, cross wind loading, seismic loading, circumferential wind loading, thermal gradients etc. The load calculation and load combinations shall be as detailed in IS 4998 (Part 1) : 1992. The wind shield shall be analysed for cases with and without flue liner loads.</p> <p>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.</p> <p>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.</p> <p>The cross wind 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.</p> <p>The effect of the openings/cut-outs in the chimney shell shall be duly considered in the design of the windshield. The minimum thickness of shell shall not be less than 500mm.</p> <p>The stresses for the shell design shall not exceed the limits given in Cl. 7.0 of IS:4998 (PART-I) 1975 for various combinations of loads, excepting the stress in concrete for the case of dead load + wind load which shall not exceed $0.30f_{ck}$ where f_{ck} is the characteristic compressive strength of concrete.</p> <p>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 maximum spacing of the reinforcement bars shall not be more than 200 mm on each face. The circumferential reinforcement in the top 3 meters of the windshield</p>		
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	<p>shall be twice that required from design forces. The clear cover to reinforcement shall be 50 mm.</p> <p>There shall be a continuous ring of concrete shell without any opening for a height of atleast 5m below the soffit of flue duct openings.</p> <p>There shall not be any reverse (outward) slope in the inside face of chimney shell. Where there is a sudden change in slope/ profile of the shell, the circumferential reinforcement shall be increased to twice the requirement as per the design in a circumferential band extending atleast 3m above and below such slope/profile change level.</p> <p>The diameter of the reinforcing bar for the main vertical reinforcement of shell shall not be less than 25mm for a shell height upto the top level of flue duct opening.</p> <p>Shell thickness between any two 10m reference levels shall not vary more than 150mm.</p> <p>The minimum thickness of shell/closure wall at beam support recess/ opening locations shall be 100mm.</p> <p>Grade of concrete for chimney shell, and other super structure shall be minimum M 30. Only OPC cement shall be used for Chimney shell and other super structure.</p> <p>The final design shall be checked & verified by 'Wind Tunnel Test' and shall be conducted at a reputed institution. Dynamic interference effects due to additional chimney(s)/NDCTS's and other tall structures located in the area or in the future expansion stage of the project shall be determined along with the other topographical features of the local area through model test.</p> <p>3.14.04 Flue Liners</p> <p>The flue gas parameters & various operating conditions for selection of flue liner material, material specification for flue liner and the criteria of flue gas exit velocity for sizing the flue liner shall be as specified elsewhere in the specification.</p> <p>For flue liner with base metal as mild steel, the thickness of the base metal shall be determined from structural considerations. The thickness of any clad metal/coating/block lining etc. provided on the base metal shall not be considered for computing the structural strength of flue liner. The minimum thickness of the mild steel base metal shall, however, not be less than that specified elsewhere in the specification.</p> <p>Two manholes placed diametrically opposite shall also be provided in each flue at all internal platform levels.</p> <p>The supporting/restraining arrangements of the liners should be such that expansion of the liners longitudinally or circumferentially is not restrained.</p> <p>Clean-out door shall be provided below the flue for the removal of ash.</p> <p>3.14.05 Internal Platforms</p> <p>The platforms shall be designed for dead, imposed (live), erection work and other possible loadings and temperatures effects. These platforms shall provide support and lateral restraint to the steel liners and provide access for inspections and maintenance. Forces imposed on the floors due to lateral restraint of flues shall be enhanced aptly for impact effects. These platforms shall also be designed suitably for</p>		
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<p>3.14.06</p> <p>3.14.07</p> <p>3.14.08</p>	<p>the liner erection works. The platform shall be made up of chequered floor panels supported on grid of structural steel beams. All beams shall have bolted connections. The maximum permissible deflection in main steel girders supporting flue liner shall be span/1000.</p> <p>Internal Staircase</p> <p>The staircase shall have a clear passage way width of not less than 800 mm and a clear headroom of not less than 2100 mm. The riser height shall not be more than 175 mm and tread width shall not be less than 225 mm.</p> <p>Foundation</p> <p>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. 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 any load case/combination with wind. No allowance shall be made in the stresses for design of foundation for wind loading. The foundation diameter to depth ratio shall be maintained to around 10 and should preferably not exceed 12. The diameter of the reinforcing bar for the main radial and tangential reinforcement for the foundation shall not be less than 25mm. The spacing of radial steel at the outer edge of the foundation shall not be more than 250mm. Grade of concrete for foundation shall be minimum M 25.</p> <p>Thermal insulation</p> <p>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 coefficient of thermal conductivity of insulation shall not be more than 0.52mW/cm/oC at a mean temperature of 100oC.</p> <p>The insulation thickness shall be determined based on the maximum/minimum 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 55 degree Celsius. 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.</p> <p>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 using MS galvanised pins and speed washer.</p>		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 14 OF 69</p>

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<p>3.14.09</p>	<p>Chimney Painting</p> <p>(i) All exposed steel surfaces (including exterior surface of mild steel flue liner in case the design does not envisage provision of thermal insulation on the exterior surface of flue liner) except surfaces of steel wind strakes shall be painted as specified in corrosion protection clause of this specification.</p> <p>(ii) All exposed surfaces of steel wind strakes shall be painted with epoxy phenolic coating system having total 240 microns DFT.</p> <p>a) All steel surfaces shall be provided with two component epoxy primer coat (having solid by volume minimum 51% \pm2%) of minimum 70 micron DFT to be applied over blast cleaned surface conforming to Sa 2½ finish of ISO 8501-1 with surface profile 40-60 Micron. The primer coat shall be applied in shop immediately after blast cleaning by airless spray technique.</p> <p>b) Primer coat shall be followed with the application of Intermediate coat of epoxy phenolic coating (solid by volume minimum 63%) of minimum 100 micron DFT. This coat shall be applied in shop after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.</p> <p>c) Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% \pm2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This coat shall be applied in shop after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer.</p> <p>(iii) All steel parts embedded in concrete like Strake embedment assembly including bolts, nuts, washers, pipe sleeves and insert plate shall be galvanized as per IS:4736. The minimum weight for galvanizing shall be 610 g/sq.m and shall comply with relevant IS Codes.</p> <p>(iv) The inside surface of chimney shell above roof, horizontal surface of shell at top, underside of concrete roof slab, external surface of mini-shell above roof etc shall be painted with epoxy phenolic coating system having total 220 microns DFT.</p> <p>a) All concrete surfaces shall be provided with two component transparent polyamide cured epoxy sealer coating (having solid by volume minimum 40% \pm2%) of minimum 50 micron DFT to be applied over cleaned surface in multiple coats. Surface to be coated shall be absolutely dry, clean and dust free.</p> <p>b) Sealer coat shall be followed with the application of Intermediate coat of epoxy phenolic coating (solid by volume minimum 63%) of minimum 100 micron DFT. This coat shall be applied after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.</p> <p>c) Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% \pm2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours</p>		
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<p>3.14.10</p>	<p>exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This coat shall be applied after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer.</p> <p>d) The entire external surface of chimney shell shall be painted with epoxy phenolic coating as specified in (iv) above in alternate bands of 'signal red' and 'bright white' colours.</p> <p>Electrical System</p> <p>415V, normal and emergency AC power supply for chimney shall be derived from main plant power supply system. Emergency supply shall feed 20% of platform lighting, 50% of staircase lighting, aviation obstruction lighting and elevator load. All other loads shall be connected on normal power supply.</p> <p>Ambient temperature for design of all equipment shall be considered as 55 deg. C which is likely to be encountered inside the chimney. The equipment shall be suitable for installation and render trouble free operation at higher ambient temperature and rigorous weather conditions prevailing at chimney.</p> <p>All equipment supplied shall comply with relevant IS Standards.</p> <p>The distribution boards of chimney shall comprise switch fuse units of appropriate ratings. Emergency board shall have two incomers, one from emergency supply and other from normal AC distribution board itself. Auto changeover scheme shall be provided in emergency board to enable changeover to healthy source on failure of any source.</p> <p>Dry type isolating transformer of Dyn connection shall be provided in emergency board to obtain neutral lead, in case 3 phase 3 wire emergency supply is derived from main plant.</p> <p>Various platforms shall be illuminated by dust tight HPSV well glass lighting fixtures. Average illuminations level of 150 lux shall be maintained on equipment and 70 lux on platforms & 100 lux on staircases (minimum 1 lighting fixture at each landing). Any additional fixture to take care of dark patches/shadows shall also be provided. Lighting system shall be controlled through MCB provided in lighting panel.</p> <p>A lighting and power panel each shall be located at grade level and at other in between levels as required. All distribution boards, aviation lighting controls, etc. shall be located at grade level only. At each platform, 1 No. 63A, 415V welding receptacle and 1 No. 20A, 240V receptacle shall be provided and shall be fed from power panel. Wiring installation for lighting fixture shall be of PVC insulated copper/aluminium wires through galvanised steel conduits.</p> <p>Aviation obstruction lighting system shall conform to the requirements of the latest rules and regulations of the International Civil Aviation Organization (ICAO), National Airports Authority (NAA) and Directorate of Air Routes and Aerodromes (DARA). The type of aviation obstruction lighting system shall be of medium intensity aviation obstruction lights having an effective intensity of 2000 to 20,000 cd depending upon back ground illuminance. Obstacle lights shall have a day time effective intensity of minimum 20000 cd. The intensity of lights shall be 20000 cd ± 25% at twilight and shall reduce automatically to a night time intensity of 2000 cd ± 25% through the use of photo-cell. The obstacle lights shall flash simultaneously at a rate between 20 to 60 per minute. A minimum of three levels will be provided with aviation obstruction</p>		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 16 OF 69</p>

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	<p>lights and there will be four light units per level. The lowest level should not be lower than 45 meters above the ground and vertical spacing of the intermediate levels could vary between 45 and 105 meters. The intermediate lights shall be spaced as equally as possible. Aviation obstruction lighting shall be complete with lights, photo cell, controller, special cables, etc..</p> <p>A temporary aviation obstruction lighting system shall be provided during construction of the chimney.</p> <p>Cables from distribution board to lighting panels/power panels/receptacles shall be 1100V grade, multicore FRLS HR-PVC insulated, PVC inner sheathed, armoured, PVC outer sheathed stranded copper/ Aluminum laid on galvanised sheet steel cable trays. Cables shall be terminated using double compression type cable glands and solder less crimping type tinned copper cable lugs. Minimum size of the power cable shall not be less than 2.5 sq.mm copper or 4 sq.mm Aluminum. Minimum size of control cable shall not be less than 1.5 sq.mm.</p> <p>Lightning protection system shall comprise minimum 3 vertical air terminations for each flue liner, horizontal air terminations and minimum 4 Nos. of down conductors spaced 90 degrees apart routed all along chimney height on external surface and connected to the earthing system. Down conductors shall be of minimum 50x6 mm galvanized steel strip. Each down conductor shall be provided with a test link at 1 metre above ground level. Each test link shall be enclosed in a galvanised sheet steel enclosure. Above ground level earthing and lightning protection system shall comprise galvanised steel strips. These materials provided at top 12 meters shall have additional coating of 2 mm thick seamless lead cover and the accessories like nuts, bolts, washers etc. shall be of stainless steel to take care of corrosion. Chimney earthing system shall be interconnected to main plant earthing system.</p> <p>A temporary lightning protection & earthing system shall be provided during construction of the chimney till a permanent lightning protection & earthing system is installed. In no case reinforcement bars of Shell should be used as earthing Down Conductors</p> <p>Communication system comprising of telephone socket at every internal platform level and at grade level, necessary wiring installation, a telephone hand set, junction boxes etc. shall also be provided. Telephone cables shall be of minimum 0.6 mm diameter annealed high conductivity electro copper conductor, PVC insulated, twisted, PVC tape wrapped, screened, rip corded, PVC sheathed, conforming to relevant ITD (Indian Telephones Department) specifications.</p> <p>All equipment to be supplied shall be of type tested quality. The Contractor shall submit for Owner's approval the reports of all type tests as listed below:</p> <p>(A) Distribution boards/panels-Degree of protection tests</p> <p>(B) Aviation lights:</p> <p>(1) Intensity Test</p> <p>(2) Degree of protection test</p> <p>For various equipment, the technical requirements and practices shall conform to the relevant clauses of the main plant electrical specification.</p> <p>3.14.11 Rack and Pinion Elevator</p> <p>A rack and pinion elevator, with a load carrying capacity of 400 kg (min) (passenger cum goods), cabin floor size of 1100 mm x 1000 mm (min.) and an operating speed</p>		
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	<p>of 40 m/min. (approx.), shall be provided for travel from the grade level to the top of the chimney. A landing platform shall be provided at all access/ platform levels. The elevator shall be of a proven and approved make. Enclosure shall be fabricated from tubular steel and expanded metal or wire mesh, 2.1 m high (Approx.). A Safety device comprising of an over speed governor in constant mesh with the rack by means of a flame hardened steel pinion shall be provided to protect the cab against over speed during the cab downward motion and the same shall actuate the brake mechanism and stop the down ward motion gradually. The lift shall be installed using anchor fasteners. The electrical requirement of the system shall conform to the main electrical specification. Drive motor shall be of S3 duty class with CDF of 25% and maximum number of 120 starts per hour in 55 degree Celsius ambient temperature. The motor shall be provided with internal 220V AC single phase space heaters or an alternate heating system. The elevator shall be supplied, installed, painted, tested, commissioned etc. complete with all mandatory spares (as specified in Part-F of this specification) and operation maintenance manual</p> <p>4.00.00 Drainage & Water Supply Works</p> <p>4.01.00 Drainage System:</p> <p>The drainage arrangements shall be so planned so as to ensure quick disposal of drainage water without stagnation and / or overflow. It is envisaged to clean the facility buildings etc. with water periodically.</p> <p>Minimum 4 nos. down comers shall be provided in each building at corners.</p> <p>For Conveyors, each down comer shall lead the water / slurry to pit (of 2 Cu.M capacity) to allow settling of lime/gypsum. The water from the pit shall overflow into contractor's R.C.C drain, which will lead the discharge finally into owner's drain routed alongside the nearby road.</p> <p>For Ball Mill building, Gypsum dewatering building, FGD control room building, peripheral drains (Brick drains with steel gratings provided around the building) shall lead the water / slurry to a local pit (of 2 Cu. M. capacity) near each facility to allow settling. The water from the pit shall overflow into contractor's R.C.C drain, and finally into owner's drain routed alongside the nearby road.</p> <p>In case of Control rooms and M. C. C. buildings Pump houses, etc, water / slurry coming from down comers shall discharge into peripheral drains (Brick drains with steel gratings provided around the building) which will lead the water / slurry into contractor's R.C.C drain, which will lead the discharge finally into owner's drain routed alongside the nearby road.</p> <p>Contractor's scope shall also include construction of necessary culverts under the rail lines / roads as per railway / I. R. C. standards and approval of Railway culverts from concern Railway authorities.</p> <p>4.02.00 Internal and external water supply, drainage etc.</p> <p>The scope for potable water supply includes all distribution systems, tanks, pipes, fittings etc. as required and as described here or elsewhere in the specifications.</p>		
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	<p>The scope for service water supply and dust control water supply shall be as described elsewhere in the specifications.</p> <p>For water supply, medium class galvanized mild steel pipes conforming to IS: 1239 shall be used.</p> <p>All facility buildings shall be provided with open surface brick drains of minimum size of 300 mm width and 300 mm depth all around the periphery. All drains excepting the peripheral drains around facility building shall be of R. C. C. construction. Drains shall have removable steel grating cover and shall be provided with edge protection angles.</p> <p>The scope for foul water from toilets shall include layout and laying of sewers up to the Employer's main sewer line for sewerage system together with all fittings and fixtures and inclusive of ancillary works such as connections, manholes and inspection chambers within the building and from the building to the Employer's sewer line.</p> <p>For rain water down comer and those to be used for conveying water / slurry generated from cleaning of buildings floors, Galvanised MS pipes conforming to IS: 1239 (for 150 mm NB Medium grade pipes) with welded joints shall be used for MCC buildings, penthouse, control rooms, ball mill building, gypsum dewatering building, storage sheds.</p> <p>Galvanising shall be as per IS: 4736. The minimum mass of zinc coating shall not be less than 400 gms/sq.m. as per IS:6745. The zinc coating shall be smooth and shall be subjected to testing as per IS: 2633, for uniformity of coating. The zinc coating shall be free from all defects as per IS: 2629.</p> <p>All rain water down comers shall be provided with roof drain heads and complete with shoes bends, junctions, sockets, adapters, brackets and finished with anti corrosive painting over a coat or primer.</p> <p>For design of building drainage system IS: 1742 shall be followed.</p> <p>For sanitary / sewerage pipes above ground, sand cast iron pipes conforming to IS : 1729 with leak proof lead joints.</p> <p>For underground drain pipes, minimum class NP - 2 pipes conforming to IS: 458. At road crossings, concrete pipes of class NP 3 conforming to IS: 458 and at rail crossing R.C.C. box culvert to be provided.</p> <p>For sewerage below ground stoneware pipes conforming to IS: 651 with concrete bedding and haunch.</p> <p>5.00.00 COLOUR COATED AND OTHER SHEETING WORK</p> <p>5.01.00 Material</p> <p>a) Wall Cladding & Roofing Material</p> <p>Troughed permanently colour coated sheet of approved shade and colour shall be</p>		
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	<p>i) either of steel with minimum 0.6mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150</p> <p>ii) or of minimum 0.5mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150</p> <p>iii) or of steel of minimum 0.4mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150</p> <p>Alternatively aluminium feed material of minimum bare metal thickness of 0.7 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254.</p> <p>b) Metal Deck Roof Material</p> <p>Troughed permanently colour coated metal decking sheets shall be</p> <p>i) either of steel with minimum 0.8mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275</p> <p>ii) or of minimum 0.6mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275</p> <p>iii) or of steel of minimum 0.6mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275.</p> <p>Alternatively aluminium feed material of minimum bare metal thickness of 0.9 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254 can also be used for metal decking.</p> <p>Thickness tolerance of (+/-) 0.04mm is permissible. However, all design calculations shall be carried out on the basis of lowest value of sheet thickness provided.</p> <p>5.02.00 Colour Coating</p> <p>Steel shall be colour coated with total coating thickness of at least 40 microns (nominal) comprising of silicon modified polyester (SMP with silicon content of 30% to 50%) paint or Super Polyester paint, of minimum 20 microns (nominal) dry film thickness (DFT) on external face over primer coat of minimum 5 microns (nominal) and minimum 10 microns (nominal) SMP or super polyester paint over primer coat of minimum 5 microns (nominal) on internal face. SMP and Super polyester paint systems shall be of industrial finish of product type 4 of AS/NZ2728.</p> <p>5.03.00 Design Criteria</p> <p>For wall cladding insulated / uninsulated sides and roof, permanently colour coated sheet of troughed profile shall be used. The nominal depth of trough shall be 30 mm.</p>		
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	<p>For profiled metal decking sheets (to be used for RCC floor slab or roof slab) the sectional modulus and moment of inertia of troughed profile per meter width shall be so as to limit the deflection of sheets to span/250 under total super imposed loading (DL +LL) comprising the self-weight of metal deck sheet, dead weight of green concrete and an additional construction load 100kg per sq.m for two span condition. The section modulus and moment of inertia of troughed profile shall be computed as per the provisions of IS 801 for satisfying the deflection and strength requirements.</p> <p>For metal deck sheets used for roofing (with or without RCC) and side cladding, the sectional modulus and moment of inertia of troughed profile per metre width shall be such that the deflection of sheets is limited to span/250 under design wind pressure for two span condition. The sectional modulus and moment of inertia of troughed profile shall be computed as per the provisions of IS 801 for satisfying the deflection and strength requirements. No increase in allowable stress is permissible under wind load condition.</p> <p>5.04.00 Fasteners</p> <p>Side cladding/roofing/decking sheets shall be fixed to the runner/purlins using self-drilling special coated fasteners conforming to corrosion resistant class 3 of AS3566 and tested for 1000 hours salt spray test. Spacing of Self-drilling fasteners in transverse direction (along runners/purlin) shall be equal to the pitch of trough or 250(+/-100) mm, whichever is lesser and in longitudinal direction at every runner/purlin location.</p> <p>Shear anchor studs shall also be provided through troughed permanently colour coated metal decking sheets metal deck, which are to be used as permanent shuttering, at regular interval on all top flange / flange plate of structural beams.</p> <p>The shear anchor studs for fixing metal deck sheet to floor structural beams shall conform to Type-B studs specified in AWS D1.1/D1.1M or equivalent as shear connector of 19mm diameter and 100mm length manufactured from cold drawn round steel bars conforming to the requirement of ASTM A 29, of grade designation 1010 through 1020, of standard quality with either semi-killed or killed, welded by Drawn Arc Stud Welding through metal deck sheet.</p> <p>The shear anchor studs for fixing metal deck sheet to roof structural purlins shall conform to Type-B studs specified in AWS D1.1/D1.1M or equivalent as shear connector of 16mm diameter and 65mm length manufactured from cold drawn round steel bars conforming to the requirement of ASTM A 29, of grade designation 1010 through 1020, of standard quality with either semi-killed or killed, welded by Drawn Arc Stud Welding through metal deck sheet.</p> <p>Alternatively, J/U type hooks shall be used in roofing which shall be provided in transverse direction (along runners/purlin) at a spacing equal to the pitch of trough or 250(+/-100) mm, whichever is lesser and in longitudinal direction at every runner/purlin location.</p> <p>5.05.00 Miscellaneous Details</p> <p>To minimize the number of joints, the length of the sheet shall preferably be not less than 4.5m, cut pieces shall not be used, unless specifically approved by the Engineer. However, the actual length shall be such so as to suit the purlin / runner spacing.</p>		
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	<p>Lap between the sheets shall be at least 150mm in the longitudinal direction and at least one crest wide in the transverse direction which shall be properly anchored / fixed with fasteners.</p> <p>Z spacers if required shall be made of at least 2 mm thick galvanised steel sheet of grade 350 as per IS 277</p> <p>Sealant used for cladding shall be butyl based, two parts poly sulphide or equivalent approved, non stainless material and be flexible enough not to interface with fit of the sheets</p> <p>Filler blocks as a trough filler shall be used to seal cavities formed between the profiled sheet and the support or flashing. The filler blocks shall be manufactured from black synthetic rubber or any other material approved by the Engineer.</p> <p>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 metal cladding. Overlap shall be min. 150 mm or as specified by manufacturer.</p> <p>5.06.00 Pre-Fabricated Insulated Metal Sandwich Panels</p> <p>For structures where Pre-Fabricated Insulated Metal Sandwich Panels shall be used for Roofing, the sandwich panels shall comprise top sheet as troughed permanently colour coated sheet & bottom sheet as plain permanently colour coated with 50mm thick insulation sandwiched between the two sheets. Each sheet shall be</p> <ol style="list-style-type: none"> i) either of steel with minimum 0.6mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 ii) or of minimum 0.5mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150 iii) or of steel of minimum 0.4mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150. <p>Alternatively aluminium feed material of minimum bare metal thickness of 0.7 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254.</p> <p>Metal sheets (steel or aluminium) shall be colour coated with total coating thickness of at least 40 microns (nominal) dry film thickness (DFT) comprising of Silicon Modified Polyester (SMP with silicon content of 30% to 50%) paint or Polyester paint, of minimum 20 microns (nominal) SMP or polyester paint on one side (exposed face), over minimum 5 micron (nominal) primer coat and minimum 10 micron (nominal) SMP or Polyester paint over minimum 5 micron (nominal) primer coat on other side. SMP and Super Polyester paint shall conform to product type 4 of AS/NZS 2728. Troughed sheet shall be of approved profile, sectional properties, (suitable for the specified loading / deflection and purlins / runners spacing), colour and shade.</p>		
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	<p>Special coated fastener conforming to corrosion resistant Class 3 of AS3566 and tested for 1000 hours salt spray test shall be used for fixing Pre-Fabricated Insulated Metal Sandwich Panels with the structural members below.</p> <p>The contractor shall prepare working drawings of sheeting system including end and side laps, fixing details etc. before starting sheeting work at site.</p>		
5.07.00	<p>Polycarbonate Sheets</p> <p>The polycarbonate sheet to be used for cladding and glazing purpose in conveyor galleries, Transfer points & pump houses shall have toughed profile to match with the metal cladding profile. Minimum 3.0mm thick fire retardant and UV resistant polycarbonate clean sheet of approved make shall be used. The polycarbonate sheet shall be installed along with the metal cladding so as to have a watertight lapping arrangement. Suitable detailing shall be made to cater for the thermal expansion. IS 14434 to be referred for other details</p>		
6.00.00	<p>Roof Details</p>		
6.01.00	<p>Roof slab shall be minimum 150 mm thick (above the top surface (crest) of the metal deck sheet) and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom.</p>		
6.02.00	<p>900 mm high and minimum 100 mm thick R. C. C. parapet wall shall be provided over roofs of all buildings. Parapet wall shall have suitable coping. External face of parapet wall of the buildings provided with metal cladding shall also be finished with metal cladding of design and colour as per approved architectural drawings.</p>		
6.03.00	<p>Junction of roof and parapet shall be provided with 150 x 150 mm size concrete fillet.</p>		
6.04.00	<p>Drain level shall be provided with 45 x 45 cm size khurras having minimum thickness of 30 mm of M-15 concrete over PVC sheet of 1 m x 1m x 400 micron and finished with 12 mm 1 : 3 cement : sand plaster.</p>		
6.05.00	<p>Roofs of all control rooms, M. C. C. rooms, penthouse etc., shall have roof water proofing treatment. Roof water proofing treatment shall be as follows:</p> <ol style="list-style-type: none"> 1) Application of polymerised mastic over the RCC roof to achieve smooth surface as primer coat. 2) Application of high solid content liquid applied urethane based elastomeric water proofing membrane, over the primer coat, to give uniform joint less dry film thickness of minimum 1.5 mm (as per ASTM C 836 and C 898). 3) For efficient disposal of rain water, the run off gradient for the roof shall not be less than 1: 100. This gradient shall be provided by screed concrete M-15 (using 12.5 mm coarse aggregate) and / or cement mortar (1: 4) over the elastomeric water proofing membrane with 25mm thick cement mortar (1:4) topping. 4) Wearing course at top, shall consist of 25 mm thick P. C. C. (M-15) cast in panels of maximum 1.2 x 1.2 m size and reinforced with 0.56 mm diameter galvanized chicken wire mesh and sealing of joints using sealing compound / elastomeric water proofing membrane. Pathways for handling of materials and movement of personnel shall be provided with 22 mm thick chequered cement concrete tiles as per IS : 13801 for a width of 1000 mm in place of P. C. C. 		
6.06.00	<p>For efficient disposal of rain water, the run off gradient for the roof shall not be less than 1:100. This gradient can be provided either in structure or subsequently by</p>		
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	<p>screed concrete M-15 (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.</p>		
6.07.00	<p>Medium class galvanised mild steel pipes conforming to IS: 1239/ IS: 3589 with welded joints shall be provided for rain water down comers to drain off rain water from the roof. These shall be suitably concealed with masonry work, to match with the exterior finish. The number and size of down comers shall be governed by IS: 1742 and IS: 2527. RCC roof shall be provided with 45 x 45 cm size Khurras having minimum thickness of 30 mm with M-15 concrete over PVC sheet of 1mx1mx400micron and finished with 12 mm thick cement sand plaster 1:3.</p>		
6.08.00	<p>Access to RCC roof of Gypsum dewatering building, FGD Control room building, MCC building, Ball mill building shall be through RCC staircase, and roof access to all other buildings all shall be through cage ladder as per requirement.</p>		
6.09.00	<p>Fillets at junction of roof and vertical walls shall be provided with cast - in - situ cement concrete (M-15) nominal mix followed by 12 mm thick 1:4 cement sand plaster.</p>		
6.10.00	<p>The rainwater down comers shall be provided with suitable C.I. grating at inlet point.</p>		
7.00.00	<p>RCC Floors, Paving & Grade Slab details</p> <p>The floor slabs shall be minimum 150 mm thick (above the top surface (crest) of the metal deck sheet) and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom.</p> <p>In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.8mm as permanent shuttering. The detailed material property requirement of metal deck sheet is specified elsewhere in the specification. These profiled metal deck sheets shall be fixed to the structural steel beams/ purlins using headed shear anchor studs specified elsewhere in the specification.</p> <p>Chequered plates (used for floors, walkways etc.) shall be minimum 6 mm thick. Mild steel flats/angles of suitable size shall be welded to the bottom portion of chequered plates at a designed spacing to stiffen chequered plates suitably. Chequered plates shall be fixed by staggered welding of suitable size. Floors of trenches shall have integral finish to concrete base.</p> <p>Toe guard of size 100 x 6 mm shall be provided at various openings provided in floors e.g. around stair case openings, chute openings and other similar cutouts. For conveyor walkways, angle runner to act as toe guard shall be provided.</p> <p>R. C. C. floors (where no brick masonry walls are provided) shall be provided with handrails all along the periphery.</p> <p>RCC paving of minimum 150 mm thick with M25 grade concrete, 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 200mm compacted thick for normal duty paving and 400mm</p>		
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	<p>compacted thick for heavy duty paving with 63 mm and down aggregate with interstices filled with selected moorum/ non-expansive soil 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. For normal duty paving, reinforcement of the RCC paving shall consist of minimum 8mm dia bars @ 200 mm c / c in both directions at the centre of the slab. For heavy duty paving/ passage, reinforcement of the RCC paving shall consist of minimum 10mm dia bars @ 200 mm c / c in both directions at the centre of the slab.</p> <p>Paving areas shall be provided with the metallic hardener floor finish as specified elsewhere in the specification.</p> <p>Passages shall be provided inside the FGD block connecting to the outer periphery road to have access to the various facilities/buildings. These passage areas shall be provided with heavy duty paving for movement of heavy vehicles. The top surface of the passages shall be finished with 50 mm thick metallic hardener topping. Heavy duty paving shall also be provided for the areas in the equipment lay down area, unloading & maintenance area with 50 mm thick metallic hardener topping.</p> <p>Lightly loaded areas such where no heavy traffic movement is envisaged shall be provided with Normal Duty paving.</p> <p>All facility buildings shall be provided with 750 mm wide plinth protection all around. It consists of 50 mm thick P.C.C. M-20 grade with 12 mm maximum size aggregate over 200 mm thick stone soling using 40 mm nominal size rammed, consolidated and grouted with fine sand</p> <p>An area of minimum 5 m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection. Further, heavy duty paving shall be provided for passages connecting the outer periphery road to have access to the various facilities/buildings.</p> <p>Plinth level of all buildings shall be kept at least 500 mm above the finished grade / formation level.</p> <p>Suitable open RCC drains shall be provided to dispose off storm water drain. The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain.</p> <p>Sewer lines (Cast Iron), interconnected by sewer manholes (RCC) at regular intervals (not exceeding 30 meter centre to centre) shall be provided to dispose off sewage from FGD block to sewage pump house.</p> <p>GRADE SLAB OF BUILDINGS AT GROUND FLOOR</p> <p>In buildings, the grade slab shall consist of 150mm thick RCC M25 grade base slab over an under bed as specified below. The under bed for ground floor slab shall consist of 75mm thick 1:4:8 PCC on stone soling of 200mm compacted thick with 63 mm and down aggregate with interstices filled with well graded selected sand/ moorum/ non-expansive soil on compacted and dressed sub - grade. Reinforcement for the slab shall consist of minimum 8mm dia. bars @ 200 mm c/c at top & bottom of the slab in both directions. However, at unloading & maintenance area, stone soling of minimum 400mm thick and grade slab with minimum 10mm dia bars @ 200 mm c/c at top and bottom in both directions shall be provided.</p> <p>Further, top surface of grade slabs shall be finished with 50mm thick metallic hardener topping.</p>		
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<p>8.00.00</p>	<p>Brickwork and allied masonry works</p> <p>All brick walls shall be non - load bearing in-filled panel walls.</p> <p>All brickwork shall be designed as per Indian Standards and shall be plastered on both faces. All external walls shall be minimum one brick thick in 1: 6 cement: sand mortar. Brick walls shall be provided with 12 mm and 18 mm thick 1: 6 cement: sand plaster on smooth and rough face of the brick work respectively.</p> <p>Bricks to be used in brickwork shall be of minimum Class designation 50.</p> <p>Brickwork cladding for various structures shall be so provided that there is a clear gap of 40 mm between inside face of external brick wall and outside face of column flange. Structural steel wall beams supporting brickwork shall be suitably encased with plaster or 1: 2: 4 concrete as the case may be. In case of box type steel beam, encasement shall be done with cement sand plaster in specified thickness and proportions over G. I. wire netting of 0.9 mm thickness.</p> <p>Parapets, chajjas, windows and door heads, architectural faces, fins etc. shall be provided with drip course in 1 : 4 cement sand mortar.</p> <p>50 mm thick Damp proof course shall be provided at plinth level for all brick wall.</p> <p>All R. C. C. ceilings shall be rendered smooth and finished with whitewash unless otherwise specified. Ceiling of control rooms, M. C. C. rooms (except areas provided with false ceiling) shall be provided with 6 mm thick plaster.</p>		
<p>9.00.00</p>	<p>Earthing Mat</p> <p>40 mm Dia MS Rods as earthing mat, placed at a distance of 1.0M away and at depths between 0.60M and 1.00M shall be supplied and laid all around the periphery of buildings, structures, and outdoor equipment, as per the approved drawings. Risers of 40 mm Dia MS Rods and connecting to the above Earthing mat shall also be supplied and laid in position by the Contractor, as per the approved drawings. Risers shall be laid up to a height of 300 mm above the local Ground level, at each of the columns of the buildings on outside of the buildings, and minimum 2 (Two) numbers for structures and outdoor equipment. The contractor also supply and lay necessary number of 3.0 M deep vertical 40 mm Dia MS Rods Earthing electrodes and connecting them to the Earthing mat, as per the approved drawings and the supplying and laying of 40 mm Dia MS Rods for connecting the Contractor's earthing mat with the Employer's earthing mat separately at two locations.</p>		
<p>10.00.00</p>	<p>SITE LEVELLING</p> <p>Site leveling of gypsum storage area , lime storage area , gypsum dewatering area , truck hopper and associated areas to be levelled in one block. Each block shall be finished to the formation level as specified in drawing. Bidder shall deploy adequate number of experienced site leveling contracting agency(s) with requisite earth moving and compacting equipment to complete the work as per schedule.</p> <p>Bidder shall carry out the topographical survey before he commences detailed design and site leveling. This survey shall cover the entire FGD area including gypsum</p>		
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	<p>storage ,gypsum handling area , lime storage area ,gypsum dewatering area , truck hopper area, limestone grinding and slurry storage area in Bidder's scope of work. Based on field observations the contractor shall prepare and submit for Owners review the survey maps of the surveyed sited on suitable scale, indicating grid lines, contour lines and demarcating all permanent features like roads, railways, waterways, buildings, power lines, natural streams, trees etc. For each area two sets of survey maps shall be prepared and submitted, one showing the spot levels and contours with grid lines and the other showing the grid lines, contours and permanent features</p> <p>Since the construction of roads and drains for the FGD area including gypsum storage ,gypsum handling area , lime storage area ,gypsum dewatering area , truck hopper area, limestone grinding and slurry storage area is included in the scope of Bidder, it shall be the responsibility of the Bidder to ensure that these facilities are also constructed along with site leveling works. Bidder shall ensure that road access and drainage facilities for each block is available when site leveling in that block is completed. Unless otherwise instructed by the Engineers, all roads and drains within a block shall be constructed by the bidder within a month from the date of completion of site leveling of that block.</p> <p>The specified formation level(s) shall be achieved either by excavation where the existing ground levels are higher than the specified formation level or by raising by controlled filling with borrowed earth where the existing ground levels are lower than the specified level</p> <p>All materials arising out of site clearance and excavation shall be the property of owner. They shall be dealt with in the manner specified by the Engineer. Earth / boulders / rock etc. excavated and useful portion (serviceable materials) of trees cut shall be stacked at suitable places within Owner's acquired land for the plant including the reservoir and the ash disposal area in a manner as directed by the engineer. Woods, branches, trunks of trees shall be termed as serviceable material. Other materials like twigs, leaves, roots, vegetable and organic matters etc. shall be termed as unserviceable material and shall be sorted out from the serviceable materials before disposal. They shall be cleared from the area and disposed off at places within Owner's acquired land for the plant including the reservoir and the ash disposal area in a manner as directed by the engineer.</p> <p>If the excavated material is suitable and accepted by the Engineer as fill material, the same can be used for filling in other areas where raising by filling is required. Otherwise the same shall be taken and stacked at places(s) within the plant boundary as directed by the Engineer.</p> <p>Filling with rock shall be done only after the written permission of the Engineer in the following manner:</p> <p>Filling with rock shall be done only in areas identified for laydown and preassembly .</p> <p>Original ground after removal of all organic and vegetable matters shall be consolidated by rolling as directed by the engineer subject to a minimum of six passes of 8-10 tonnes roller.</p>		
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	<ul style="list-style-type: none"> - Excavated rock shall be laid (on original ground or after filling 300 mm thick layers of soil as specified), in layers not exceeding 1000 mm and rolled with vibratory roller (10-15 tonnes static weight) with minimum six passes. - Over the compacted layer of rock, soil shall be filled in horizontal layers not exceeding 300mm in compacted thickness. The soil shall be compacted as specified elsewhere. - It shall be ensured that the top soil layer is in minimum 3 layers of 300 mm each. To achieve this the thickness and number of rockfill layers below can be suitably adjusted. <p>Contour map and spot levels of the area based on the preliminary survey carried out by Owner is enclosed for the purpose of guidance of Bidder. However, Owner does not take any responsibility about the accuracy of the survey details furnished and any variation of the said data shall not constitute a valid reason for changing the terms and conditions of the contract. Bidder is requested to carry out his independent assessment of the existing ground levels before furnishing his bid. Detailed survey shall be carried out by Bidder after award of work and all findings as stated earlier shall be submitted for Owner's review.</p> <p>Before commencement of cutting/filling, all organic and vegetable matters like grass. Plants shrubs bushes, weeds, trees (with girth less than 30 cm measured at height of 1m above ground level) etc. in the areas to be filled, shall be completely removed along with their roots and disposed off. .It shall also be ensured that the area to be filled is clear of any water, slush etc. Original ground shall be compacted by rolling as directed by the Engineer subject to a minimum of six passes of 8 to 10 tonne roller. The earth shall then be spread in horizontal layers not exceeding 300 mm in compacted thickness. Each layer shall be watered and compacted with proper moisture content and with such equipment as may be required to obtain a compaction of 95% or more of Standard Proctor's maximum dry density. The moisture content of the fill material shall be controlled to obtain near optimum moisture content during compaction.</p> <p>The fill material shall be tested for determining optimum moisture content and maximum dry density by Standard Proctor Test as per IS : 2720 (Part-VII). The fill material shall also be tested for determining moisture content before compaction as per IS:2720 (Part-II) For each of the above tests, one sample for every 10,000 cubic metre of fill material shall be tested. Additional samples shall be tested, whenever there is a change in the source or type of fill material. The compacted soil shall be tested for its dry density as per IS2720 (Part-XXIX) or Part-XXVIII). Samples shall be taken at the rate of one sample for every 10,000 sq.m. area for each compacted layer. In addition random checks shall be carried out in compacted soils by means of Proctor needle penetration. Bidder shall submit to the Engineer, the test results immediately after completion of the tests. A sample shall be deemed to have passed the test when the in-situ dry density is equal to or more than the specified percentage of maximum dry density. If a sample taken from a layer fails to pass the test, the layer shall be further compacted till two samples</p>		
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	<p>taken and tested from this layer pass without any negative deviation. Only after this. spreading of further layers shall be taken up.</p> <p>Before start of filling, the Bidder shall submit to the Owner his proposal for the methodology to be adopted for compaction for each type of fill material. The Bidder shall also carry out compaction trials to establish the proposed methodology. The Bidder shall start the compaction work only after approval of the methodology by the Owner</p> <p>The surface of the cut/filled up areas after reaching final level shall be dressed to the required levels and slopes. The difference in levels shall not be more than +/- 10cm locally.</p> <p>The borrow areas outside the overall plant boundary limits for obtaining suitable fill material which is required over and above the earth available after cutting high grounds within the plant area, for site levelling shall be arranged by the Bidder himself and all expenses in respect of royalties, taxes, duties, etc. for borrow areas/fill material shall be borne by him. He shall also obtain and submit to the Owner the necessary clearances/permission from the concerned authorities for the borrow areas/fill material.</p> <p>Material suitable for filling shall be loaded and transported to the filling site by the Bidder.</p> <p>Any coarse grained or fine grained low plastic soil, free from shingle, salts, organic matter, sod or any other foreign substances, may be used for filling. The Bidder shall test the fill material to establish its suitability and submit its results to the Owner. Fill material shall be approved by the Owner. The following types of materials shall not be used for filling:</p> <ol style="list-style-type: none"> Material from swamps, marshes and bogs. Expansive clays Peat, logs, stumps, sod and perishable materials. Materials susceptible to combustion Any material or industrial and domestic produce which will adversely affect other materials in the work. Materials from prohibited areas <p>Bidder shall include in his offer any extra filling that may be required on account of subsidence of the original ground due to overburden of filling above and/or compaction works for site levelling.</p>		
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	<p>After levelling, the contractor shall establish concrete pillars at the intersection points of the grid lines for future reference. These pillars shall project at least 450 mm above the formation level and shall be labelled permanently with their respective coordinates and reduced levels.</p> <p>Filling upto the specified formation level shall extend at least 2.0m beyond the outside face of boundary wall/fence. Thereafter, it shall be finished at a suitable slope (not steeper than 1 Vertical:2 Horizontal) and provided with good quality dry stone pitching minimum 300mm thick for slope upto level difference of 3m. If the level difference is more than 3m, the stone pitching shall be provided with RCC bands with suitable design and benching.</p> <p>11.00.00 FENCING</p> <p>Fencing with toe wall and steel gates shall be provided around the gypsum storage area , lime storage area , gypsum dewatering area , truck hopper and associated areas . Fencing shall comprise of PVC coated GI chain link fencing of minimum 8G (including PVC coating) of mesh size 75 mm and of height 2.4 m above the toe wall. The diameter of the steel wire for chain link fence (excluding PVC coating) shall not be less than 12G. All Fence posts shall be of 75 x 75 x 6 MS angles spaced at 2.5 m c/c distance. All corner posts will have two stay posts and every tenth post will have transverse stay post. Suitable R. C. C. foundation for the post and stays shall be provided based on prevailing soil conditions. Gates shall be sturdy with locking provisions.</p> <p>Toe walls of brick masonry shall be provided between fence posts all along the run of the fence with suitable foundation. Toe wall shall be minimum 200 mm above the formation 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 on both sides and painted with two coats of cement paint of approved colour and shade. Toe wall shall be provided with weep holes at suitable spacing.</p> <p>12.00.00 ROADS</p> <p>All roads shall be of rigid pavements unless otherwise specified. The design of rigid pavement shall be carried out as per IRC: 58. The effects of design wheel load, maximum tyre inflation pressures, tyre contact area for the vehicle, traffic loads, environmental factors such as temperature changes in the pavement, other factors, like impact, load repetitions, etc., are to be taken. Detailed plate load tests to determine the modulus of sub grade reaction "K" shall be carried out as per the procedure outlined in IS: 1888. The design traffic load shall be a minimum value of 4 million standard axles. The road shall be designed for 30 years of life and considering a minimum traffic growth rate of 1 per cent per annum. The concrete pavement for roads shall be minimum 250 mm thick slab.</p> <p>The road construction including its shoulders, base, sub base and concrete pavement shall be as per IRC standards. IRC: 58 shall be followed for the pavement design and IRC: 15 shall be followed for the construction of the concrete pavement.</p>		
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	<p>The road base shall be with minimum 150 mm thick dry lean concrete over granular sub base. Dry lean concrete shall be laid by a mechanical paver and compacted by vibratory rollers. Concrete pavement of the road shall be done with fully mechanized paver fitted with electronic sensors for construction techniques. Dry lean concrete shall be minimum M10 grade and concrete pavement slab shall be minimum M35 grade concrete.</p> <p>The finished top (crest) of all roads shall be 350 mm above the surrounding finished ground level.</p> <p>The sub grade under all roads and its shoulders shall be compacted to achieve 95 per cent or more of Standard Proctor's Density MDD using mechanical means.</p> <p>Cutting / extending / rerouting / remaking of existing roads including associated works to maintain continuity of road system / network shall also be carried out.</p> <p>All culverts and RCC bridges at crossings of all roads / rail tracks / facilities with drains / nallahs / channels / roads / rail tracks / pipes / other facilities, etc. are to be designed and constructed.</p> <p>Unless otherwise specified, all roads shall be double lane roads.</p>		
<p>13.00.00</p>	<p>GATE ALONG BOUNDARY WALL:</p> <p>The gate shall be complete with fabricated hinges, MS aldrops with locking arrangement, tempered steel pivot, guide track of MS tee, bronze aluminum ball bearing, castor wheel etc.</p> <p>All gates shall be given anti-corrosive treatment in three coats.</p> <p>The structural steel shall confirm to IS: 2062 (latest) and all other relevant IS codes.</p> <p>Beside the each gate one room of size not less than 3m X 3m shall be provided for security guards. The room shall be made of brick/ RCC and with RCC roof. In addition to the room, one toilet block shall also be provided.</p>		
<p>14.00.00</p>	<p>LIME & GYPSUM HANDLING AND ASSOCIATED BUILDINGS STORM WATER DRAINAGE SYSTEM</p> <p>Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc with a return period of 50 years. These values shall be based on rainfall intensity of 90mm/hr. All RCC drains shall be either RCC Cast-in-Situ or RCC Pre-cast drains. The minimum grade of concrete shall be M25 for RCC Cast-In-Situ drains and M30 for RCC Pre-cast drains. The maximum velocity for RCC open drains shall be limited to 1.8 metre per second. However, minimum velocity of 0.6 metre per second for self - cleansing shall be ensured. Bed slope not milder than 1 in 1000 shall be provided.</p> <p>Open RCC rectangular section, unless required otherwise due to functioned requirement, shall be provided for all drains. The thickness of side walls and bottom slab of RCC drains shall be minimum 150mm or as per design considerations whichever is higher for drains upto depth of 1m from formation level. For depth of drain more than 1m from formation level, the thickness of side walls and bottom slab</p>		
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	<p>of RCC drains shall be minimum 200mm or as per design considerations whichever is higher. The drains shall be provided on both sides of roads. These shall be designed to drain the road surface as well as all the free and covered areas, etc. Box culverts shall be provided at all rail, road and other crossings.</p> <p>All drains inside the building shall have minimum 40 mm thick grating covers. In areas where heavy equipment loads would be coming, precast RCC covers shall be provided in place of steel grating.</p> <p>The invert levels of the in-plant and plant peripheral drains shall be kept such that water can be discharged by gravity to the main / trunk drains under all conditions.</p> <p>The invert levels of the drains shall be decided in such a way that the water can easily be discharged to the natural water bodies above the high flood.</p> <p>15.00.00 SEWERAGE SYSTEM</p> <p>The connection of sewer pipe line for the associated buildings of FGD and Lime and gypsum handling area to nearest owner's sewage network is in bidder's scope.</p> <p>Cement concrete pipes of class NP-3 as per IS:458 shall be used below ground level for sewage disposal in all areas. However, for pressure pipes and under roads spun C.I. pipes conforming to IS:1536 of required class shall be used.</p> <p>RCC manholes with CI cover shall be provided at every 30m along the length, at connection points, and at every change of alignment, gradient or diameter of a sewer pipeline. This shall be as per IS:4111.</p> <p>Sewage pump house shall be provided as per IS:4111.</p>		
<p>16.00.00</p> <p>LOADING</p> <p>16.01.00</p>	<p>For consideration of loads on structures IS : 875 - 'Code of practice for structural safety of buildings' shall be followed. In addition to the dead load, live load, equipment load (including impact / vibration). Temperature loads etc. various loading conditions arising due to operation and maintenance of equipment shall be considered in the design. The structure and equipment shall also be designed for seismic loads as per the "Criteria for Earthquake Resistant Design of Structures and equipment" and the "Criteria for Wind Resistant Design of Structures and equipment" specified in the "Project Information section" of technical specification. Wind and seismic forces shall not be considered to act simultaneously. The following minimum live loads shall be adopted for the design of various structures. If actual expected load is more than the specified load, then actual load is to be considered.</p>		
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	<p>a) Roofs 150 Kgs. / Sq. M. for accessible roofs and 75 Kgs. / Sq. M. for non - accessible roofs. In addition to this dust load (Dead load) of 150 Kgs. / sq. m. on flat roofs & 75 Kgs. / sq. m. on inclined roofs shall also be considered.</p> <p>b) R. C. C. floors 500 Kgs. / Sq. M.</p> <p>c) Stair and balconies 500 Kgs. / Sq. M.</p> <p>d) Toilet rooms 200 Kgs. / Sq. M.</p> <p>e) Chequered plate floors 400 Kgs. / Sq. M.</p> <p>f) Walkways (including walkways in conveyor galleries) 300 Kgs. / Sq. M.</p> <p>g) Conveyor galleries In addition to the live loads, loads due to cable trays, fire fighting / service water pipes shall also be considered @ 125 Kgs. / m (minimum) on each of the longitudinal girder. Roof-truss members are to be checked for supporting fire fighting pipes/ Service water pipes.</p> <p>h) Road Culverts and its allied structures including R. C. C. pipe crossing & road crossing of trenches. For class 'AA' loading and checked for class A loading as per IRC standard.</p> <p>i) Channels / trenches In addition to earth pressure and water pressure, etc. additional earth pressure due to surcharge of 2T / Sq. M. shall also be considered for design.</p> <p>j) Covers for trenches / channels Covers for channels & trenches, shall be designed for a live load of 0.4T Sq. M. and loading as mentioned under clause in trenches, whichever is critical.</p>		
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	<p>k) Sumps and tanks and other underground basement type structures</p> <p>In addition to earth pressure with a surcharge of 2T / Sq. M. (or surcharge due to Railway loading whichever is critical for Railway load bearing structures etc.) and sub - soil water pressure etc. These are also to be designed for the following conditions :</p> <p>i) Water / liquid inside and no earth outside (applicable only to such structures which are liable to be filled up with water or any liquid).</p> <p>ii) Earth with surcharge outside and no water / liquid inside</p> <p>iii) For underground (basement) structures protection against buoyancy during execution and after execution shall be ensured without superimposed loadings with minimum factor of safety of 1.2 against buoyancy.</p> <p>If the erection load is higher than the specified live loads on any floor or part thereof, then the erection loads are to be considered for the design.</p> <p>Permissible increase in stresses of materials and bearing pressure of soil due to wind load or seismic load shall be as per relevant I. R. S. and I. S. code.</p> <p>16.02.00 Crane load</p> <p>For crane loads, an impact factor of 25% and lateral crane surge of 10% (of lifted weight + trolley weight) shall be considered in the analysis of frame according to the provisions of IS:875. The longitudinal crane surge shall be 5% of the static wheel load. Longitudinal surge and lateral surge shall not be considered to act simultaneously.</p> <p>16.03.00 Temperature load</p> <p>For temperature loading, the total temperature variation shall be considered as 2/3 of the average maximum annual variation in temperature. The average maximum annual variation in temperature for this purpose shall be taken as the difference between the mean of the daily minimum ambient temperature during the coldest month of the year and mean of daily maximum ambient temperature during the hottest month of the year. The structure shall be designed to withstand stresses due to 50% of the total temperature variation.</p> <p>Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with provision of twin columns. The maximum distance of the expansion joint shall be as per the provisions of IS: 800 and IS: 456 for steel and concrete structures respectively.</p> <p>17.00.00 DESIGN CRITERIA</p> <p>17.01.00 The design of all R. C. C. structures shall be carried out as per 'code of practice for plain and reinforced concrete for general building construction', IS : 456 (latest).</p>		
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17.01.00	Design of steel structures shall be done by the Working stress method. Design shall be as per provisions of IS:800 :1984 and other relevant IS standards.		
17.02.00	Minimum size of the angle section to be used as structural members shall be 50 X 50 X 6. Minimum weld size shall be 6 mm. Connections shall be designed for 70 % of shear capacity of the member or the actual shear force, whichever is higher. The steel structures using tubular sections shall be designed and fabricated as per IS:806 – “Code of Practice for use of steel tubes in general building construction.” and EN 1993-1-8:2005. Minimum grade of steel & thickness of Tubular/Hollow sections shall be Yst 240 Mpa & 4.0mm respectively		
17.03.00	The building shall conform to local bye - laws, rules and regulations for industrial buildings and also B. I. S. publications, SP 32 and 41.		
17.04.00	Slotted holes shall not be assumed to act as expansion joint for relieving of stresses and suitable bearings shall be provided at the supports.		
17.05.00	Stresses for all structures shall be checked for the higher of the forces obtained from gust factor method and the peak wind speed method.		
17.06.00	Horizontal bracing system shall be provided at floor levels around the openings.		
17.07.00	Shear force in steel columns shall be transferred to the pedestals / foundations exclusively either through foundation bolts or the shear key arrangement.		
17.08.00	For design of liquid retaining structures, IS : 3370 (Part - I to IV) (latest) shall be followed. Face of the structure in contact with liquid shall be designed as un - cracked section. For design of R. C. C. pipes for culverts, latest editions of IS : 458, IS : 783 should be followed.		
17.09.00	For design of all underground structures / foundations, ground water table shall be assumed at the formation level (i. e. the adjoining ground level). For all underground structures like tunnel, underground transfer point and underground hopper etc. crack width shall be limited to 0.2mm.		
17.10.00	Design of masonry walls shall be made as per IS : 1905.		
17.11.00	Civil task drawing indicating various equipment loading and supporting arrangement and floor loads to be submitted along with the design calculation.		
17.12.00	Minimum 0.12% of reinforcement shall be provided on the top face of the foundation concrete on either direction and minimum percentage of reinforcement at bottom face of foundation shall be same as that stipulated for beam as per IS:456.		
17.13.00	Foundations for all tanks shall be designed for as per IS: 803.		
17.14.00	Footings shall be so proportioned to as to minimise the differential settlement.		
17.15.00	All gallery supporting trestles shall be so proportioned that the transverse deflection of gallery due to wind / seismic load should not exceed trestle height / 1000 as stipulated in IS: 11592. This deflection condition shall be strictly followed. Peak wind speed method shall be considered for checking the transverse deflection.		
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17.16.00	The crusher and transfer house structures shall be so designed that transverse deflection at places where conveyor galleries meet, should be equal to the respective transverse deflection of conveyor supporting trestles.									
17.17.00	<p>Deflection criteria</p> <p>The maximum Horizontal Deflection for various structures shall not exceed and be limited to the following:</p> <table border="1"> <thead> <tr> <th>Sl. No.</th> <th>Description</th> <th>Maximum value of</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)</td> <td>Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)</td> </tr> <tr> <td>2.</td> <td>For other Buildings</td> <td>Height/325</td> </tr> </tbody> </table>	Sl. No.	Description	Maximum value of	1.	For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)	Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)	2.	For other Buildings	Height/325
Sl. No.	Description	Maximum value of								
1.	For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)	Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)								
2.	For other Buildings	Height/325								
17.18.00	<p>a) Permissible deflection (unless specified otherwise in this specification) for latticed framework and beams of floors other than drive floor shall be span/325.</p> <p>b) The allowable deflection for beams directly supporting drive machinery shall be restricted to span/500 unless specified otherwise in this specification.</p> <p>c) The deflection for manually operated cranes & monorail supporting beams shall not exceed span/500. For electric overhead cranes :</p> <p>1) upto 50 t capacity : span/750</p> <p>2) over 50 t capacity : span/1000</p> <p>d) The vertical deflection of metal deck sheet for roofing and side cladding shall be limited to span/250</p> <p>e) The permissible vertical deflection for beams supporting drive machinery shall be restricted to span / 500 and for other beams it shall be within span / 325.</p> <p>f) Permissible deflection for all purlins, cladding runners, roofing/cladding sheets and grating / chequered plates shall be span/250. However, the maximum vertical deflection of Grating/ Chequered plate shall be limited to 6 mm.</p>									
17.19.00	<p>a) Dispersion of load in any direction through soil shall be as per IS: 8009 (relevant part).</p> <p>b) Dispersion of load through concrete shall be considered at an angle of 45 degrees with horizontal from the edge of contact area.</p>									
17.20.00	a) The design and construction of RCC structures shall be carried out as per IS: 456. Working stress method shall be adopted for the design wherever									
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17.21.00	<p>specifically mentioned in this specification.</p> <p>b) For design and construction of steel-concrete composite members, IS: 11384 shall be followed.</p> <p>c) For reinforcement detailing, IS: 5525 and SP: 34 shall be followed.</p> <p>d) Two layers of reinforcement (on both inner and outer faces) shall be provided for RCC wall sections having thickness 150 mm or more.</p> <p>a) All RCC liquid retaining/conveying shall be designed by working stress method as outlined in clause no. 4.5 of IS 3370 (Part-2) 2009 unless specified other wise.</p> <p>b) Water proofing treatment shall be provided for liquid retaining/ carrying structures and basement type structures (requiring dry working condition). Dense and durable concrete with water cement ratio not more than 0.45 shall be used. Plasticiser /super-plasticiser cum water proofing compound shall be added to the concrete. All the construction/expansion joints shall be provided with PVC water bar and/or chemical injection grouting as per IS:6494. As applicable internal/external surface of such structures shall be provided with acrylic based polymer modified cementitious composite coating system for critical structures. For liquid carrying/retaining structures, minimum two coats of such coating shall be applied. For external application wherever the surface is in contact with the earth, fine silica/quartz sand of 0.6 mm nominal size shall be added in the coating mix for better abrasion resistance and total nominal thickness of such coating shall be minimum 1.5 mm. For non critical structures minimum two coats of bitumen grade 85/25 as per IS:702, mixed with 1% of anti-stripping compound meeting the requirement of IS:6241, shall be applied. The total application of bitumen shall not be less than 1.7 kg/sq.m.</p> <p>Bidder shall submit a comprehensive scheme for water proofing treatment based on above or any other alternative scheme, internationally accepted for Employer's approval prior to commencement of work.</p> <p>c) All liquid retaining/carrying structures shall be tested for water tightness as per the provisions of IS: 3370 and IS: 6494 and in case of leakage, the same shall be rectified by chemical injection grouting through nozzles.</p>		
17.22.00	<p>For design of all underground structures, foundations, etc. ground water table shall be assumed at the finished ground level unless specified otherwise.</p>		
17.23.00	<p>Earth pressure for all underground structures shall be calculated using coefficient of earth pressure at rest or co-efficient of active earth pressure, whichever is applicable, depending upon the structural configuration. However, for the design of substructure of pump houses, earth pressure at rest shall be considered. Co-efficient of passive earth pressure shall be used only in design of shear keys for stability against sliding.</p>		
17.24.00	<p>a) Following loading conditions shall be considered in addition to the loading from super structure for the design of substructure of pump house, channels, sumps, tanks, trenches and other underground structures containing liquid</p> <p>i) Water pressure from inside and no outside pressure, like earth pressure, ground water and surcharge pressure (applicable only to structures, which are liable to be filled up with water or any other liquid.)</p> <p>ii) Earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside.</p>		
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	<p>iii) Design shall also be checked against buoyancy due to the ground water during construction as well as after construction stages. Minimum factor of safety of 1.2 against buoyancy shall be ensured considering empty condition inside and ignoring the superimposed loadings. Provision of pressure relief valves/flap valves, etc., shall not be permitted to counter the buoyancy unless specified otherwise.</p> <p>iv) Base slab and piers of the pump houses shall also be designed for the condition of different combination of pump sumps being empty during maintenance stages with maximum ground water level.</p> <p>b) Intermediate dividing pier of pump sumps and partition wall (if applicable) in channel shall be designed considering water on one side only and other side being empty for maintenance.</p> <p>c) All pump houses and other substructures (wherever applicable) shall be checked for stability against sliding and overturning during construction as well as operating conditions for various combinations of loads.</p> <p>17.25.00 Design of Block Foundation</p> <p>a) Block foundation resting on soil shall be analyzed using elastic half space theory. In case the foundation is supported over piles, Novak's approximation shall be used for determining the spring constant and damping ratio of pile groups. The mass of the RCC block shall be at least three times the mass of machine. Free vibration analysis of the foundation shall be carried out to evaluate the natural frequencies. The fundamental natural frequency shall be kept at least 20% away from the operating frequency (speed). Forced vibration analysis shall be carried out if the dynamic forces are made available by the machine supplier in which case the amplitude limits stipulated by the machine supplier and ISO 10816, whichever is lower, shall be satisfied.</p> <p>Reinforcement design shall be done by working stress method as per IS:456-2000 and IS:2974 (Part-IV).</p> <p>b) For the foundations supporting minor rotating 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 structure, floors, etc., suitable vibration isolation shall be provided by means of springs, neoprene pads, etc., and such vibration isolation system shall be designed suitably.</p> <p>18.00.00 Coating on RCC water retaining structures (other than drinking water)</p> <p>Epoxy phenolic coating shall be applied on internal surfaces of the RCC water retaining structures, as per details specified below:</p> <p>All concrete surfaces shall be provided with two component transparent polyamide cured epoxy sealer coating (having solid by volume minimum 40% \pm2%) of minimum 50 micron DFT. Surface to be coated shall be absolutely dry, clean and dust free.</p> <p>Sealer coat shall be followed with the application of epoxy phenolic coating (solid by volume minimum 63%) of minimum 400 micron DFT. This coat shall be applied after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.</p>		
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	<p>Coating on RCC water retaining structures (drinking water)</p> <p>Internal surfaces of RCC water retaining structures shall be provided with minimum 400 micron Food grade epoxy coating complying to FDA Title 21, Part 175.300. Surface to be coated shall be absolutely dry, clean and dust free</p> <p>19.00.00</p> <p>Fabrication</p> <p>All steel structures shall be fabricated in factory, transported and erected at site. All factory fabricated structures shall have bolted field connections.</p> <p>Chimney flue liners can either be fabricated at factory in segments, transported and welded at site before erection or fabricated at site. For Chimney flue liners, to prevent flue gas leakages, the applicable field joints shall necessarily be welded.</p> <p>20.00.00</p> <p>Electrodes</p> <p>20.01.00</p> <p>The electrodes used for welding shall be of suitable type and size depending upon specifications of the parent material, the method of welding, the position of welding and quality of welds desired. Only low hydrogen electrodes shall be used for welding of medium /high tensile steel and for mild steel plate thickness above 20 mm.</p> <p>20.02.00</p> <p>All low hydrogen electrodes shall be baked and stored before use as per manufacturer's recommendation. The electrodes shall be re-baked at 250°C - 300°C for one hour and later on cooled in the same oven to 100° C. It shall be transferred to a holding oven maintained at 60°C - 70°C. The electrodes shall be drawn from this oven for use.</p> <p>20.03.00</p> <p>Where coated electrodes are used they shall meet the requirements of IS: 814 and relevant ASME - Sec. II. Covering shall be heavy to withstand normal conditions of handling and storage.</p> <p>20.04.00</p> <p>Only those electrodes that give radiographic quality welds shall be used for welds, which are subjected to radiographic testing.</p> <p>20.05.00</p> <p>Where bare electrodes are used these shall correspond to specification of the parent material. The type of flux-wire combination for submerged arc welding shall conform to the requirements of F-60 class of AWSA-5-17-69 and IS: 3613. The electrodes shall be stored properly and the flux shall be baked before use in an oven in accordance with the manufacturer's requirements as stipulated.</p> <p>20.06.00</p> <p>The contractor shall take specific approval of the weld for the various electrodes proposed to be used on the works before any welding is started.</p> <p>20.07.00</p> <p>Edge Preparation for Welding</p> <p>Suitable edge as per weld joint detail shall be prepared either by machines or by automatic gas cutting. All edges cut by flame shall be ground before they are welded.</p> <p>20.08.00</p> <p>Pre Heating and Post Heating</p> <p>Mild steel and medium / high tensile steel plates thicker than 20mm, will require Pre-Heating of the parent plate prior to welding as mentioned in Table - 1 for mild steel and Table - 2 for medium / high tensile steel, however, higher pre heat temperature</p>		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 39 OF 69</p>

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20.09.00	<p>may be required as per approved welding procedure and it shall be followed. In welding materials of unequal thickness, the thicker part shall be taken for this purpose.</p> <p>Base metal shall be preheated, notwithstanding provisions of IS: 9595 to the temperature given in Table - 1 for mild steel and Table - 2 for medium / high tensile steel, prior to welding or tack welding. When base metal not otherwise required to be pre heated is at a temperature below 0°C it shall be pre heated to atleast 20°C., prior to tack welding or welding. Pre heating shall bring the surface of the base metal to the specified pre heat and this temperature shall be maintained as minimum inter-pass temperature welding is in progress.</p> <p style="text-align: center;">TABLE - 1 MINIMUM PREHEAT AND INTERPASS TEMPERATURE FOR WELDING MILD STEEL</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="text-align: left;">Thickness of thicker part at Point of welding</th> <th colspan="2" style="text-align: center;">Welding Using</th> </tr> <tr> <th style="text-align: center;">Low hydrogen electrode or submerged arc welding</th> <th style="text-align: center;">Other than low hydrogen electrode</th> </tr> </thead> <tbody> <tr> <td>Upto and including 20mm</td> <td style="text-align: center;">None</td> <td style="text-align: center;">None</td> </tr> <tr> <td>Over 20mm and up to and including 40mm</td> <td style="text-align: center;">20°C</td> <td style="text-align: center;">Not allowed</td> </tr> <tr> <td>Over 40mm and up to and including 63mm</td> <td style="text-align: center;">66°C</td> <td style="text-align: center;">Not allowed</td> </tr> <tr> <td>Over 63mm</td> <td style="text-align: center;">110°C</td> <td style="text-align: center;">Not allowed</td> </tr> </tbody> </table> <p>Note: Type of electrode and the preheating requirements for welding shall be as per approved welding procedure.</p> <p style="text-align: center;">TABLE - 2 MINIMUM PREHEAT AND INTERPASS TEMPERATURE FOR WELDING MEDIUM / HIGH TENSILE STEEL</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="text-align: left;">Thickness of thicker part at Point of welding</th> <th colspan="2" style="text-align: center;">Welding Using</th> </tr> <tr> <th style="text-align: center;">Low hydrogen electrode or submerged arc welding</th> <th style="text-align: center;">Other than low hydrogen electrode</th> </tr> </thead> <tbody> <tr> <td>Upto and including 20mm</td> <td style="text-align: center;">None</td> <td style="text-align: center;">Not Allowed</td> </tr> <tr> <td>Over 20mm</td> <td style="text-align: center;">120oC - 140°C</td> <td style="text-align: center;">Not Allowed</td> </tr> </tbody> </table> <p>Note : Type of electrode and the preheating requirements for welding of medium and high tensile steel shall be as per approved welding procedure.</p> <p>Pre heating may be applied by external flame which is non-carbonizing like LPG, by electric resistance or electric induction process such that uniform heating of the</p>	Thickness of thicker part at Point of welding	Welding Using		Low hydrogen electrode or submerged arc welding	Other than low hydrogen electrode	Upto and including 20mm	None	None	Over 20mm and up to and including 40mm	20°C	Not allowed	Over 40mm and up to and including 63mm	66°C	Not allowed	Over 63mm	110°C	Not allowed	Thickness of thicker part at Point of welding	Welding Using		Low hydrogen electrode or submerged arc welding	Other than low hydrogen electrode	Upto and including 20mm	None	Not Allowed	Over 20mm	120oC - 140°C	Not Allowed
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	<p>surface extending up to a distance of four times the thickness of the plate on either side of the welded joint is obtained.</p>		
20.10.00	<p>Thermo-chalk, thermo-couple or other approved methods shall be used for measuring the plate temperature.</p>		
20.11.00	<p>All butt welds with plates thicker than 50mm and all site butt welds of main framing beam supporting the bunker shall require post weld heat treatment as per procedure given in AWS D-1.1. Post heating shall be done up to 600oC and rate of application shall be 200oC per hour.</p>		
20.12.00	<p>The post heat temperature shall be maintained for 60 minutes per 2.5cm thickness. For maintaining slow and uniform cooling, asbestos pads shall be used for covering the heated areas.</p>		
21.00.00	<p>Paving, Drainage and Sewage</p> <p>RCC paving of minimum 150 mm thick with M25 grade concrete, over an underbed as specified herein shall be provided. 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 200mm compacted thick for normal duty paving with 63 mm and down aggregate with interstices filled with selected moorum 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.</p> <p>2.5 m wide paving with metallic hardener around periphery of all sumps and underground tanks shall be provided.</p> <p>Suitable drains shall be provided to dispose off storm water as well as floor wash of the FGD area block. The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain.</p> <p>Sewer lines (Cast Iron), interconnected by sewer manholes (RCC) at regular intervals (not exceeding 30 meter centre to centre) shall be provided to dispose off sewage from FGD area to the nearest available manhole of the owner.</p> <p>The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr. The maximum velocity for pipe drains and open drains shall be limited to 2.4m/sec and 1.8 m/sec. respectively. However, minimum velocity of 0.6m/sec. for self-cleansing shall be ensured. Bed slope not milder than 1 in 1000 shall be provided. The open drains shall be open rectangular drains of RCC unless required otherwise due to functional requirement. RC box culverts shall be provided at rail, road or other crossings.</p> <p>Sewers shall be designed for a minimum self-cleansing velocity of 0.75m/sec and the maximum velocity shall not exceed 2.4m/sec.</p> <p>22.00.00</p> <p>Statutory Requirements</p> <p>Bidder shall comply with all the applicable statutory rules pertaining to Factories Act, Fire Safety Rules at Tariff Advisory Committee. Water Act for pollution control, Explosives Act, etc.</p>		
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<p>23.00.00</p>	<p>Provisions of safety, health and welfare according to Factories Act shall be complied with. These shall include provision of continuous walkways along the crane - girder level on both sides of building, comfortable approach to EOT crane cabin, railing, fire escape, locker room for workmen, pantry, toilets, rest room etc.</p> <p>Provisions for fire proof doors, number of staircases, fire separation wall, lath plastering/encasing the structural members (in fire prone areas), type of glazing etc. shall be made according to the recommendations of Tarrif Advisory Committee.</p> <p>Statutory clearances and norms of State Pollution Control Board shall be followed.</p> <p>Bidder shall obtain approval of Civil/Architectural drawings from concerned authorities before taking up the construction work.</p> <p>INSPECTION, TESTING AND QUALITY CONTROL</p> <p>Sampling and testing of major items of civil works viz. earthwork, concreting, structural steel work (including welding), piling, sheeting, etc. shall be carried out in accordance with the requirements of this specification. Wherever nothing is specified relevant Indian Standards shall be followed. In absence of Indian Standard equivalent International Standards may be used.</p> <p>The Bidder shall submit and finalise a detailed field Quality Assurance Programme before starting of the construction work according to the requirement of this specification. This shall include frequency of sampling and testing, nature/type of test, method of test, setting of a testing laboratory, arrangement of testing apparatus/equipment, deployment of qualified/experienced manpower, preparation of format for record, Field Quality Plan, etc. Tests shall be done in the field and/or at a laboratory approved by the Engineer. The Bidder shall furnish the test certificate from the manufacturer's of various materials to be used in the construction.</p>		
<p>24.00.00</p>	<p>CONCRETE</p> <p>All R. C. C. works to be done under this specification, unless specified otherwise shall be design mix concrete. Minimum grade of concrete for various structures shall be as follows:</p> <ul style="list-style-type: none"> a) M25 - For all underground / sub-structural/ super-structure R. C. C. work. b) M30- For Block Foundation c) M35- For spring supported RCC deck <p>Minimum 75 mm thick P.C.C M-7.5 shall be provided as mud mat below all foundations.</p> <p>For concreting of underground structures requiring water tightness, plasticizer cum water proofing admixture shall be added to the concrete mix.</p> <p>Both coarse and fine aggregates shall conform to IS: 383 for concrete, shotcreting etc. unless otherwise mentioned.</p>		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 42 OF 69</p>

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<p>25.00.00</p> <p>25.01.00</p> <p>25.02.00</p>	<p>Excavation, Backfilling, Disposal and Stacking of materials Details</p> <p>Excavation in Soil</p> <p>Excavation for foundation shall be to the bottom of lean concrete and as shown on drawing or as directed by the Engineer. The bottom of all excavations shall be trimmed to required levels and when excavation is carried below such levels by error, it shall be brought back to the specified level by filling with concrete of nominal mix 1 : 3 : 6 (cement: coarse sand: 40 mm down aggregates), as directed by the Engineer.</p> <p>The Contractor shall ascertain for himself the nature of materials to be excavated and the difficulties, if any, likely to be encountered in executing this work. Cofferdams, sheet piling, shoring, bracing to maintain suitable slopes, draining etc. shall be provided and installed by the contractor, to the satisfaction of the Engineer.</p> <p>Surplus excavated materials shall be disposed off by the contractor at locations up to a lead of 5 kms from the plant boundary wall as directed by the engineer.</p> <p>The Contractor shall have to constantly pump out any water collected in excavated pits and other areas due to rain water, springs etc. and maintain dry working conditions at all times until the excavation, placement of reinforcement, shuttering, concreting, Backfilling is completed. The Contractor shall remove all slush/muck from the excavated areas to keep the work area dry. The Contractor, if required, shall employ sludge pumps, for this purpose.</p> <p>For other details, excavation clauses as given at “Foundation system and Geotechnical Data Chapter” given at “Project Information section” of technical specification, are to be referred.</p> <p>Excavation in Rock</p> <p>For the work of excavation in rock, Contractor shall engage specialised agency having experience of excavation in rock involving wedging and blasting. The agency shall be subject to approval of Engineer and the Contractor shall furnish details of relevant experience in support while seeking approval for the agency.</p> <p>Blasting shall be resorted to only with the written permission of the Engineer. All the statutory laws, (Explosives Act etc.) rules, regulations, Indian Standards etc. pertaining to the acquisition, transport, storage, handling and use of explosives etc. shall be strictly followed.</p> <p>The contractor shall obtain Licenses from Competent Authorities for undertaking blasting work as well as for procuring, transporting to site and storing the explosives as per Explosives Act. The Contractor shall be responsible for the safe transport, use, custody and proper accounting of the explosive materials.</p> <p>Surplus excavated materials shall be disposed off by the contractor at locations up to a lead of 5 kms from the plant boundary wall as directed by the engineer. The Contractor shall have to constantly pump out any water collected in excavated pits and other areas due to rain water, springs etc. and maintain dry working conditions at all times until the excavation, placement of reinforcement, shuttering, concreting, backfilling is completed. For other details for excavation in rock, clauses as given at</p>		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 43 OF 69</p>

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<p>25.03.00</p>	<p>“Foundation system and Geotechnical Data Chapter” given at “Project Information section” of Technical specification, are to be referred.</p> <p>Backfilling, Disposal and Stacking of materials</p> <p>Backfilled earth shall be compacted as per “Foundation system and Geotechnical Data Chapter” given at “Project Information section” of technical specification.</p> <p>However, the backfill under the rail lines and roads shall be compacted to minimum 95 % of the standard proctor density at OMC unless otherwise stated by rail Authorities.</p> <p>The contractor is required to excavate upto any depth as shown on the drawings or as directed by the Engineer. Lifting of excavated materials shall be done either by manual or mechanical or both means if called for by the Engineer.</p> <p>The disposal / stacking areas for excavated materials shall be indicated by the Engineer. The carriage of excavated materials shall be done by the methods mentioned below:</p> <p>The excavated materials shall be carried beyond the initial lead of 50 m but upto 500 m by manual / animal labour or by mechanical means. If directed by the Engineer this material shall be used directly for filling purposes.</p> <p>For leads exceeding 500 m the Contractor shall transport the excavated materials by mechanical means only and as directed by the Engineer. The Contractor may be allowed to carry materials through Kuccha roads. Providing and maintaining of the Kuccha roads shall be the responsibility of the Contractor. The transported material shall be neatly stacked as directed by the Engineer.</p> <p>Some excavated materials required for filling purposes, may have to be carried upto a lead of 500 m and stacked as per instructions of the Engineer. Excavated materials carried beyond 500 m shall normally be for disposal purpose only. Double handling of materials shall be avoided as far as possible. However, depending on site condition excavated materials carried beyond a lead of 500 m may also be required to be brought back for filling purpose.</p> <p>Materials to be used for filling purpose shall be stone, sand or other inorganic materials and they shall be clean and free from shingle, salts, organic matter, large roots and excessive amount of sod, lumps, concrete or any other foreign substances which could harm or impair the strength of the substances in any manner. All clods shall be suitably broken to small pieces. When the material is mostly rock boulders, these shall be broken into pieces not larger than 150 mm size before backfilling and shall be backfilled in layers of 300mm interstices filled with sand. In case of broken rock boulders used for back filling, the top cover shall be with 1.0m thick soil. The layers of rock boulders, interstices filled with sand shall be compacted by plate vibrators. Sand used for filling shall be clean, medium grained and free from impurities. Fines less than 75 microns shall not be more than 20%. In any case, the materials to be used for filling purposes shall have the prior written approval of the Engineer.</p>		
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<p>26.00.00</p>	<p>In case the materials have to be brought from pits / quarries, then it shall be the Contractor's responsibility for identification of such quarry areas, obtaining approval from their use from concerned authorities, excavation / quarrying loading and carriage of such material, unloading and filling at specified locations. The Contractor shall pay any fees, royalties etc. that may have to be paid for utilisation of borrow areas.</p> <p>GALVANISING</p> <p>All burrs and irregular edges of the structural steel members to be galvanised shall be ground smooth before galvanising.</p> <p>Purity of Zinc to be used for galvanising shall be 99.5 % as per IS : 209 (latest edition).</p> <p>The weight of the zinc coating shall be at least 610 Gms. / m² unless noted otherwise.</p>		
<p>27.00.00</p>	<p>CHEMICAL INJECTION GROUTING</p> <p>Minimum, 12 mm dia (NB) threaded nozzle of suitable length, shall be provided over the surface and along the construction joint line in a grid pattern at a spacing not exceeding 1.5 m c / c before concreting operation. Adequate precaution shall be taken to keep the nozzles plugged at both ends to prevent them from getting closed by concrete.</p> <p>For fixing of any nozzle in set concrete suitable size hole shall be drilled, preferably by using percussive hammer drill electrically operated, in grid pattern and grouting nozzle shall be fixed in these holes.</p> <p>After the nozzles are fully set, neat cement slurry admixed with water soluble non - shrink polymer / monomer based chemical shall be injected through the net - work of nozzles with low pressure grout pumps at a pressure of about 2.0 Kgs. / cm². Cement slurry shall be prepared by mixing cement with non-shrink polymer/monomer @ 500 gm/50 kg bag of cement and water, ensuring that Water: Cement ratio does not exceed 2 (by weight). Wetter the structure, lesser should be the water cement ratio. The property of the polymer/monomer should be such that when it is mixed with water @0.5% by weight of water, the viscosity of the resultant solution (water and polymer/monomer) should not be more than 1.2 centipoises. Plasticizing agent shall be added wherever required. The grouting shall be started at very low pressure and increased gradually to a required pressure. The grouting shall continue, till the hole refuses to take any further grout, even at an increased pressure. Applied pressure shall not be more than the designed strength of the concrete. After completion of grouting operation, the nozzles shall be sealed properly to the satisfaction of the Engineer.</p>		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 45 OF 69</p>

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<p>28.00.00</p> <p>28.01.00</p> <p>28.02.00</p> <p>28.03.00</p> <p>28.04.00</p>	<p>POLYMER MODIFIED CEMENTITIOUS COATING</p> <p>Materials</p> <p>Modified liquid polymer blend shall be a dispersion containing 100 % acrylic based polymer solids. Polymer shall be mixed in the ratio of 1 cement: 0.5 polymer (for minimum solid content of polymer 30%).</p> <p>Portland cement based dry powder.</p> <p>Clean, fine specially prepared quartz sand approximately 0.6 mm size.</p> <p>Mixing</p> <p>The liquid polymer shall be stirred well and cement based powder shall then be added slowly to make a Slurry Mix. For preparation of Brush Topping Mix, quartz sand shall be added slowly and mixed well till a homogeneous mixture is obtained. The mix shall be used within half an hour of the preparation. Addition of quartz sand may not be necessary, in case dry power contains the same.</p> <p>Properties of Coating</p> <p>It must adhere to wet surface.</p> <p>It should develop adequate bond strength, with the concrete surface, not less than 2 N / Sq. mm.</p> <p>Co - efficient of permeability shall be about 5×10^{-10} Cm / Sec.</p> <p>Water absorption after continuous soaking shall not be more than 1 %.</p> <p>The materials shall be permeable under water vapour.</p> <p>The material shall be resistant to acids and alkalis present in the soil and underground water with normal pH value between 4 and 14.</p> <p>The co - efficient of thermal expansion of the material shall be close to that of concrete.</p> <p>Application</p> <p>The concrete surface shall be cleaned and made free from grease, oils or loosely adhered particles. The surface shall be damp without any free water. For exterior underground part, application (b) pertaining to Brush topping Mix shall be followed.</p> <p>(a) For Slurry Mix</p> <p>A minimum of 2 coats shall be applied on the surface. The first coat being applied, when the surface is still damp and left to harden for 4 to 6 hours. After 4 to 6 hours of the application of second coat, it shall be finished by rubbing down with a soft dry</p>		
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	<p> sponge. The coverage shall not be less than 1 : 1 Kgs. / m² in the 2 coats. A lap of 75 mm shall be provided at the joints.</p> <p>The coating shall be air dried for 4 to 6 hours and, thereafter, cured for 7 days after the application of last coat.</p> <p>(b) For Brush Topping Mix</p> <p>This shall be applied in two coats. A primary coat of slurry mix can also be first applied on the surface as first coat. After the coating has dried up, a coat of Brush Topping Mix shall be applied over it with a push broom or any other similar brush. It shall be left in broom finished condition. The nominal thickness shall be 1.5 mm and minimum thickness shall be 1.0 mm. A lap of 75 mm shall be provided at the joints. It shall be ensured that no pinhole exists and rebrushing shall be done to cover the pinholes, if any.</p> <p>The Coating shall be air dried for 4 to 6 hours and thereafter cured for 7 days after the application of last coat.</p> <p>Rate of application of coating shall be established to achieve the required thickness.</p>		
29.00.00	<p>Architectural Concepts</p> <p>Buildings shall be architecturally treated in such a way that it 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 comprehensive scale, blending with the surroundings and taking full consideration of the climatic conditions and the building orientation. All the buildings shall be architecturally treated in such a way so as to be in harmony with the surroundings. The over all composition may have straight or curvilinear profiles.</p> <p>Necessary projections, fins, parapets, chajjas etc. in addition to the minimum area specified elsewhere in this specification shall be provided as required.</p> <p>Nothing extra shall be payable for any changes required while getting the drawings / scheme approved and for executing the same.</p> <p>All structures, buildings and facilities shall be designed as per provisions of National Building Code 2005 and Local building by - laws as applicable including provisions of the Factories Act of the State concerned, with regard to requirement of free access, stairs, minimum head room, walkways, ventilation, toilets etc. and safety requirements like railings, fire escapes etc. Further all layouts and detailed drawings shall meet the relevant statutory requirements specified in recommendations of Petroleum act, Explosives act and Indian Electricity rules' as applicable.</p>		
29.01.00	FINISHING SCHEDULE		
29.01.01	<p>Flooring</p> <p>The nominal total thickness of floor finish shall be 50mm i.e. underbed & topping. The floor shall be laid on an already laid and matured concrete base.</p>		
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	<p>Flooring of tiles / stone shall be fixed with 18 mm thk cement sand mortar 1:4, above PCC under bed (M 20 (with graded aggregate of nominal size 12.5mm) design mix)</p> <p>Flooring of Concrete hardener topping shall be provided above the PCC underbed (M 20 (with graded aggregate of nominal size 12.5mm) design mix).</p> <p>29.01.02 Wherever specified Heavy duty ceramic tiles of size 300x300x7 mm thick (minimum) of reputed manufacturer (Kajaria, Orient, Johnson or equivalent) of approved finish shade and colour to be used. Vitrified ceramic tiles wherever specified shall be 600x600 mm with minimum 9.5 mm thickness and of reputed manufacturer (Kajaria, Johnson, Orient or equivalent).</p> <p>29.02.00 Floor finish & skirting:</p> <p>The nominal thickness of floor finish shall be 50 mm.</p> <p>Floors of toilets, pantries / kitchen shall be finished with Heavy duty (grade-5) dust pressed ceramic tiles 300mmx300mm x7 mm thick as per IS:15622, including pointing the joints with white cement mixed with matching pigment, of approved make, size & colour shade.</p> <ol style="list-style-type: none"> (1) Floors of Office Room, Labs, Control Rooms, RIO Rooms and all other A/c Room shall be finished with Mirror polished Vitrified ceramic tiles (minimum 9.5 mm thk) with 3 mm groove joints as per approved pattern, pointed neatly with 3X4mm stainless epoxy grout SP- 100 of Laticrete or approved equivalent in approved colour to match colour of tile. (2) Suitable supporting arrangement shall be provided with M.S. angles / channels on cable trenches in MCC and Control rooms for mounting Control panels / MCC. (3) In rest of the areas, IPS (Cement concrete flooring) with Concrete hardener topping shall be 12mm thick with ordinary grey cement using uniformly graded, properly treated iron particles shall be provided. (4) Floors and sides of under ground RCC structures like valve pits, trenches and tanks shall have simultaneous (integral) neat cement finish at the time of concreting. (5) The interconnecting walkway between various structures, buildings and facilities shall be finished with 22 mm chequered concrete tiles at top. 1000 mm wide walkway of 22mm thick chequered concrete tiles shall be provided on terrace for maintenance purpose, in all RCC /Metal deck roof buildings. (6) Skirting in general shall be 150mm high, Dado in toilet, kitchen & pantry shall be up to specified height (up to 2200 mm for toilets, up to 600 mm high above counter top in kitchen and pantry area). The dado height shall be measured from finished floor level. Skirting and Dado shall match with the floor finish. (7) Battery Room shall be provided with Acid resistant tile on horizontal and vertical surfaces, at all levels for all type of works, including One coat of bitumen primer followed by 12 mm thick bituminastic layer, 20 mm thick Acid Resistant tiles, 6 mm thick under-bed by potassium silicate mortar, 6 mm thick pointing of joints of tiles with acid/alkali resistant epoxy/furane mortar up 		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 48 OF 69</p>

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	<p>to a depth of 20 mm and bituminastic end sealing. 1200 mm high dado on wall shall be with 12 mm thk Acid resistant tiles of the similar finish and the joints to be finished as per flooring tiles, with the rest of wall height and ceiling finished in chemical resistant paint (chlorinated rubber based).</p> <p>(8) Well polished 18 mm thick Kota stone jointed with neat cement slurry mixed with pigment to match the shade of the stone including rubbing and cleaning, complete, to be provided in entrance area, entrance steps, Entrance area, staircases (tread, riser, landings, skirting).</p> <p>29.03.00 Sunken RCC slab shall be provided in false flooring area and toilet, Kitchen and pantry, so as to keep the finished floor level of these areas same as that of the surrounding area.</p> <p>29.04.00 Water proofing treatment to be provided on sunken portion of all vertical and horizontal surfaces of depressed portions of all toilets, W.C., kitchen, Pantry and the like consisting of :</p> <p>(i) Ist course of applying cement slurry @ 4.4 kg/sq.m mixed with water proofing compound conforming to IS 2645 in recommended proportions including rounding off junction of vertical and horizontal surface.</p> <p>(ii) IInd course of 20 mm cement plaster 1:3 (1 cement: 3 coarse sand) mixed with water proofing compound in recommended proportion including rounding off junction of vertical and horizontal surface.</p> <p>(iii) IIIrd course of applying blown or residual bitumen applied hot at 1.7 kg. per sq.m of area.</p> <p>(iv) IVth course of 400 micron thick PVC sheet. (Overlaps at joints of PVC sheet should be 100 mm wide and pasted to each other with bitumen @ 1.7 kg/sq.m).</p> <p>29.05.00 Acid / Alkali Resistant Treatment:</p> <p>Acid / alkali resistant lining treatment shall be provided in different areas as follows:</p> <p>Neutralization Pit: The walls shall be provided with one coat of bitumen primer, followed by 18 mm thick bitumastic layer, 115 mm thick A.R. bricks, 6 mm thick under bed of potassium silicate mortar, pointing the joints of bricks with acid / alkali resistant epoxy / furane mortar upto a depth of 20 mm and bitumastic end sealing. Suitable plasters shall be provided with A.R. bricks at regular intervals depending upon the height of lining, as per the specification.</p> <p>The floor of neutralization pit shall be provided with acid / alkali resistant lining treatment as given in the above para, except that the 115 mm thick A.R.tile layer shall be replaced by 75 mm thick A.R. tile layer and pilasters shall be omitted.</p> <p>The ceiling of neutralization pit shall be provided with one coat of epoxy primer followed by 2 coats of epoxy paint (150 micron).</p> <p>Acid / Alkali storage area / projections above the floor, pedestals projecting from the floor / saddles. : The floor shall be provided with one coat of bitumen primer followed</p>		
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	<p>by 12 mm thick bitumastic layer, 20 mm thick A.R. tiles, 6 mm thick under - bed by potassium silicate mortar, 6mm thick pointing of joints of tiles with acid / alkali resistant epoxy / furane mortar up to a depth of 20 mm and bitumastic end sealing. Dado of 12 mm thk Acid Resistant tiles up to 1.0M high shall also be provided if applicable in case of walls nearby.</p> <p>Alum/Lime Storage area and first floor of Chemical House : One coat of bitumen primer followed by 12mm thick bitumastic layer, 20 mm thick A.R. tiles, 6 mm thick underbed of potassium silicate mortar, 6mm thick pointing of joints of tiles with acid /alkali resistant epoxy /furane mortar up to a depth of 20 mm and bitumastic end sealing.</p> <p>Alum solution preparation tank:</p> <p>The wall shall be provided with one coat of bitumen primer followed by 12 mm thick bitumastic layer, 75 mm thick A.R. tiles, 6 mm thick underbed by potassium silicate mortar, pointing of joints of tiles with acid / alkali resistant epoxy / furane mortar upto a depth of 20 mm and bitumastic end sealing.</p> <p>The floor shall be provided with acid / alkali resistant lining treatment as given in the above para except that the 75 mm thick A.R. tile layer shall be replaced by 12 mm thick A.R. tile layer.</p> <p>Basket of Alum solution preparation tank: 5 mm thick epoxy lining over a coat of epoxy primer.</p> <p>Curved surfaces of saddles shall have minimum 12 MM thick bitumastic layer to support the vessel / tanks.</p> <p>Effluent Drains: Acid Resistant lining treatment indicated for the storage area shall be provided on the bed as well as walls of the drains with 38 MM AR tiles. The underside of the pre-cast slab cover shall be applied with one coat of epoxy primer and two coats of epoxy coating, total DFT 150 microns.</p> <p>Lime tank: Two coats of bitumen paint conforming to IS: 9862, with total DFT 150 microns.</p>		
29.06.00	Walls		
29.06.01	All walls shall be non-load bearing infilled panel walls. All external walls shall be minimum one brick thick masonry wall.		
29.06.02	All external and internal walls shall be with minimum one brick masonry (230 or 250 mm) including toilet walls. Toilet partition low height walls shall be minimum half brick masonry.		
29.06.03	For all air conditioned areas/ rooms, wherever metal cladding is envisaged as cladding material, additional brick masonry wall (230mm thick) shall also be provided in addition to metal cladding for effective air conditioning. This brick wall shall be plastered & painted as specified elsewhere in the specification.		
29.06.04	RCC transoms and mullions of size 115x115mm with suitable reinforcement shall be provided wherever necessary to reinforce the brickwork.		
29.06.05	50 mm thick DPC in Cement concrete (M-20) with water proofing compound followed by two layers of bitumen coating 85/ 25 grade as per IS: 702 @ 1.7 kg/ sq.m. shall be provided at plinth level before starting the masonry work.		
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29.06.06	The bricks shall be laid with cement mortar (1:6) for one brick thick walls and (1:4) for half brick thick walls IS: 1905, IS: 2212 and SP -- 20 shall be followed for brick work design and construction.
29.07.00	Plastering
29.07.01	External (rough) surface of walls shall be plastered with 18 mm thick cement plaster, consisting first (base) layer of 12 mm thick plaster in cement sand mortar (1:6) and second (finishing) layer of 6 mm thick plaster in cement sand mortar (1:4). The internal (smooth) surface of walls shall have 12 mm thick plaster in cement sand mortar (1:6). All external / internal RCC surfaces including RCC parapet walls shall be provided with minimum 12mm thick plaster in cement sand mortar (1:4) except walls of underground structures like cable trenches / valve pits etc.
29.07.02	All exposed faces of R.C.C. walls of structures, buildings and facilities shall have minimum 12 mm thick cement sand plaster 1:6.
29.07.03	All RCC ceilings (except areas provided with false ceilings and cable vault ceiling) shall be provided with 6 mm thick cement sand plaster 1:4.
29.07.04	All plastering work shall conform to IS: 1661.
29.08.00	Painting
29.08.01	All painting on masonry or concrete surface shall preferably be applied by roller. If Applied by brush then same shall be finished off with roller.
29.08.02	All paints shall be of approved make including chemical resistant chlorinated rubber paint.
29.08.03	Minimum two finishing coats of paint shall be applied over a coat of primer.
29.08.04	The thinner shall not be used with textured paint (Sandtex Matt or equivalent) finish.
29.09.00	Internal Finish
29.09.01	All Air conditioned areas shall have 2mm of polymer based water resistant putty (wall putty) to given an even and smooth surface. Acrylic emulsion paint shall be as per IS: 5411 (Part - 1). Acrylic distemper shall be as per IS: 428. Air - conditioned areas shall be applied with minimum 2 coats of acrylic emulsion paint. All other areas shall be applied with minimum 2 coats of Acrylic distemper.
29.09.02	Toilet, Pantry / Kitchen areas shall have dado with Designer ceramic tiles, 300x200mm (matt finish) upto 2.2 m height and shall match with floor finish. Above dado, Acrylic distemper shall be applied.
29.09.03	Areas coming in contact with chlorine fumes or acid / alkali shall have two coats of acid / alkali resistant chlorinated rubber paint over suitable primer on walls above dado & ceiling. The paint shall be of approved colour shade and make.
29.10.00	External Wall Finish
	One pack, ready mix and ready to use, resin / polymer bonded granular textured coating finish of 2.5 mm (natural coloured graded stone chips), of approved colour, and shade for all types of plastered and / or exposed concrete surface, in all kinds of works, at all levels, including preparation of surface, preparation of working drawing,

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	<p>labour, material, equipment, handling, transportation, mixing, laying, applying finishing, testing, curing, making grooves, scaffolding, staging, etc., all complete, as per specifications, drawings and instructions of the Engineer-in-charge.</p> <p>Toe wall of chain link fencing shall be provided with two coats of Acrylic Smooth Exterior Paint</p> <p>The finish shall be of approved colour shade and make.</p>		
29.11.00	<p>Ceiling Finish</p> <p>Ceiling shall have min. two (2) coats of Acrylic distemper except AC areas & Battery room.</p>		
29.11.01	<p>For painting on concrete, masonry and plastered & surface, IS: 2395 shall be followed. For painting on steel work and ferrous metals, IS: 1477 shall be followed.</p>		
29.11.02	<p>Fire resistant transparent paint (confirming to IS: 162) shall be provided on all wood work, over French police or flat oil paint. French polish shall confirm to IS : 348. Flat oil paint shall confirm to IS: 1237.</p>		
29.12.00	<p>Doors, Windows, Ventilators, Louvers, Rolling Shutters & Glazing</p>		
29.12.01	<p>Adequate Doors, Windows, Louvers and Ventilators shall be provided for proper lighting and ventilation of all buildings. The area of windows shall be at least 10% of the floor area of the respective building. In addition to the above, wherever room height is more than 3.5 m, a band of ventilators of 600 mm height (minimum) shall be provided at the top.</p>		
29.12.02	<p>Unless specified all doors, of air conditioned areas, entrance lobby of all buildings shall have electro colour coated (anodised) aluminium frame work with glazing. Windows, ventilators & partitions of all buildings shall have electro colour coated (anodised) aluminium frame work with glazing. All doors of toilet, kitchen, pantry & store areas shall be of factory made pre - laminated solid core flush door shutters, as per IS: 2202 (Part-II) with pressed steel door frame. Control room shall have Aluminium glazed door & partitions. All other doors (unless otherwise specified) shall be of steel.</p>		
29.12.03	<p>All steel doors shall consist of double plate flush door shutters. The door shutter shall be 45 mm thick with two outer sheets of 18 G rigidly connected with continuous vertical 20 G stiffeners at the rate of 150 mm centre to centre. Side, top and bottom edges of shutters shall be reinforced by continuous pressed steel channel with minimum 18 G. The door shall be sound deadened by filling the inside void with mineral wool. Doors shall be complete with all hardware and fixtures like door closer, tower bolts, handles, stoppers, aldrops, etc.</p>		
29.12.04	<p>Wherever functionally required, rolling shutters of suitable size approved by the Owner, with suitable operating arrangement manual/ electric shall be provided to facilitate smooth operations. Rolling shutters shall conform to IS: 6248.</p>		
29.12.05	<p>All windows and ventilators at ground floor level shall be provided with suitable anodised aluminum grill.</p>		
29.12.06	<p>Fire proof doors with panic devices shall be provided at all fire exit points as per the requirements. However minimum Fire rating shall be 2 hours. These doors shall be double cover plated type with mineral wool insulation.</p>		
29.12.07	<p>Hollow excluded Section of minimum 2 mm wall thickness as manufactured by INDAL, Jindal, Hindalco or equivalent shall be used for all Aluminium doors, windows, ventilators and Partitions.</p>		
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29.12.08	The doors, Windows & ventilators frame shall be of suitable size & thickness for fixing the glazing. The Glazing thickness shall be minimum 6 mm thk clear toughened glass for all glazed doors, windows, ventilators & partitions. Windows in air conditioned areas shall be provided with 24mm thick hermetically sealed composite double glazing.		
29.12.09	Doors and windows on external walls shall be provided with sunshade over the openings with width 600 mm more than the opening width. The projection from the finished face of the wall for sunshade shall generally be 450 mm over window openings, 750 mm over door openings and 900 over Rolling shutters, or as decided and approved by the Engineer.		
29.12.10	Float glass or flat transparent sheet glass shall conform to IS: 2835.		
29.12.11	All glazing work shall conform to IS: 3548.		
29.12.12	Windows in conveyor gallery shall be provided with welded wire fabric of 1.6mm thick wire as per IS: 4948 and 12mm x 30mm mesh size.		
30.00.00	WATER SUPPLY, DRAINAGE AND SANITATION		
30.01.00	Polyethylene water storage tank conforming to IS: 12701 shall be provided (for the use of toilet, pantry and kitchen) over the roof, with adequate capacity depending on the number of users and 8 hours requirement complete with all fittings including float valve, stop cock etc. The capacity of tank shall be calculated minimum 500 liters, per toilet, pantry and kitchen		
30.02.00	Galvanised MS pipe of medium class conforming to IS: 1239 shall be used for internal piping works for potable water supply.		
30.03.00	Sand C.I. pipes with lead joints conforming to IS: 1729 shall be used for sanitary works above ground level.		
30.04.00	The facilities provided in the toilet block shall depend on the number of users. However, minimum facilities to be provided shall be as stipulated below. IS: 1172 shall be followed for working out the basic requirements for water supply, drainage and sanitation. In addition, IS: 2064 and IS: 2065 shall be also be followed.		
30.05.00	<p>Each toilet block shall have the following minimum facilities. Unless specified all the fittings shall be of chromium plated brass (fancy type).</p> <p>The common toilet area shall have finished floor level at 15 mm below the finished floor level of surrounding area.</p> <p>Following minimum fittings & fixtures together with associated plumbing works shall be provided as specified below.</p>		
Sl. No.	Type of Fitting / Fixtures	Gents Toilet	
i)	1 no wall mounted coloured glazed vitreous china European water closet with flush valve.	1 No.	
ii)	Coloured glazed vitreous china flat back lipped urinals with photo voltaic controlled automatic flushing system including all requisite fittings and fixtures	1	
iii)	Wash Basin (oval shape) with photo voltaic control system and all requisite fittings and fixtures to be fixed on concrete platform finished with 18mm thick first	1 No.	
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	<table border="1"> <tr> <td></td> <td>grade polished granite stone</td> <td></td> </tr> <tr> <td>iv)</td> <td>Wall to wall mirror minimum 450 mm high (minimum 6mm thick float glass) including all fittings</td> <td>1 No.</td> </tr> <tr> <td>v)</td> <td>Stainless steel Towel Rail 600mm Long x 20 mm dia.</td> <td>1 No.</td> </tr> <tr> <td>vi)</td> <td>Stainless steel Liquid soap holder cum dispenser with requisite fittings.</td> <td>1 No.</td> </tr> <tr> <td>vii)</td> <td>Overhead Drinking water storage tank (Minimum 500 Litres capacity)- High density polyethylene (cylindrical/vertical) molded seamless type.</td> <td>1</td> </tr> <tr> <td>viii)</td> <td>Overhead Service water storage tank (Minimum 500 Litres capacity)- High density polyethylene (cylindrical/vertical) molded seamless type</td> <td>1 No.</td> </tr> </table>		grade polished granite stone		iv)	Wall to wall mirror minimum 450 mm high (minimum 6mm thick float glass) including all fittings	1 No.	v)	Stainless steel Towel Rail 600mm Long x 20 mm dia.	1 No.	vi)	Stainless steel Liquid soap holder cum dispenser with requisite fittings.	1 No.	vii)	Overhead Drinking water storage tank (Minimum 500 Litres capacity)- High density polyethylene (cylindrical/vertical) molded seamless type.	1	viii)	Overhead Service water storage tank (Minimum 500 Litres capacity)- High density polyethylene (cylindrical/vertical) molded seamless type	1 No.	
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viii)	Overhead Service water storage tank (Minimum 500 Litres capacity)- High density polyethylene (cylindrical/vertical) molded seamless type	1 No.																		
	<p>One No. drinking water connection with C.P. brass valve for fixing water cooler by Owner.</p> <p>Required plumbing work from Owner's service water terminal point to the service water tank and from tank to the toilet accessories mentioned above.</p> <p>Required plumbing work from Owner's potable water terminal point to the drinking water tank and from tank up to the water coolers.</p> <p>Janitor room. Adequate space shall be provided.</p> <p>Provision for installation of water cooler.</p>																			
30.06.00	All structures, buildings, facilities, liquid storage tanks shall be provided with peripheral surface brick drains of all around periphery and suitably connected to nearest Owner's drain. Overflow and drains from storage tanks shall be laid to and suitably connected to Owner's open surface drains.																			
30.07.00	The sewerage and waste water disposal system shall consist of providing all associated plumbing and underground pipe works together with all fittings and fixtures and inclusive of ancillary works such as connections, manholes and inspection chambers, including connection to Owner's nearest main sewer line or as directed by Engineer. If required, R.C.C. septic tank and soak pit of required capacity shall be provided by the Bidder.																			
30.08.00	<p>Miscellaneous Architectural Items</p> <p>(a.) In all buildings suitable arrangement with provision of floor traps for draining the water collected from leakage, floor washing, fire fighting etc. shall be provided on all floors which shall be connected to rain water down comers.</p> <p>(b.) Wherever required minimum 1000 high hand railing with 32 NB M.S. pipes medium class as per IS : 1239 shall be provided, with toe & knee rail and toe guard plate, around all floor / roof openings, around periphery of Neutralisation Pit, projections of balconies, walkways, platforms, steel staircase etc.</p> <p>(c.) However for RCC staircases in structures, buildings and facilities, railings with 20 mm square MS bar balustrades with suitable anti corrosive paint of approved colour MS flats for knee & toe guard with 50mm Ø NB MS pipe hand rail at top shall be provided.</p> <p>(d.) All air conditioned areas / common corridors shall be provided with false ceiling constructed from 15 mm mineral Fibre Board in tile form of</p>																			
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	<p>600x600mm with supporting system as per manufacture guidelines. 50 mm thick mineral wool insulation (conforming to IS : 8183) shall be provided with as under deck insulation). Additional hangers and height adjustment clips shall be provided for return air grills, light fixtures, Air conditioning ducts etc. Minimum headroom below false ceiling shall be 3.0 m.</p> <p>(e.) Under - deck insulation shall be provided on the ceiling (underside of roof slab) and underside of floor slab of air - conditioned areas depending upon the functional / air - conditioning requirements. The under - deck insulation shall consist of 50 mm thick mineral wool insulation conforming to IS : 8183 backed with 0.05 mm thick aluminium foil & 24 G x 25 mm mesh wire netting and shall be fixed to ceiling with 24 G wire ties and suitable fixing arrangements.</p> <p>(f.) Parapets, chajjas, window / door heads, architectural facias, fins etc., shall be provided with drip course in cement mortar (1 : 3).</p> <p>(g.) 150mm thick fillets at junction of roof slab / chajja slab and parapet / vertical walls shall be provided with cast - in - situ cement concrete 1 : 2 : 4 nominal mix, followed by 12 mm thick cement sand plaster (1 : 4).</p> <p>(h.) Suitable provision shall be made for fixing of ceiling fans in office areas of different structures, buildings and facilities.</p>		
31.00.00	CORROSION PROTECTION		
31.01.00	GENERAL		
	<p>(a) All Steel structures shall be provided with painting as given in the specification. Further, painting system shall also meet the requirements of Corrosivity category C3 (durability High) as per ISO 12944. Painting system for steel surfaces embedded in Concrete is given separately.</p> <p>(b) All Painting shall be done as per technical specification. Painting scheme shall be submitted by the bidder for approval of employer.</p> <p>(c) All steel structures shall be designed by following basic design criteria in ISO 12944 Part 3. However, where it is not feasible to follow the design criteria given in ISO 12944 Part 3 where the steel surface are inaccessible for application of protective coating, corrosion allowance of 1.5 mm shall be kept in thickness(over the design thickness) of structural steel members.</p> <p>(d) Painting scheme shall be resubmitted by the Bidder for approval of employer.</p>		
31.02.00	PAINTING OF STEEL SURFACES EMBEDDED IN CONCRETE:		
	<p>a) For the portion of Steel surfaces embedded in Concrete, the surface shall be prepared by Manual Cleaning and provided with Primer Coat of Chlorinated Rubber based Zinc Phosphate Primer of Minimum 50 Micron Dry Film Thickness (DFT).</p> <p>b) All threaded and other surfaces of foundation bolts and its materials, insulation pins, Anchor channels, sleeves, etc. shall be coated with temporary rust preventive fluid and during execution of civil works, the dried film of coating shall be removed using organic solvents.</p>		
31.03.00	PAINTING OF STEEL SURFACES (OTHER THAN THOSE EMBEDDED IN CONCRETE)		
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	<p>a) All steel surfaces shall be provided with two component moisture curing zinc (ethyl) silicate primer coat (having minimum 80% of metallic Zinc content in dry film, solid by volume minimum 60% $\pm 2\%$) of minimum 70 micron DFT to be applied over blast cleaned surface conforming to Sa 2 ½ finish of ISO 8501-1 with surface profile 40-60 Micron. The primer coat shall be applied in shop immediately after blast cleaning by airless spray technique. Zinc dust composition and properties shall be Type-II as per ASTM D520-00.</p> <p>b) Primer coat shall be followed with the application of Intermediate coat of two component polyamide cured epoxy with MIO Content (containing lamellar MIO minimum 30% on pigment, solid by volume minimum 80% $\pm 2\%$) of minimum 100 micron DFT. This coat shall be applied in shop after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.</p> <p>c) Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% $\pm 2\%$) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This coat shall be applied shop after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer.</p> <p>Notes:</p> <ol style="list-style-type: none"> 1. For Primer, high quality surface preparation is necessary and good amount of moisture is required for proper curing. Below 70 % relative humidity, curing time may go up to 7 days or more. In such a case additional water sprinkling may be ensured for completion of curing. Additionally Inorganic zinc silicate cannot be recoated; even with itself. Typically it should be used when coating bare steel surface for first time. 2. The most frequent problem associated when top coating Primer is bubbling/pin holing especially with non-weathered zinc silicate coatings. To a great extent, this bubbling of finish paint can be eliminated by applying a mist coat of intermediate/topcoat as the first pass of the product, allow the bubbles to subside and then apply a full coat, as required. 3. In case top coating of zinc silicate with epoxy/polyurethane coatings, is expected to be delayed, it is advisable to use a suitable tie coat to avoid formation of white rust. However, if white rust forms then clean the surface with high pressure water, dry and apply the subsequent coats as required. 4. Touch up paintings on damaged areas: Surface preparation by manual tools, wire brush/ emery paper etc. Minimum 6 inches peripheral area, adjoining to damaged area to be covered. If metal surface is exposed, it is to be painted with Zinc rich epoxy (70 micron) or suitable primer with existing paint scheme. If primer is intact, intermediate & top coat to be done with specified DFT in scheme. <p>31.04.00 COATING FOR MILD STEEL PARTS IN CONTACT WITH WATER.</p> <p>a) All mild Steel parts coming in contact with water or water vapour shall be hot dip galvanised. The Minimum Coating of Zinc shall be 610 Gms / 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.</p>		
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	<p>b) The galvanising shall be followed by the application of an etching Primer and dipping in black bitumen in accordance with BS: 3416, unless otherwise specified.</p>		
31.05.00	<p>Gratings</p> <p>All gratings shall be blast cleaned to Sa 2 ½ finish or cleaned by acid pickling as per ISO 8501-1 and shall be hot dip galvanized at the rate of 610 Gms / Sq. M.</p>		
31.06.00	<p>Hand Railings and Ladders</p> <p>All Mild steel handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. as per IS: 4736. However, Stainless steel handrails shall be provided as specified in General Architectural Specification clause 9.0.0.</p>		
31.07.00	<p>Sea Worthiness</p> <p>All Steel Sections and fabricated Structures, which are required to be transported on sea, shall be provided with anti corrosive Paint before shipment to take care of sea worthiness.</p>		
31.08.00	<p>For Reinforced Concrete Work.</p> <p>i) The protection for concrete sub-structure shall be provided based on aggressiveness of the soil, chemical analysis of soil/sub-soil water and presence of harmful chemicals/salts.</p> <p>ii) The protection to super structure shall depend on exposure condition and degree of atmospheric corrosion.</p> <p>This shall require use of dense and durable concrete, control of water cement ratio, increase in clear cover, use of special type of cement and reinforcement, etc., coating of concrete surface, etc.,</p> <p>Bidder shall furnish the details of corrosion protection measures.</p>		
32.00.00	<p>Miscellaneous</p>		
32.01.00	<p>Ordinary form work shall be used in roofs and floor slabs in transfer houses, footings, pedestals, cable trenches, pits etc., Plywood form work shall be used for all over ground exposed work like columns, beams, floors and ceilings in control room and M. C. C. buildings.</p>		
32.02.00	<p>Monorail girders and fixtures shall be provided for monorails at the locations as required and as described elsewhere in these specifications or drawings. Monorail openings in the walls shall be provided with steel frame doors preferably sliding type or otherwise open able inside, access platforms and ladders.</p>		
32.03.00	<p>Steel frame around openings in roof and on external walls for mounting of exhaust fans shall be provided.</p>		
32.04.00	<p>Ready mix non - shrink cementitious grout of reputed manufacturer as approved by the Employer shall be used for grouting of block outs and foundation bolts, underpinning of base plates and machine bases. Crushing strength of grout shall be one grade higher than the foundation concrete. Minimum crushing strength shall be 30 N / mm² unless higher strength requirement is specified by the equipment supplier or the grout manufacturers.</p>		
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32.05.00	The bottom of steel in case of cable / pipe galleries and trestles shall be generally 3m above the ground except for rail / road crossing where it shall be 8m above the rail top / road crest/ground. Further in bunker areas it shall be 8 m above the ground.		
32.06.00	Polysulphide Sealing Compound shall be two-part polysulphide sealant and shall be from approved manufacturer, conforming to IS : 12118. Materials shall consist of polysulphide polymer and a curing agent. Gun grade material shall be used unless otherwise specified. The application of the sealant shall be strictly followed as per manufacturer's guidelines.		
33.00.00	SHOTCRETING		
33.01.00	General Requirements		
33.01.01	Generally, shotcreting shall be done in accordance with IS : 9012.		
33.01.02	Reinforcement for shotcreting shall be as detailed below, unless specified otherwise. Reinforcement in one direction consisting of 6 mm M. S. bars at 750 mm c / c shall be connected to the lugs for fastening of the wire fabric. This shall be used in case of 50 mm or above thick shotcreting.		
33.01.03	Wire fabric conforming to IS : 1566 shall be used as reinforcement and shall consist of wire, 3 mm diameter, spaced 50 mm both ways and shall be electrically cross welded. Wire fabric shall be securely tied to 6 mm bars for 50 mm thickness. Adjacent sheet of wire fabric shall be lapped at least 100 mm and tied.		
33.01.04	Clear cover to reinforcement mesh shall not be less than 15 mm.		
33.01.05	Minimum thickness of shotcreting shall be 50 mm. for abrasion resistant work and 25 mm for ordinary surface protection work.		
33.02.00	Material Generally, the materials shall be in accordance with aggregates specification given hereunder.		
33.02.01	Fine aggregate shall consist of natural sand or crushed stone from a known source and shall be strong, hard, coarse, sharp, chemically inert, clean and free from any coating. It shall be free from clay, coal or coal residue, organic or any other impurities that may impair the strength or durability of the concrete and shall conform to IS : 383.		
33.02.02	Fine aggregate (Sand) shall be well graded and particles shall range in size within the following limits. The Engineer, may approved the use of any other grading as per requirement or as per IS : 9012.		
33.02.03	The fineness modulus shall be preferably between 2.5 and 3.3. Any other value can be used, with prior approval of the Engineer.		
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33.03.00	Application		
33.03.01	After the placement of reinforcement and / or welded mesh and not more than six hours prior to the application of shotcrete, the surface shall be thoroughly cleaned of all loose materials and dirt. The Contractor shall properly prepare the surfaces, reinforcement and / or welded mesh to receive the shotcrete. Cleaned surfaces shall be wetted not more than hour prior to shotcreting.		
33.03.02	The mix as placed on surface shall be one part cement to three parts approved sand by mass. Cement and sand shall be dry mixed; not water shall be added after mixing and before using in the gun. The quantity of water when added shall be only that which is sufficient to hydrate the cement. For average atmospheric conditions, the water cement ratio for shotcrete in place shall be between 0.35 and 0.5 by mass. Suitable admixture shall be used wherever required.		
33.03.03	A uniform pressure of not less than 3 Kg/cm ² at the nozzle shall be maintained. Necessary adjustments shall be made to ensure this pressure, taking into account the length of hose and height of the place to be shotcreted, above location of the machine.		
33.03.04	The application shall proceed in an upward direction. Beams, stiffeners and intermediate walls, if any, shall be wrapped with wire fabric and completely covered with shotcreting. All rebound shall be removed from the area of application as the work progresses and such rebound material shall not be reused.		
33.03.05	As soon as the freshly shotcreted surface shows the first dry patches, a fine spray of water shall be applied to keep too moist. After the surface has hardened, it shall be kept continuously moist for minimum seven days. If there is extreme heat, especially when accompanied by hot winds, the shotcreted surface, immediately upon completion, shall be covered with burlap or similar covering, which must be kept continuously moist for 14 days after shotcreting. The temperature of the lining shall not be permitted to exceed 38°C during placing of concrete.		
34.00.00	VIBRATION ISOLATION SYSTEM		
	These specifications are meant for the design, supply and erection of vibration isolation system for supporting crushers.		
34.01.00	Supporting Arrangement		
34.01.01	<p>For Crushers:</p> <p>The crushers shall be supported on vibration isolation system consisting of steel helical springs and viscous dampers. The supporting arrangement for each crusher shall consist of an R. C. C. deck supported on steel helical spring units and viscous damper units which in turn shall be supported on girders. The girders shall be an integral part of the crusher house building.</p> <p>The part of the structure consisting of the R. C. C. deck, springs and viscous dampers shall hitherto be referred to as “spring supported foundation”. The part of the structure, which is below the spring shall hitherto be called “supporting structure”.</p>		
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<p>34.01.02</p> <p>34.02.00</p> <p>34.02.01</p>	<p>The Contractor should do the Engineering / design, supply and erection of vibration isolation system consisting of steel helical spring units and viscous dampers supporting the top deck which in turn would support the crushers. The vibrations isolation system supplied shall be of a proven make. The Contractor or his sub - contractor who designs and supplies the system should have designed, supplied and installed such systems for not less than five machines of speeds and unbalance forces comparable to the machine proposed by the vendor. The vibration isolation systems installed by the contractor or his sub - contractor in such machines should have been working satisfactorily for at least five years.</p> <p>Scope of Work</p> <p>Scope of work shall include the following :</p> <p>(a.) Engineering</p> <p>(1.) Design of the vibration isolation system using steel helical springs and viscous dampers to support an R. C. C. top deck supporting the equipment. This includes the static and dynamic analysis of the vibration isolation system with the R. C. C. top deck and the equipment.</p> <p>(2.) Structural design of the R. C. C. top deck including preparation of General Arrangement drawings, detailed reinforcement drawings, bar - bending schedules etc.</p> <p>(3.) Calculation of loads on the structure supporting the springs and viscous dampers, their points of application and the stiffness requirements of the supporting structure.</p> <p>(4.) Drawings showing embedments and their locations and details on the R. C. C. top deck.</p> <p>(5.) Drawings showing blockouts, recesses etc. on the top deck.</p> <p>(6.) Design of the supporting structure, including preparation of detailed drawings and bill of materials.</p> <p>(b.) Supply including packing and transportation to site</p> <p>(1.) Steel helical spring units and viscous dampers, including associated auxiliaries for installation of the spring units and dampers like steel shims, adhesive pads etc.</p> <p>(2.) Frame (s) for pre-stressing of spring elements.</p> <p>(3.) Suitable hydraulic jacks system including electric pumps, high pressure tubes etc. required for the installation, alignment etc. of the spring units, two extra hydraulic jacks, one hand operated pump and spares for the hydraulic jack system as required.</p>		
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	<p>(c.) Erection and Commissioning</p> <p>(1.) Complete erection and commissioning of the vibration isolation system including :</p> <p>(2.) Pre-stressing of spring elements, placing of spring elements in position, checking clearances on the shuttering of the R. C. C. top deck, construction of the supporting structure and the R. C. C. top deck, releasing to pre-stress in spring elements and making final adjustments and alignments after machine installation etc.</p> <p>(3.) 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 completion of the work for which these specifications are intended.</p> <p>(4.) This part of the specifications is for vibration isolation system. For the construction of the supporting structure for the crusher and the top deck, the relevant parts of the specification should be referred to.</p> <p>(d.) Documentation</p> <p>(1.) Submission of detailed design calculation, analysis (static and dynamic) and drawings for Employer's acceptance and approval.</p> <p>(2.) Furnishing methodology of providing shuttering and its removal as well as concreting of deck slab, installation of springs and dampers and the sequence of operation.</p> <p>(3.) Furnishing installation and maintenance manual indicating equipment, procedure etc., necessary for installation, maintenance of vibration isolation system.</p> <p>(4.) Furnishing a check list for confirming the readiness of the civil fronts for the installation of vibration isolation system and equipment required at each stage installation.</p> <p>(5.) Bill of materials of various elements such as springs, visco-dampers, with their rating, stiffness etc., included in supply.</p> <p>(6.) Detailed specifications of the vibration isolation system and various items included in the supply and the standard (local or international) to which they conform.</p> <p>(7.) Proposed erection strategy of the entire system.</p> <p>34.03.00 Design Requirements for Crusher Foundation</p> <p>34.03.01 Dynamic Analysis</p> <p>Detailed dynamic analysis shall be done for the top deck together with springs and dampers and the natural frequencies and amplitudes of vibration shall be</p>		
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	<p>determined. A mathematical model of the top deck shall be formulated with three - dimensional beam / plate finite elements for the purpose of analysis with the spring idealised with vertical and horizontal stiffnesses. The mass of the machine together with that of the top deck shall be considered for the analysis.</p> <p>Natural frequencies upto at least 10 % above the operating speed shall be determined and these frequencies shall be checked against the design criteria.</p> <p>Forced response dynamic analysis shall be carried out for the operating condition unbalance forces using a sinusoidal forcing function. Unbalance forces as given by this specifications shall be used for his purpose. The amplitudes shall be checked against the design criteria. The dynamic forces from this analysis shall be used for structural design with a suitable fatigue factor.</p>		
34.03.02	<p>Isolation Efficiency</p> <p>The vibration isolation system shall be designed for about 90 % isolation efficiency.</p>		
34.03.03	<p>De-coupling</p> <p>A ratio of the least 10 (ten) shall be ensured between the stiffness of the supporting structure and the stiffness of the spring system in the vertical direction to achieve de-coupling between the two (the stiffness of the spring system being lower). This ensures that dynamic analysis of the supporting structure need not be carried out.</p>		
34.03.04	<p>Frequency Criteria</p> <p>The frequency criterion has already been laid down implicitly by the isolation efficiency criteria and de-coupling required.</p> <p>The first bending mode frequency of the top deck shall be at least 20 % above the operating speed.</p>		
34.03.05	<p>Unbalance Forces for Crushers</p> <p>Unbalance forces arising out of all the following cases shall be considered for checking the design and amplitudes.</p> <p>(a.) Balance quality grade Q 40 as per VDI 2060 - 1966.</p> <p>(b.) One hammer broken condition. The missing hammer shall be assumed to be closest to the crusher non - drive end of the crusher.</p> <p>(c.) Three hammers broken condition. All the three hammers broken shall be assumed to be from the same suspension bar and located at the non - drive end of the crusher.</p>		
34.03.06	<p>Amplitude Criteria for Crushers</p> <p>The calculated amplitudes (mean to peak values) shall not exceed following limits under the specified conditions.</p>		
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	<p>1) Operating speed of 750 RPM</p> <p>(a.) 150 microns for an unbalance force arising out of balance quality grade Q 40 as per VDI 2060 - 1966.</p> <p>(b.) 300 microns in case of a one hammer broken condition.</p> <p>(c.) Amplitudes need not be checked for a three hammer broken condition.</p> <p>2) Operating speed of 450 RPM</p> <p>(a.) 200 microns for an imbalance force arising out of balance quality grade Q-40 as per VDI -2060-1966.</p> <p>(b.) 400 microns in case of a one hammers broken condition.</p> <p>(c.) Amplitude need not be checked for a three hammer broken condition.</p> <p>For intermediate operating speed between 450 to 750 RPM the amplitude limits can be linearly interpolated.</p> <p>The amplitude limits mentioned above are in both vertical and horizontal directions. The amplitudes shall be calculated at critical points on the top surface of the R. C. C. deck. The amplitudes shall be checked for the most unfavorable superposition of modes in any direction. However, phase difference between the maximum amplitude occurring in different directions due to the rotating vector may be considered while superimposing the modes.</p> <p>34.03.07 Unbalance force and Amplitude Criteria</p> <p>The unbalance forces and amplitude criteria shall be as per the equipment manufacturer's recommendations or as per VDI 2060/ VDI 2056, whichever is more stringent.</p> <p>34.03.08 Transient Resonance</p> <p>Transient resonance, which may occur during the start - up or coasting down condition of the crusher, shall be checked, and the amplitudes in such a condition should not exceed one - and - half times those at operating speed for each design condition.</p> <p>34.04.00 Strength Criteria</p> <p>The following criteria shall apply for the design of top deck :</p> <p>(a.) Dead loads, live loads, Seismic loads and dynamic loads shall be considered for the design. The most unfavorable combination shall considered for design.</p> <p>(b.) Seismic loads shall be assumed to act together with dynamic loads for a one millimeter eccentricity in the rotor. However, seismic loads and dynamic loads arising out of hammer breakage need not be considered together</p>		
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	<p>(c.) Fatigue shall be considered while designing for dynamic forces. A fatigue factor of 2.0 shall be used on all dynamic forces to arrive at the equivalent static force for the purpose of design.</p> <p>(d.) Working stress method shall be used for the design of R. C. C. deck. In survival condition, 10 % overstressing may be permitted.</p> <p>(e.) The R. C. C. top deck shall be at least of M35 grade of concrete as per IS : 456.</p> <p>(f.) Fatigue need not be considered for the three hammer broken condition.</p> <p>(g.) For calculating unbalance forces, the heaviest hammer (plain or toothed) shall be considered.</p>		
34.05.00	<p>Approval of Designs and Drawings</p> <p>All design calculation, drawings and documents shall be in English. All design calculations and drawings shall be submitted to Employer for approval. However, approval of such designs and drawings shall not relieve the contractor of his responsibility regarding the adequacy of the foundation to carry the design forces.</p>		
34.06.00	<p>Standards</p> <p>Latest revisions of the following Codes shall be used for the design of the crusher foundations.</p> <p>(a.) IS : 456 Code of Practice for Plain and Reinforced concrete.</p> <p>(b.) IS : 2974 (Part IV) Code of Practice for Design and Construction of Machine Foundations (Part IV) for rotary type machine of low frequency.</p> <p>(c.) IS : 1893 (Criteria for Earthquake Resistant Design of Structures).</p> <p>(d.) DIN 4024 Machine Foundations :</p> <p>Flexible supporting structures for machines with rotating masses.</p> <p>(e.) DIN 2089</p> <p>Helical Compression Springs out of round wire and rod; calculation and Design.</p> <p>(f.) DIN 2096</p> <p>Helical Compression Springs out of round wire and rod; quality requirements for hot formed compression springs.</p> <p>(g.) VDI 2056 - Criteria for assessing mechanical vibrations of machines.</p> <p>(h.) VDI 2060 - Criteria for assessing the state of balance of rotating rigid bodies. not be permitted to exceed 38°C during placing and curing</p>		
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35.00.00	<p>Packaging and Transportation.</p> <p>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 should be taken into account. The contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing.</p>		
36.00.00	<p>Plant Life</p> <p>The plant shall be designed for a minimum operating life of 30 years under the conditions of operation. Assurance shall be given that plant components are adequate for this lifetime. If there are any exceptional items of the plant on which an assurance of meeting this clause cannot be given, life of such components and the difficulties associated with them shall be stated.</p>		
37.00.00	<p>PTFE (Poly Tetra Fluoroethylene) Bearing</p> <p>The bearing shall be of reputed make and manufacturer as approved by the Engineer, for required vertical load and end displacement/rotation. PTFE bearing shall be sliding against highly polished stainless steel and the coefficient of friction between them shall be less than 0.06 at 55 kg/sq.cm. In order to prevent cold flow in PTFE surface it shall be rigidly bonded by a special high temperature resistance adhesive to the stainless steel substrata. The stainless steel surface that slides against the PTFE is mirror polished. The stainless steel shall be bonded to the top plate by special high strength adhesive. The thickness of stainless steel plate shall be between 1.0 mm to 1.5 mm.</p>		
38.00.00	<p>TESTS FOR MATERIAL / WORKMANSHIP</p> <p>All tests required for all materials, quality of workmanship or any other tests as desired by the Engineer shall be at contractor's cost.</p>		
39.00.00	<p>MATERIALS</p>		
39.01.00	<p>For Civil, Structural and Architectural works</p> <p>Employer will not supply any material. All materials including cement, reinforcement steel and structural steel, whatsoever required for execution and completion of the entire scope of work covered under this specification shall be arranged by the contractor at his own cost. All materials procured by the contractor shall meet the quality requirements specified in this specification.</p> <p>The contractor shall keep sufficient stock of cement and steel at site at any point of time when the work is in progress excluding what has been already incorporated in the works, so that any disruption / delay in availability of these materials during procurement will not affect the progress of work at site. The minimum quantity of such materials in stock at site shall not be less then the Requirement of one (1) month in case of Cement and Requirement of two (2) Consecutive months in case of Steel.</p>		
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39.02.00	<p>Structural steel</p>		
	<p>Structural Steel (including embedded Steel) shall be straight, sound, free from twists, cracks, flaw, laminations and all other defects. Structural steel shall comprise of mild steel, medium strength steel and high tensile steel as specified below.</p>		
39.02.01	<p>Mild Steel</p> <p>a) Rolled sections shall be of grade designation E250, Quality A/BR, Semi-killed/killed conforming to IS 2062. All steel plates shall be of Grade designation E250, Quality BR (fully killed), conforming to IS 2062 and shall be tested for impact resistance at room temperature. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalised and shall also be 100% ultrasonically tested as per ASTM –A578 level B-S2.</p> <p>b) Pipes shall conform to IS 1161.</p> <p>c) Hollow (square and rectangular) steel sections shall be hot formed conforming to IS: 4923 and shall be of minimum Grade Yst 240.</p> <p>d) Chequered plate shall conform to IS 3502 and shall be minimum 6 mm thick excluding projection. Steel for chequered plate shall conform to grade E250A semi killed of IS: 2062 or equivalent grade conforming to ASTM & BS standards only.</p>		
39.02.02	<p>Medium and High Tensile Steel</p> <p>Rolled Sections and plates shall be of grade designation E350 or higher, Quality B0 (Fully killed), conforming to IS 2062. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalised and shall also be 100% ultrasonically tested as per ASTM –A578 level B-S2.</p>		
39.03.00	<p>Fly ash based Portland pozzolona cement conforming to IS: 1489 Part - I shall preferably be used. However, the contractor may use other types of cements conforming to IS: 269, IS: 8112, IS: 12269, & IS: 455.</p>		
39.04.00	<p>Reinforcement steel shall conform to:</p> <p>a) Mild steel bars of grade I of IS: 432 Part – I or grade A of IS: 2062.</p> <p>b) High yield strength deformed TMT steel bars of grade Fe-500 having minimum elongation of 14.5 % or Fe-500D, and conforming to other requirements of IS 1786.</p>		
40.00.00	<p>CODES AND STANDARDS</p> <p>All standards, specifications, acts and code of practice referred to herein shall be the latest editions including all applicable official amendments and revisions. Other Indian, foreign Codes and Standards not listed here but referred to elsewhere within this specification shall also be deemed to be part of this list.</p> <p>In case of conflict between this specification and those (IS standards, codes etc.) referred to herein, the former shall prevail.</p>		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 66 OF 69</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>Some of the relevant Indian standards, Acts and Codes applicable to this section of the specification are listed below</p> <p>IS : 383 Specification for coarse and fine aggregates from natural sources for Concrete.</p> <p>IS : 432 Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.</p> <p>IS : 456 Code of practice for plain and reinforced concrete.</p> <p>IS : 458 Specification for concrete pipes.</p> <p>IS : 516 Method of test for strength of concrete.</p> <p>IS : 800 Code of practice for use of structural steel in general building construction.</p> <p>IS : 814 Specification for covered electrodes for metal arc welding for weld steel.</p> <p>IS : 816 Code of practice for use of metal arc welding for general construction.</p> <p>IS : 817 Code of practice for training and testing of metal arc welders.</p> <p>IS : 875 (Pt. I to V) Code of practice for design loads other than earthquake) for buildings and structures.</p> <p>IS : 1038 Steel doors, windows and ventilators.</p> <p>IS : 1172 Basic requirements for water supply, drainage and sanitation.</p> <p>IS : 1361 Steel windows for industrial buildings.</p> <p>IS : 1786 Specification for high strength deformed steel bars and wires for concrete reinforcement.</p> <p>IS : 1892 Code of practice for subsurface investigation for foundation.</p> <p>IS : 1893 Criteria for earthquake resistant design of structures.</p> <p>IS : 1904 Code of practice for design and construction of foundations in soils; general requirements.</p> <p>IS : 1905 Code of practice for structural safety of buildings - Masonry walls.</p> <p>IS : 1948 Specification for aluminium doors, windows and ventilators.</p> <p>IS : 2062 Steel for general structural purposes.</p>		
<p align="center">LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION-VI, PART-B</p> <p align="center">BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p align="center">SUB-SECTION-IV-D CIVIL WORKS</p>	<p align="center">PAGE 67 OF 69</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>IS : 2131</p> <p>IS : 2212</p> <p>IS : 2645</p> <p>IS:2720 (Part-II, IV TO VIII, XIV, XXI, XXIII, XXIV, XXVII TO XXIX, XL)</p> <p>IS : 2911</p> <p>(Part-1/Sec.1)</p> <p>(Part-1/Sec.2)</p> <p>(Part-IV)</p> <p>IS : 2974 (Part - I TO V)</p> <p>IS : 3370 (Part I to IV)</p> <p>IS : 3658</p> <p>IS : 3664</p> <p>IS : 4326</p> <p>IS : 4990</p> <p>IS : 5624</p> <p>IS : 7215</p> <p>IS : 8112</p> <p>IS : 9103</p> <p>IS : 9595</p> <p>IS : 10262</p> <p>IS : 13311</p> <p>IS : 13755</p>	<p>Method of standard penetration test for soils.</p> <p>Code of practice for brickwork.</p> <p>Specification for Integral cement water proofing compounds.</p> <p>Methods of test for soils - determination for water content etc code of practice for earth work on canals.</p> <p>Code of practice for design and construction of pile foundations.</p> <p>Driven cast in situ concrete piles.</p> <p>Bored cast-in-situ concrete piles.</p> <p>Load test on piles.</p> <p>Code of practice for design and construction of machine foundations.</p> <p>Code of practice for concrete structures for the storage of liquids.</p> <p>Code of practice for liquid penetrant flaw detection.</p> <p>Code of practice for ultra sonic testing by pulse echo method.</p> <p>Code of practice for earthquake resistant design and construction of buildings.</p> <p>Specification for plywood for concrete shuttering work.</p> <p>Specification for foundation bolts.</p> <p>Tolerances for fabrication steel structures.</p> <p>Specification for 43 grade Ordinary Portland Cement.</p> <p>Specification for admixtures for concrete.</p> <p>Code of procedure of manual metal arc welding of mild steel.</p> <p>Recommended guidelines for concrete mix design.</p> <p>Method of non - destructive testing of concrete.</p> <p>Dust pressed ceramic tiles with water absorption of 3%, E6% (Group B11a)</p>	
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 68 OF 69</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>ASTM 898 -89 Standard guide for use of high solid content, cold liquid-applied elastomeric water proofing membrane for use with separate wearing course.</p> <p>AS/NZS 2728 Pre finished / pre painted sheet metal product for interior / exterior building applications – Performance requirements.</p> <p>AS : 1365 Standards for steel manufacturing.</p> <p>AS : 1397 A steel sheet & strip – hot – dipped-zinc-coated or Aluminium-Zinc coated.</p> <p>AS : 3566 Self drilling screws for building and construction industry.</p> <p>IRC : 37 Guidelines for the design of flexible pavements.</p> <p>- Manual on sewerage and sewage treatment (Published by CPH & EEO) As updated.</p> <p>Indian Explosives Act. 1940 as updated.</p> <p>For “Foundation System and Geotechnical Data” refer “Project Information section” of Technical specification.</p>		
<p>LOT-1A PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOCUMENT NO.: CS-0011-109(1A)-2</p>	<p>SUB-SECTION-IV-D CIVIL WORKS</p>	<p>PAGE 69 OF 69</p>



TITLE:

**TECHNICAL SPECIFICATION FOR
BORED CAST-IN-SITU RCC PILES**

SPECIFICATION NO. PE-TS-442-600-C021

VOLUME - II B

SECTION - D | SUB-SECTION - D21

REV.NO. 00 DATE 19/11/2018

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VOLUME: II B

SECTION - D

SUB-SECTION – D21

BORED CAST-IN-SITU RCC PILES

SPECIFICATION NO. PE-TS-442-600-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/M ³ 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.	
3.03.03	The longitudinal reinforcement shall project 50 times its diameter above cut off level unless otherwise indicated.	


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<p>3.03.04</p> <p>3.03.05</p> <p>3.03.06</p> <p>3.03.07</p> <p>3.03.08</p> <p>3.03.09</p> <p>3.03.10</p> <p>3.03.11</p> <p>4.00.00</p> <p>4.01.00</p> <p>4.01.01</p> <p>4.01.02</p>	<p>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.</p> <p>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.</p> <p>The minimum clear distance between the two adjacent main reinforcement bars shall normally be 100 mm for the full depth of cage.</p> <p>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.</p> <p>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).</p> <p>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.</p> <p>Minimum clear cover to the longitudinal reinforcement shall be 50 mm, unless otherwise mentioned.</p> <p>Bundling of bars is not permitted.</p> <p>PILE INSTALLATION</p> <p>Installation of piles shall be carried out as per pile layout drawings, installation criteria, and the direction of the Engineer.</p> <p>Equipment and Accessories</p> <p>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.</p> <p>List and details of equipment and accessories proposed to be used for the job shall be submitted along with the bid.</p>																					


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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 boring. The bentonite slurry mixing and recirculation plant shall be suitably designed and installed.	


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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 minimum specified strength in accordance with IS: 456 at requisite workability (slump).	


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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 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.	


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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.	
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.	


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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	
	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,	


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	<p>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.</p> <p>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.</p>	
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	
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.	


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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. <ul style="list-style-type: none"> 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. <p>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.</p>	
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	

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<p>5.09.03</p> <p>6.00.00</p> <p>6.01.00</p>	<p>testing the integrity of the shaft and is not intended to replace the use of static load testing.</p> <p>Low Strain Integrity Test Methodology:</p> <ol style="list-style-type: none"> 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. 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. 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. 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. 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. More than one recording of signals shall be done until repeatability of signals is achieved on the same pile. The tests shall be conducted at 3-6 locations to cover the entire cross section of the pile. <p>PILE TESTING</p> <p>Pile load test shall be carried out as per IS:2911 Part-4 (latest edition) or as directed by Engineer.</p> <p>INITIAL LOAD TEST</p> <p>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</p>																					

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	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 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.	

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8.00.00 RATES AND MEASUREMENTS	<p>The clauses below shall apply for item rate contracts only. They shall not be applicable to turnkey/lump sum Contracts.</p>	
8.01.00 Rates		
8.01.01	<p>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.</p>	
8.01.02	<p>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.</p>	
8.01.03	<p>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.</p>	
8.01.04	<p>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.</p>	
8.01.05	<p>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.</p>	
8.01.06	<p>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.</p>	
8.01.07	<p>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,</p>	

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	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.	
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.	

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8.02.02	<p>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:</p> <p>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.</p> <p>ii) Standard hooks, cranks, bend, authorized laps, supports, hangers and chairs which are covered in approved bar bending schedule shall be measured in tones.</p> <p>iii) Dowels, neither shown on the drawings nor instructed by the Engineer, but required for construction facilities shall not be measured.</p>	
8.02.03	<p>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.</p>	
8.02.04	<p>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.</p>	
8.02.05	<p>The item for pile integrity test shall be measured in terms of no. of piles tested.</p>	



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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)	Pull out/Tension (MT)
*	*	*	*
*	*	*	*

A2. Installation criteria
 The installed pile(s) shall satisfy the following criteria.

A2.1 In Soil/weathered Rock
 a) Minimum length of the pile shall be _____* m below COL.
 b) 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
 a) 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.
 b) 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
 Installation criteria

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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

Sl.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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<p>14. SPT* N values in soil (from the nearest bore hole). +UCS** value in rock (from the nearest bore hole).</p> <p>* Standard penetration Test ** Unconfined compression strength</p> <p>15. Chiseling if any, from..... m to m</p> <p>16. Date and time of start and completion of concreting.</p> <p>17. Method of placing concrete</p> <p>18. Concrete quantity Actual</p> <p>Theoretical</p> <p>19. Ref. Number of test cubes</p> <p>20. Grade and slump of concrete</p> <p>21. Results of test cubes</p> <p>22. Reinforcement details: Main Reinforcement No. _____ Dia. _____ Depth _____</p> <p style="text-align: right;">Stirrups: Type No. _____ Dia. _____ Spacing _____</p> <p>23. Any other information regarding obstructions, delay and other interruption to the sequence of work.</p>		



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BORED CAST-IN-SITU RCC PILES

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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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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/M ³ 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.	
3.03.03	The longitudinal reinforcement shall project 50 times its diameter above cut off level unless otherwise indicated.	

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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.	
4.01.02	List and details of equipment and accessories proposed to be used for the job shall be submitted along with the bid.	

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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 boring. The bentonite slurry mixing and recirculation plant shall be suitably designed and installed.


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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 minimum specified strength in accordance with IS: 456 at requisite workability (slump).	


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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 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.	

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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.	
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.	

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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	
	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,	

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<p>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.</p> <p>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.</p>		
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	
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.	

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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.	
	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	

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	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.	
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	

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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
(Part 1 & 11) | - | Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement. |
| IS: 456 | - | Code of practice for plain and reinforced concrete. |
| IS: 1200
(Part 23) | - | Measurement of Building and Civil Engineering works 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
Part I/Sec 2 | - | Code of practice for design and construction of pile foundations - Bored cast-in-situ concrete piles. |
| IS: 2911
Part IV | - | Code of practice for design and construction of pile 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. |



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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,

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	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.	
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.	

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8.02.02	<p>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:</p> <p>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.</p> <p>ii) Standard hooks, cranks, bend, authorized laps, supports, hangers and chairs which are covered in approved bar bending schedule shall be measured in tones.</p> <p>iii) Dowels, neither shown on the drawings nor instructed by the Engineer, but required for construction facilities shall not be measured.</p>	
8.02.03	<p>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.</p>	
8.02.04	<p>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.</p>	
8.02.05	<p>The item for pile integrity test shall be measured in terms of no. of piles tested.</p>	



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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

- a) Minimum length of the pile shall be _____* m below COL.
- b) 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

- a) 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.
- b) 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

Installation criteria

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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.



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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 materialcuttings 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	