35.02.00 Contractor shall be responsible for examining all the shipment and notify the Employer immediately of any damage, shortage, discrepancy etc. for the purpose of Employer's information only. The Contractor shall submit to the Employer every week a report detailing all the receipts during the week. However, the Contractor shall be solely responsible for any shortages or damage in transit, handling and / or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.

35.03.00 The Contractor shall maintain an accurate and exhaustive record detailing out the list of all equipment received by him for the purpose of erection and keep such record open for the inspection of the Employer.

35.04.00 All equipment shall be handled very carefully to prevent any damage or loss. No bare wire ropes, slings, etc. shall be used for unloading and/or handling of the equipment without the specific written permission of the Employer. The equipment stored shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the store shall be moved to the actual location at the appropriate time so as to avoid damage of such equipment at Site.

35.05.00 All electrical panels, controls gear, motors and such other devices shall be properly dried by heating before they are installed and energised. Motor bearings, slip rings, commutators and other exposed parts shall be protected against moisture ingress and corrosion during storage and periodically inspected. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion due to prolonged storage.

35.06.00 All the electrical equipment such as motors, etc. shall be tested for insulation resistance at least once in three months from the date of receipt till the date of commissioning and a record of such measured insulation values maintained by the Contractor. Such records shall be open for inspection by the Employer.

35.07.00 The Contractor shall ensure that all the packing materials and protection devices used for the various equipments during transit and storage are removed before the equipment are installed.

35.08.00 The consumables and other supplies likely to deteriorate due to storage must be thoroughly protected and stored in a suitable manner to prevent damage or deterioration in quality by storage.

35.09.00 All the materials stored in the open or dusty location must be covered with suitable weatherproof and flame-proof covering material wherever applicable.

35.10.00 If the materials belonging to the Contractor are stored in areas other than those earmarked for him, the Employer will have the right to get it moved to the area earmarked for the Contractor at the Contractor's cost.

35.11.00 The Contractor shall be responsible for making suitable indoor storage facilities to store all equipment which require indoor storage. Normally, all the electrical equipments such as motors, control gear, generators, exciters and consumables like

electrodes, lubricants etc. shall be stored in the closed storage space. The Employer, in addition, may direct the Contractor to move certain other materials, which in his opinion will require indoor storage, to indoor storage areas which the Contractor shall strictly comply with.

36.00.00 CONSTRUCTION MANAGEMENT

36.01.00 The field activities of the Contractors working at Site, will be coordinated by the Employer and the Employer decision shall be final in resolving any disputes or conflicts between the Contractor and other Contractors and tradesmen of the Employer regarding scheduling and co- ordination of work. Such decision by the Employer shall not be a cause for extra compensation or extension of time for the Contractor.

36.02.00 The Employer shall hold weekly meetings of all the Contractors working at Site, at a time and place to be designated by the Employer. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Employer and shall strictly adhere to those decisions in performing his Works. In addition to the above weekly meeting, the Employer may call for other meeting either with individual Contractors or with selected number of Contractors and in such a case the Contractor if called, will also attend such meetings.

36.03.00 Time is the essence of the Contract and the Contractor shall be responsible for performance of his works 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 for such delays by increasing his work force or by working overtime or otherwise accelerate the progress of the work to comply with the schedule and shall communicate such actions in writing to the Employer, satisfying that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action.

36.04.00 The Employer shall however not be responsible for provision of additional labour and/or materials or supply or any other services to the Contractor except for the co-ordination work between various Contractors as set out earlier.

36.05.00 **Site management during construction phase till handing over of plant**

Bidder shall ensure that the plant site within the plant boundary is managed in a coordinated and professional way all through the construction phase till handing over of plant, ensuring safe, easy & unhindered working conditions and a healthy & hygienic working environment at site. He shall ensure the following measures at site while executing the project.

a) Proper housekeeping by systematic and proper disposal of earth from excavations (separately for usable & surplus earth), muck (from pile bores or otherwise), wastes (from dismantling of pile tops, concrete works etc), packing & insulation wastes, steel scrap, cable wastes etc generated during construction / erection works. Suitable disposal sites for each of above shall be identified in the layout and at site in the beginning of the project itself. It shall be ensured that all agencies engaged by the bidder follow the discipline to dispose off of earth spoils and wastes at the

designated places. Preferably once in a week suitable time slot will be identified for housekeeping by all agencies and suitable instructions shall be issued in this regard. Bidder may engage a separate agency or identify a gang for collection of wastes and disposal to designated places. Suitable arrangement / tieup will also be made for periodic disposal of wastes/ scrap from the designated places.

b) All fabrication areas shall be suitably hard crusted to provide a water free and proper working platforms. Suitable sheds preferably pre engineered structures to be provided for paint shops, fabrication workshops etc for ensuring all weather work conditions for onsite structural works. For the main plant and auxiliary buildings, bidder should preferably plan the works in such a way that structural fabrication is done in suppliers' offsite works / workshops and onsite fabrication works are avoided / kept minimum.

c) Suitable onsite maintenance workshop for day to day breakdown maintenance heavy plant and equipment like batching plants, cranes, earth moving equipment, poclains, welding equipment etc. The workshop shall have stock of frequently needed spares and suitable repair facilities with experienced technicians/mechanics. A central test laboratory equipped with test equipment for routine tests like tests on soil, concrete, bricks, aggregates, welds etc with experienced staff shall be established at the start of the project itself.

d) All office and covered store buildings of the bidder and its agencies shall be of prefab/ pre-engineered / porta cabin construction. Shabby semi finished constructions in brickwork/ GI / asbestos roof etc shall not be permitted.

e) First aid facilities and amenities like rest rooms, suitable pre engineered toilets (separate for men and women), drinking water fountains/tanks, canteen, crèche for women workers shall be planned and established at the beginning of the project itself. These facilities shall be located distributed over the plant area to enable easy access by the construction workers and staff and shall be marked on the plant layout. Suitable treatment for toilet discharge, like bio digesters etc shall be planned and conventional septic tanks / soak pits etc shall be avoided.

f) Proper lighting of all construction / erection areas. Bidder shall erect adequate number of high lighting masts in main plant, offsite, office and store areas for lighting during night. DG sets of adequate capacity shall be provided for emergency backup. The street lighting along the roads shall also be priortised along with road construction. The construction power ring main shall be planned and erected immediately after the award.

g) Well planned and coordinated storage and movement of plant, equipment and construction materials. System wise / agency wise storage / laydown areas shall be planned and marked on the plant layout at the beginning itself. Bidder shall ensure that all its agencies comply to the areas allocated to them and follow the designated storage and movement plans. Adequate covered storage shall be constructed for storage of critical equipments like switchgears, MCCs, insulation etc.

h) Proper access control for construction workers, staff and visitors. Bidder shall ensure that suitable electronic based gate pass system is in place from start of project itself

to keep record and track of all workers, staff and visitors entering/exiting the plant premises shift wise on daily basis.

i) Compliance to all safety requirements as specified elsewhere in the tender documents. Bidders shall establish a safety centre at the start of the project itself. It shall have a 24X7 manned safety control room in addition to a permanent safety equipment display room, separate training / lecture hall with AV facilities for safety training, store room with adequate stock of specified safety equipment, a first aid room and other amenities. Bidder shall install CCTV cameras at all strategic locations in the plant area which shall be linked to the safety control room.

j) Compliance to all environment and other conditions stipulated by the concerned statutory authorities while according clearance / NOC to the project. Bidder shall ensure adequate sprinkling of water by deploying water tankers to prevent the fugitive dust nuisance during construction.

k) Development of suitable landscape & green belt areas and rainwater harvesting within the plant premises. Bidder shall plan to develop the landscape & green belt areas and rainwater harvesting from the start of the project itself. The landscape and rainwater harvesting plan shall be finalized immediately after award of work and suitable work plan with priority and schedule shall also be finalized thereafter. Top soil before excavation shall be suitably preserved and stacked for landscape and green belt development.

l) Provision of adequate shelters, water supply, sanitation and lighting in construction workers and staff camps. No camps for workers and staff shall be permitted within the plant premises and Bidder shall make separate arrangement outside the plant premises for locating and development of camps for construction workers and staff. The designated areas shall be suitably developed with infrastructure like roads, drains, water supply and sewerage and shall be free from water logging. Suitable low cost shelters will be provided for the workers. Complete area shall be secured by fencing and shall be provided adequate area lighting. Suitable waste disposal, shopping and recreation facilities will be developed in these camps.

Contractor shall ensure that due importance is given to site management as discussed above and a detailed work plan considering the above aspects is finalized immediately after the award. A senior level executive shall be identified who shall be responsible for implementation of the work plan. Suitable format for progress reporting on site management plan shall be developed and made part of the project progress report. The progress on implementation of above work plan shall be reviewed along with project progress in the monthly project review meetings with owner. In case the progress on site management plan is unsatisfactory, Engineer-in Charge may withhold upto 1% of the monthly running bill (for civil and site erection works) till such time the required progress is demonstrated. Incase in the opinion of Engineer-in-charge, bidder's actions on site management aspects is not adequate, Engineer-in- charge may get the relevant work executed through a separate agency and deduct the expenses incurred from Bidder's bill along with overheads @10 %.

37.00.00 FIELD OFFICE RECORDS

The Contractor shall maintain at his Site Office up-to- date copies of all drawings, specifications and other Contract Documents and any other supplementary data complete with all the latest revisions thereto. The Contractor shall also maintain in addition the continuous record of all changes to the above Contract Documents, drawings, specifications, supplementary data, etc. effected at the field and on completion of his total assignment under the Contract shall incorporate all such changes on the drawings and other Engineering data to indicate as installed conditions of the equipment furnished and erected under the Contract. Such drawings and Engineering data shall be submitted to the Employer in required number of copies.

38.00.00 CONTRACTOR'S MATERIALS BROUGHT ON TO SITE

38.01.00 The Contractor shall bring to Site all equipment, components, parts, materials, including construction equipment, tools and tackles for the purpose of the Works under intimation to the Employer. All such goods shall, from the time of their being brought vest in the Employer, but may be used for the purpose of the Works only and shall not on any account be removed or taken away by the Contractor without the written permission of the Employer. The Contractor shall nevertheless be solely liable and responsible for any loss or destruction thereof and damage thereto.

38.02.00 The Employer shall have a lien on such goods for any sum or sums which may at any time be due or owing to him by the Contractor, under, in respect of or by reasons of the Contract. After giving a fifteen (15) days notice in writing of his intention to do so, the Employer shall be at liberty to sell and dispose off any such goods, in such manner as he shall think fit including public auction or private treaty and to apply the proceeds in or towards the satisfaction of such sum or sums due as aforesaid.

38.03.00 After the completion of the Works, the Contractor shall remove from the Site under the direction of the Employer the materials such as construction equipment, erection tools and tackles, scaffolding etc. with the written permission of the Employer. If the Contractor fails to remove such materials, within fifteen (15) days of issue of a notice by the Employer to do so then the Employer shall have the liberty to dispose off such materials as detailed under as specified at clause no 39.02.00 of this chapter and credit the proceeds thereto to the account of the Contractor.

39.00.00 PROTECTION OF PROPERTY AND CONTRACTOR'S LIABILITY

39.01.00 The Contractor shall be responsible for any damage resulting from his operations. He shall also be responsible for protection of all persons including members of public and employees of the Employer and the employees of other Contractors and Sub- Contractors and all public and private property including structures, building, other plants and equipments and utilities either above or below the ground.

39.02.00 The Contractor will ensure provision of necessary safety equipment such as barriers, sign - boards, warning lights and alarms, etc. to provide adequate protection to persons and property. The Contractor shall be responsible to give reasonable notice to the Employer and the Employers of public or private property and utilities when

such property and utilities are likely to get damaged or injured during the performance of his Works and shall make all necessary arrangements with such Employers, related to removal and/or replacement or protection of such property and utilities.

40.00.00 PAINTING

For painting refer Part-A, sub section-III, Section VI of Technical specification.

Painting for structures shall conform to the painting specification specified in Part-B under Civil.

Painting for Electrical equipments/systems shall conform to the painting specification given in Electrical portion of Part-A and Part-B of technical specifications.

41.00.00 INSURANCE

41.01.00 In addition to the conditions covered under the Clause entitled "Insurance" in Section General Conditions of Contract (GCC), the following provisions will also apply to the portion of works to be done beyond the Contractor's own or his Sub-Contractor's manufacturing Works.

41.02.00 **Workmen's Compensation Insurance**

This insurance shall protect the Contractor against all claims applicable under the Workmen's Compensation Act, 1948 (Government of India). This policy shall also cover the Contractor against claims for injury, disability disease or death of his or his Sub-Contractor's employees, which for any reason are not covered under the Workmen's Compensation Act, 1948. The liabilities shall not be less than the following:

Workmen's Compensation	-	As per Statutory Provisions
Employee's Liability	-	As per Statutory Provisions

41.03.00 **Comprehensive Automobile Insurance**

This insurance shall be in such a form to protect the Contractor against all claims for injuries, disability, disease and death to members of public including the Employer's men and damage to the property of other arising from the use of motor vehicles during on or off the Site operations, irrespective of the Ownership of such vehicles. The liability covered shall be as herein indicated :

Fatal Injury	:	Rs.100,000 each person
	:	Rs.200,000 each occurrence
Property Damage	:	Rs.100,000 each occurrence

41.04.00 **Comprehensive General Liability Insurance**

41.04.01 The insurance shall protect the Contractor against all claims arising from injuries, disabilities, disease or death of members of public or damage to property of others, due to any act or omission on the part of the Contractor, his agents, his employees, his representatives and Sub-Contractors or from riots, strikes and civil commotion. This insurance shall also cover all the liabilities of the Contractor arising out of the Clause entitled "Defence of Suits" in Section General Conditions of Contract (GCC).

41.04.02 The hazards to be covered will pertain to all the Works and areas where the Contractor, his Sub-Contractors, his agents and his employees have to perform work pursuant to the Contract.

41.05.00 The above are only illustrative list of insurance covers normally required and it will be the responsibility of the Contractor to maintain all necessary insurance coverage to the extent both in time and amount to take care of all his liabilities either direct or indirect, in pursuance of the Contract.

42.00.00 UNFAVOURABLE WORKING CONDITIONS

The Contractor shall confine all his field operations to those works which can be performed 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 a proper and satisfactory manner in the performance of such Works and with the concurrence of the Employer. Such unfavourable construction conditions will in no way relieve the Contractor of his responsibility to perform the Works as per the schedule.

43.00.00 PROTECTION OF MONUMENTS AND REFERENCE POINTS

The Contractor shall ensure that any finds such as relic, antiquity, coins, fossils, etc. which he may come across during the course of performance of his Works either during excavation or elsewhere, are properly protected and handed over to the Employer. Similarly the Contractor shall ensure that the bench marks, reference points, etc., which are marked either with the help of Employer or by the Employer shall not be disturbed in any way during the performance of his Works. If, any work is to be preformed which disturb such reference, the same shall be done only after these are transferred to other suitable locations under the direction of the Employer. The Contractor shall provide all necessary materials and assistance for such relocation of reference points etc.

44.00.00 WORK & SAFETY REGULATIONS

44.01.00 **General**

i) 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.

ii) The Contractor shall follow NTPC Safety Rules as issued from time to time with respect to safety in construction & erection.

iii) 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.

iv) 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 - III.

v) 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.

vi) All equipments used in construction and erection by the contractor shall meet BIS / 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.

vii) 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.

viii) 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.

ix) 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.

x) 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 0f 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 I/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).

xi) First Aid boxes equipped with requisite articles as specified in the Rule 231 of The Building 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.

44.01.01 **Emergency Action Plan**

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.

44.01.02 **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 it 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.

44.01.03 **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. When ever 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.

44.01.04 **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.

44.02.00 **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.

44.03.00 **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.

44.04.00 **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.

44.05.00 **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.

44.06.00 **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.

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 fitted with suitable fall arresting system (Fall arrestors) for climbing/getting down through ladders to prevent fall from height.

44.07.00 **Handling of Hazardous Chemicals**

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.

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.

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.

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.

The contractor shall provide suitable personal protective equipments to the workers who are handling the hazardous and corrosive substances including alkalis and acids.

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.

44.08.00 **Eye Protection**

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.

44.09.00 **Excavation**

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.

44.10.00 **Electrical Hazards**

The contractor should ensure that all electrical installations at the construction work comply with the requirements of latest electricity acts / rules.

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.

The contractor should ensure use of single / double insulated hand tools or low voltage i.e., 110 volts hand tools.

The contractor should also ensure that all temporary electrical installations at the construction works are provided with earth leakage circuit breakers.

44.11.00 **Vehicular Traffic**

The contractor should employ vehicle drivers who hold a valid driving license under the Motor Vehicles Act, 1988.

44.12.00 **Lifting Appliances, Tools & Tackles, Lifting Gear And Pressure Plant & Equipment etc.**

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.

44.13.00 **Excessive Noise, Vibration**

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.

44.14.00 **Electrical Installations**

44.14.01 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

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.

The Engineer I/C will not grant permission to connect until he is satisfied that:

The appliance is in good condition and is fitted with suitable plug; having earth connection with the body.

Wherever armored / metallic sheathed multi core cable is used, the same armored / sheathed should be connected to earth.

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.

The installations are provided with suitable ELCBs and RCCBs wherever required.

44.15.00 **Safety Organisation**

44.15.01 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 2days 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.

44.15.02 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.

44.16.00 **Reporting of Accident and Investigation**

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.

44.17.00 **Right to stop Work**

44.17.01 The Engineer I/C 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.

44.17.02 The Contractor shall not be entitled for any damages / compensation for stoppage of work, {Sub-Clause XVIII (I)} 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.

44.18.00 **Fire Protection**

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.

44.19.00 **Penalties**

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 Clause XVIII (1) above, 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 Sub-Clause XX (II) below shall also apply in addition to the penalties mentioned in this sub-clause.

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:-

a) Fatal injury or accident causing death:

Penalty @10% of contract value or Rs. 5,00,000/- per person, which ever is less.

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.

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 I/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 I/c / Safety Officer of NTPC will also issue a notice in this regard to the contractor.

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

(1) not complied with keeping adequate PPEs in stock or

(2) defaulted in providing PPEs to his workmen

(3) not followed statutory requirements / NTPC safety rules

(4) been issued warning notice/s by NTPC head of the project on non observance of safety norms

(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.

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.

44.20.00 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 availabilitty of additional requirement for individual worker and safety equipment as per site requirement during execution of the contract till its completion.

44.21.00 **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.

44.22.00 **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.

45.00.00 FOREIGN PERSONNEL

45.01.00 The Contractor shall submit to the Employer data on all personnel he proposes to bring into India from abroad for the performance of the Works under the Contract, at least sixty (60) days prior to their departure to India. Such data will include for each person the name, his present address, his assignment and responsibility in connection with the works, and a short resume of his qualification, experience etc. in relation to the work to be performed by him.

45.02.00 Any person unsuitable and unacceptable to the Employer shall not be brought to India. Any person brought to India, if found unsuitable or unacceptable by the Employer, the Contractor shall within a reasonable time make alternate arrangements for providing a suitable replacement and repatriation of such unsuitable personnel.

45.03.00 No person brought to India for the purposes of the works shall be repatriated without the consent of the Employer in writing, based on a written request from the Contractor for such repatriation giving reasons for such an action to the Employer. The Employer may give permission for such repatriation provided he is satisfied that the progress of work will not suffer due to such repatriation.

45.04.00 The cost of passports, visas and all other travel expenses to and from India, incurred by the Contractor shall be to his account. The Employer will not provide any residential accommodation and/or furniture for any of the Contractor's personnel including foreign personnel and Contractor shall make his own arrangements for such facilities in the area allotted at Site, to him by the Employer for that purpose.

45.05.00 The Contractor and his expatriate personnel shall respect all Indian Acts, Laws, rules and regulations and shall not in any way interfere with Indian political and religious affairs and shall conform to any other rules and regulations which the Government of India and the Employer may establish from time to time, on them. The Contractor's expatriate personnel shall work and live in close co-operation and coordination with their co-workers and the community and shall not engage themselves in any other employment neither part-time nor full-time nor shall they take part in any local politics.

45.06.00 The Employer shall assist the Contractor, to the extent possible, in obtaining necessary permits to travel to India and back, by issue of necessary certificates and other information needed by the Government agencies.

46.00.00 FOUNDATION DRESSING & GROUTING FOR EQUIPMENT/ EQUIPMENT BASES

46.01.00 The surfaces of foundations shall be dressed to bring the top surface of the foundations to the required level, prior to placement of equipment/equipment bases on the foundations.

46.02.00 All the equipment/ equipment bases, shall be grouted and finished by bidder as per these specifications unless otherwise recommended by the equipment manufacturer.

46.03.00 The concrete foundation surfaces shall be properly prepared by bidder by chipping, grinding as required to bring the top of such foundation to the required level, to provide the necessary roughness for bondage and to assure enough bearing strength.

46.04.00 **Grout**

The grout for equipment foundation shall be high strength grout having a minimum characteristic compressive strength of 60 N/mm2 at 28 days. The grout shall be ready mix non-shrink, chloride - free, cement based, free flowing, non-metallic grout as recommended by equipment manufacturer. The ready mix grout shall be of reputed make as approved by the Employer.

The Grout shall have good flowability even at very low water/ grout powder ratio.

The Grout shall have characteristics of controlled expansion to be able to occupy its original volume to fill the voids and to compensate for shrinkage. Grout shall be of pre-mix variety so that only water needs to be added before use.

The mixing of the Grout shall conform to the recommendations of the manufacturer of the Grout.

46.05.00 **Placing of Grout**

46.05.01 After the base has been prepared, its alignment and level has been checked and approved and before actually placing the grout, a low dam shall be set around the base at a distance that will permit pouring and manipulation of the grout. The height of such dam shall be at least 25mm above the bottom of the base. Suitable size and number of chains shall be introduced under the base before placing the grout, so that such chains can be moved back & forth to push the grout into every part of the space under the base.

46.05.02 The grout shall be poured either through grout holes if provided or shall be poured at one side or at two adjacent sides to make the grout move in a solid mass under the base and out in the opposite side. Pouring shall be continued until the entire space below the base is thoroughly filled and the grout stands at least 25 mm higher all

around than the bottom of the base. Enough care should be taken to avoid any air or water pockets beneath the bases.

46.05.03 In addition to the above, recommendations of Grout manufacturer shall also be followed.

46.06.00 **Finishing of the Edges of the Grout**

The poured grout should be allowed to stand undisturbed until it is well set. Immediately thereafter, the dam shall be removed and grout which extends beyond the edges of the structural or equipment base plates shall be cut off, flushed and removed. The edges of the grout shall then be pointed and finished with 1:2 cement mortar pressed firmly to bond with the body of the grout and smoothened with a tool to present a smooth vertical surface. The work shall be done in a clean and scientific manner and the adjacent floor spaces, exposed edges of the foundations, and structural steel and equipment base plates shall be thoroughly cleaned of any spillage of the grout.

46.07.00 **Checking of Equipment After Grouting**

After the grout is set and cured, the Contractor shall check and verify the alignment of equipments, alignment of shafts of rotating machinery, the slopes of all bearing pedestals, centering of rotors with respect to their sealing bores, couplings, etc. as applicable and the like items to ensure that no displacement had taken place during grouting. The values recorded prior to grouting shall be used during such post grouting check- up and verifications. Such pre and post grout records of alignment details shall be maintained by the Contractor in a manner acceptable to the Employer.

47.00.00 SHAFT ALIGNMENTS

All the shafts of rotating equipment shall be properly aligned to those of the matching equipments to as perfect an accuracy as practicable. The equipment shall be free from excessive vibration so as to avoid overheating of bearings or other conditions which may tend to shorten the life of the equipment. The vibration level of rotating equipments measured at bearing housing shall conform to Zone A of ISO 10816. All bearings, shafts and other rotating parts shall be thoroughly cleaned and suitably lubricated before starting.

48.00.00 DOWELLING

All the motors and other equipment shall be suitably doweled after alignment of shafts with tapered machined dowels as per the direction of the Employer.

49.00.00 CHECK OUT OF CONTROL SYSTEMS

After completion of wiring, cabling furnished under separate specification and laid and terminated by the Employer, the Contractor shall check out the operation of all control systems for the equipment furnished and installed under these specifications and documents.

50.00.00 **COMMISSIONING SPARES**

50.01.00 It will be the responsibility of the Contractor to provide all commissioning spares including consumable spares required for initial operation till the Completion of Facilities. The Contractor shall furnish a list of all commissioning spares within 60 days from the date of Notification of Award and such list shall be reviewed by the Employer and mutually agreed to. However. such review and agreement will not absolve the Contractor of his responsibilities to supply all commissioning spares so that initial operation do not suffer for want of commissioning spares. All commissioning spares shall be deemed to be included in the scope of the Contract at no extra cost to the Employer.

50.02.00 These spare will be received and stored by the Contractor atleast 3 months prior to the schedule date of commencement of initial operation of the respective equipment and utilised as and when required. The unutilised spares and replaced parts, if any, at the end of successful completion of guarantee tests shall be the property of the Contractor and he will be allowed to take these parts back at his own cost with the permission of Employer.

51.00.00 CABLING

51.01.00 All cables shall be supported by conduits or cable tray run in air or in cable channels. These shall be installed in exposed runs parallel or perpendicular to dominant surfaces with right angle turn made of symmetrical bends or fittings. When cables are run on cable trays, they shall be clamped at a minimum intervals of 2000mm or otherwise as directed by the Employer.

51.02.00 Each cable, whether power or control, shall be provided with a metallic or plastic tag of an approved type, bearing a cable reference number indicated in the cable and conduit list (prepared by the Contractor), at every 5 meter run or part thereof and at both ends of the cable adjacent to the terminations. Cable routing is to be done in such a way that cables are accessible for any maintenance and for easy identification.

51.03.00 Sharp bending and kinking of cables shall be avoided. The minimum radii for PVC insulted cables 1100 V grade shall be 15 D where D is the overall diameter of the cable. Installation of other cables like high voltage, coaxial, screened, compensating, mineral insulated shall be in accordance with the cable manufacturer's recommendations. Wherever cables cross roads and water, oil, sewage or gaslines, special care should be taken for the protection of the cables in designing the cable channels.

51.04.00 In each cable run some extra length shall be kept at a suitable point to enable one or two straight through joints to be made, should the cable develop fault at a later date.

51.05.00 Control cable terminations shall be made in accordance with wiring diagrams, using identifying codes subject to the Employer's approval. Multicore control cable jackets shall be removed as required to train and terminate the conductors. The cable jacket shall be left on the cable, as far as possible, to the point of the first conductor branch. The insulated conductors from which the jacket is removed shall be neatly twined in bundles and terminated. The bundles shall be firmly but not tightly tied

utilising plastic or nylon ties or specifically treated fungus protected cord made for this purpose. Control cable conductor insulation shall be securely and evenly cut.

51.06.00 The connectors for control cables shall be covered with a transparent insulating sleeve so as to prevent accidental contact with ground or adjacent terminals and shall preferably terminate in Elmex terminals and washers. The insulating sleeve shall be fire resistant and shall be long enough to over pass the conductor insulation. All control cables shall be fanned out and connection made to terminal blocks and test equipment for proper operation before cables are corded together.

52.00.00 **EQUIPMENT DELIVERY AND ERECTION**

52.01.00 **General Requirements**

(a.) This part covers Contractor's responsibilities for packing, shipping, ware-housing and the installation of all equipment and materials furnished and installed under this specification.

(b.) The Contractor shall submit for Employer's approval draft manual for Equipment Delivery and Erection (EDE Manual) covering detailed instructions, write up, technical data, drawings, check-lists, documentation formats for all activities after equipment manufacture upto installation of equipment. This manual shall cover general instructions for all equipment and specific instructions for individual equipment wherever required and shall include at least the following :

(1.) Instructions for packing, shipping, receiving handling, ware-housing and storage.

(2.) Instructions for location and installation of equipment furnished by this specification.

(3.) Installation drawings for field mounted equipment, panels, cubicles and other equipment covered under this specification.

(4.) Instruction relating installation of piping/ tubing, support and routing drawings of impulse pipes/signal tubes and tube/cable trays.

(5.) Check lists and quality assurance hold points.

(6.) Format for all related documentation.

(c.) The EDE Manual shall conform to the requirements of this specification, all applicable codes and standards, recommendations of equipment manufacturers and accepted good engineering practices and shall be subject to Employer approval during detailed engineering.

(d.) The Contractor shall ensure that all work under this part shall be performed as per the requirements of this specification, Employer approved EDE Manual and drawing/documents approved by the Employer during detailed engg.

52.02.00 **Crating**

(a.) All equipment and materials shall be suitably coated, wrapped, or covered and boxed or crated for moist humid tropical shipment and to prevent damage or deterioration during handling and storage at the site.

(b.) Equipment shall be packed with suitable desiccants, sealed in water proof vapour-proof wrapping and packed in lumber of plywood enclosures, suitably braced, tied and skidded. Lumber enclosures shall be solid, not slatted.

(c.) Desiccants shall be either silica gel or calcium sulphate, sufficiently ground to provide the required surface area and activated prior to placing in the packaging. Calcium sulphate desiccants shall be of a chemical nature to absorb moisture. In any case, the desiccant shall not be of a type that will absorb enough moisture to go into solution. Desiccants shall be packed in porous containers, strong enough to withstand handling encountered during normal shipment. Enough desiccant shall be used for the volumes enclosed in wrapping.

(d.) Review by the Employer of the Contractor's proposed packaging methods shall not relieve the Contractor of responsibility for damage or deterioration to the equipment and materials specified.

(e.) All accessory items shall be shipped with the equipment. ; Boxes and crates containing accessory items shall be marked so that they are identified with the main equipment. The contents of each box and crates shall be indicated by markings on the exterior.

(f.) All boxes, crates, cases bundles, loose pieces, etc. shall be marked consecutively from No.1 upward throughout all shipments from a given port to completion of the order without repeating the same number.

(g.) An itemized list of contents shall be enclosed inside each case and one other copy securely fastened to the outside of the case in a tin or light weight sheet metal envelope or pocket. The lists shall be plainly marked and placed in accessible locations to facilitate receipt and inspection. The packing list shall indicate whether shipment is partial or complete and shall incorporate the following information on each container, etc., according to its individual shipping number:

a) Export case markings

b) Case number

c) Gross weight and net weight in Kilograms

d) Dimensions in centimeters

e) Complete description of material

(h.) Packaging or shipping units shall be designed within the limitations of unloading facilities and the equipment which will be used for transport. Complications involved with ocean shipment and the limitations of ports, railways and roads shall be considered. It shall be the Contractor's responsibility to investigate these limitations and to provide suitable packaging to permit safe handling during transit and at the job site.

(i.) Electrical equipment, control and instrumentation shall be protected against moisture and water damage. All external gasket surfaces and flange faces, couplings, motor pump shafts, bearing and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection.

(j.) Equipment having antifriction or sleeve bearings shall be protected by weather tight enclosures.

(k.) Coated surfaces shall be protected against impact, abrasion, discolouration and other damage. Surfaces which are damaged shall be repaired.

(l.) All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors. All female threaded openings shall be closed with forged steel plugs. All pipings, tubing, and conduit equipment and other equipment openings shall be sealed with metallic or other rough usage covers and tapped to seal the interior of the equipment piping, tubing, or conduit.

(m.) Provisions shall be made to ensure that water does not enter any equipment during shipment or in storage at the plant site.

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

(o.) While packaging the material, care shall be taken for the limitation from the point of view of availability of railway wagon sizes in India.

52.03.00 **Factory Assembly**

(a.) Instrument enclosures shall be supplied and erected completely in the factory with instrument, air supply and blow down piping with necessary valves, fittings, etc. and also all electrical wiring between the instruments and the enclosure terminal blocks. Control panel and cubicles shall also be fully wired in the factory. Control panel mounted equipments are to be dismounted from the panels before shipment and individually packed for shipment. Electronic control modules of the plug-in type are to be removed from equipment racks after factory checkout are individually packed for shipment. Other equipment shall be fully assembled at the factory, except for necessary shipping splits in panels.

(b.) All separately packaged accessories items and parts shall be shipped with the equipment. Containers for separately packaged items shall be marked

so that they are identified with the main equipment. An itemized packing slip, indicating what is in that carton only, shall be attached to the outside and inside of each container used for packing.

A master packing slip covering all accessories items for a given piece of equipment which are shipped in separate containers, shall be attached to one container.

52.04.00 **Equipment Installation**

(a.) **General Requirements**

(1.) The Contractor shall furnish all construction materials, tools and equipment and shall perform all work required for complete installation of all control and instrument equipment furnished under this specification.

(2.) Contractor shall prepare detailed installation drawings for each equipment furnished under this specification for Employer's approval. Installation of all equipment/systems furnished by this specification shall be as per Employer's approval.

(3.) Erection procedures not specified herein shall be in accordance with the recommendations of the equipment manufacturers. The procedures shall be acceptable to the Employer.

(4.) The Contractor shall coordinate his work with other suppliers where their instruments and devices are to be installed under specifications.

(b.) **Installation Materials**

All materials required for installation, testing and commissioning of the equipment shall be furnished by the Contractor.

(c.) **Regulatory Requirements**

All installation procedures shall confirm with the accepted good engineering practice and with all applicable governmental laws, regulations and codes.

(d.) **Cleaning**

All equipment shall be cleaned of all sand, dirt and other foreign materials immediately after removal from storage and before the equipment is brought inside the power plant building or to other installation sites. All piping and tubes shall be air blown.

(e.) **Equipment Assembly**

Equipment installed under these specifications shall be assembled if shipped unassembled. The equipment shall be dismantled and reassembled as

required to perform the installation and commissioning work described in these specifications.

(f.) **Equipment Setting**

Field mounted instruments and accessories shall be bracket or sub panel mounted on the nearest suitable firm steel work or masonry. The brackets, stands, supports and other miscellaneous hardware required for mounting instruments and accessories such as receiver gauge, air set, valve manifold, purge-meter etc. shall be furnished and installed. No field mounted instruments shall be installed such that it depends for support or rigidity on the impulse piping or on electrical connection to it.

Indicating type field mounted instruments shall be installed in such a way that centre of indicating dial shall be about 1600-1800mm from operating floor level. Non-indicating type field instruments shall be installed such that operating handle of manifold block / isolating cock comes within 1600 mm from operating floor level.

(g.) **Free-Standing Equipment**

Free-standing Cabinets shall be attached to the floor, concrete equipment bases or supporting steel as indicated on the manufacturer's drawings and the Employer's Plant Arrangement Drawings. The cabinets shall be shimmed for proper alignment before bolting them to the floor. Adjacent enclosures shall be shimmed to maintain mutually level appearance before they are attached to floor. Vibration dampening mounts shall be installed between supporting structures and panels when specified.

(h.) **Non-free Standing Equipment**

(1.) Non-free standing local enclosures and cabinets shall be mounted in accessible locations on columns, walls, or stands in locations as indicated on the Employer's Plant Arrangement Drawings. Bracket and stands shall be fabricated as required to install the local enclosures and cabinets in a workman like manner.

(2.) Rough edges and welds on all fabricated supports shall be ground smooth. The supports shall be finished with two coats of primer and two coats of paint as specified in this part.

(i.) **Equipment Location**

(1.) All individual items of equipment not located in cabinets or on panels and racks are located approximately according to the floor elevation and the nearest building column designated by the Employer.

(2.) Solenoid valves not located in enclosures or mounted on valves shall be mounted in easily accessible protected locations near the components with which they are associated.

(3.) All brackets, stands, supports and other miscellaneous hardware required for mounting devices shall be furnished and installed.

(4.) Thermometers shall be installed in the process lines and ducts as required and adjusted for ease in reading.

(5.) Permanent temperature wells on the main steam, hot reheat and cold reheat piping shall not be installed until steam blowing has been completed. Temporary temperature wells shall be installed in the main and reheat steam piping during steam blow and discarded after completion.

(6.) Any required adapting hardware such as pipe bushings, nipples, drilled caps and the like shall be provided for complete installation of control devices into process connections.

For location of C&I related equipment/devices, the requirement specified elsewhere in the technical specification may be referred.

(j.) **Installation of Field Mounted Instruments and Devices**

The Contractor shall submit installation drawings for all field mounted equipment furnished under this specification for Employer's approval. These drawings shall meet the requirements of this specification, installation drawings, applicable codes and standards and recommendations of manufacturers of instruments/devices. All installation work under this specification shall be strictly as per installation drawings approved by the Employer during detailed engineering stage.

In addition to above relevant Portion as specified elsewhere in technical specification may be referred.

(k.) **Piping Connections**

(1.) All equipment having piping connections shall be levelled, aligned and wedged in place but shall not be grouted or bolted prior to the initial fitting and alignment of connecting piping. All equipment shall, however, be grouted or bolted to its foundation prior to final bolting or welding of the connection piping.

(2.) All flanged joints shall be checked and retightened after approximately 10 days of operation at normal operating temperature.

(l.) **Equipment Checkout**

(1.) All equipment shall be cleaned after installation. Equipment subject to pressure differentials shall be checked for leakage.

(2.) After erection, all equipment having moving parts, having electrical apparatus, or subject to pressure differentials shall be trial-operated.

(m.) **Defects**

(1.) All defects in erection shall be corrected to the satisfaction of the Employer and the Project Manager. The dismantling and reassembly of Contractor furnished equipment to remove defective parts, replace parts, or make adjustments shall be included as a part of the work under these specifications.

(2.) The removal of control and instrument equipment in order to allow bench calibration, if required, and the re-installation of the said equipment after calibration shall also be included as a part of the work under these specifications.

(n.) **Equipment Protection**

(1.) All equipment to be erected under these specifications shall be protected from damage of any kind from the time of contract award until commissioning of each unit.

(2.) The equipment shall be protected during storage as described herein.

(3.) Equipment shall be protected from weld spatter during construction.

(4.) Suitable guards shall be provided for protection of personnel on all exposed rotating or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy removal and maintenance.

(5.) Equipment having glass components such as gauges, or equipment having other easily breakable components, shall be protected during the construction period with plywood enclosures or other suitable means. Broken, stolen, or lost components shall be replaced by the Contractor.

(6.) Machine finished surfaces, polished surfaces, or other bare metal surfaces which are not to be painted, such as machinery shafts and couplings shall be provided temporary protection during storage and constructional periods by a coating of a suitable non- drying, oily type, rust preventive compound.

53.00.00 WELDING - SPECIAL REQUIREMENTS

If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be performed under separate specifications, the requirements shall be submitted to the Project Manager in advance of commencement of erection work.

54.00.00 **DEVIATIONS DISPOSITIONING:**

Any deviation to the contract and employer approved documents shall be properly recorded in the format prescribed by NTPC. All the deviations shall be bought to the knowledge of employer's representative for suitable dispositioning.

55.00.00 **NON-DESTRUCTIVE TESTING (NDT):**

The contractor shall record results of NDTs carried out at site in the format acceptable to employer. All the radiographs & its report duly signed & correlated to the job shall be handed over to the employer. Sensitivity of all the test equipment shall be compatible to the job & acceptance norms agreed.

56.00.00 **TESTING EQUIPMENT & FACILITIES:**

Contractor shall provide the testing equipment and facilities necessary to carry out tests & inspections.

ANNEXURE-I

STANDARD CHECKLIST

This is an indicative list of items. The actual list shall depend on the Equipment / System being supplied by the contractor.

MECHANICAL

VALVES

1. Manually Operated Valve
2. Electrically Operated Valve
3. Pneumatically Actuated Valve
4. Hydraulically Actuated Valve
5. Safety Valve
6. Electromatic Relief Valve
7. Steam Trap
8. Non Return Valve (including Hydraulic/ Pneumatic QCNRVS)
9. Control Valve
10. Relief Valve
11. Differential Pressure Regulating Valve
12. Pinch valve

TANKS & PRESSURE VESSELS

1. Limestone silos
2. Gypsum storage silos
3. Limestone slurry tanks
4. Filtrate tank
5. Waste water tank

6. Secondary hydrocyclone feed tank
7. Lime dosing tank
8. Process water tank
9. Absorber
10. Auxiliary absorbent tank
11. Mill circuit tank
12. Any other tank not covered above
13. Vacuum tanks
14. Air Receiver(if any)

PUMPS

1. Slurry recirculation pumps
2. Gypsum bleed pumps
3. Limestone slurry pumps
4. Process water pumps
5. All other slurry pumps
6. Vacuum pumps
7. Sump pumps

PIPE WORK SYSTEM

1. Steam services
2. Water services
3. Slurry services
4. Air services
5. Constant load support
6. Spring supports
7. Hangers and other Supports

STRAINER AND FILTER

1. Strainer / Filter Basket Type
2. Strainer Rotary (Low Pressure)
3. Filter & Strainers Centrifugal Separators
4. Filter & Strainer Y-Type
5. Filter & Strainer (Plate Type)
6. Purifier
7. Filter – Compressed Air Line

FANS & COMPRESSORS

1. Booster Fans (if provided) – Axial Flow pressure Lubricated
2. Oxidation Blowers/Compressors-General

DAMPERS & GATES

1. Manually Operated Damper
2. Pneumatically Operated Damper
3. Electrically Operated Damper
4. Manually Operated Gates
5. Pneumatically Operated Gate
6. Electrically Operated Gate

DUCT WORK

1. Flue Gas Ducting
2. Expansion Joints
3. Observation & Access Door

CRANES AND ELEVATORS

1. Crane
2. Hoists

3. Passenger cum goods elevator

POWER TRANSMISSION

1. Power Transmission Gear Box
2. Bearings
3. Couplings

FGD & AUX.SYSTEM

1. Agitators
2. Air Motor
3. Process trustle
4. Limestone feeder
5. Vacuum belt filter
6. Limestone ball mill
7. Limestone Hydrocyclones
8. Primary Hydrocyclones
9. Secondary Hydrocyclones
10. Absorber internals
11. Absorber Auxiliaries

ELELCTRICAL

1. D.C. Motor
2. HV Squirrel Cage Induction Motor
3. 415 V Squirrel Cage Induction Motor
4. Motor Operated Actuators
5. Soot Blower (GGH)
6. Aux. Control and Relay Panel Desk
7. SWITCHGEARS/MCC

(I.) STANDARD CHECLISTS FOR ALL TYPES OF RELAYS USED IN SWITCHGEARS PROTECTION SYSTEM

(II.) PT CARRIAGE AND CUBICLES

(III.) CABLE/BUS DUCT/BUS BARS

(IV.) CONTRACTOR MODULE

(V.) SWITCH FUSE MODULE

(VI.) MASTER PANEL OF LUBE OIL PANEL

(VII.) FEEDER PANEL OF LUBE OIL PANEL

(VIII.) SPACE HEATER AND CABLE MODULE

(IX.) HT CIRCUIT BREAKER

(X.) 415 V CIRCUIT BREAKER

POWER CABLE

AUXILIARY CABLE

D.C. CABLE

EXPLOSION PROOF ELECTRICAL EQUIPMENT

JUNCTION BOX

CONTROL TRANSFORMER MODULE

BRUSH GEAR ASSEMBLY

AUX. CONTROL AND RELAY PANEL DESK

INDICATING INSTRUMENT

RECORDING INSTRUMENT

INTEGRATING INSTRUMENT

CONTROL & INSTRUMENTATION

1. Conductivity Measuring Equipment including Test Procedures

2. pH Analyser Including Test procedure

3. Silica Analyser
4. Level Switch (Float Actuated)
5. Level Switch (Electrode Type)
6. Level Switch (Displacer Actuated)
7. Transmitter (Float Operated Pneumatic Output including Testing procedures
8. Level indicator (Float/Pulley Type)
9. Local Temperature Indicator Including Test Procedure
10. Resistance Thermometer Element Including Test procedure
11. Thermocouple Element and Connecting Cable
12. Thermocouple and Resistance Thermometer Convertor/Transmitter Including Test Procedures
13. Temperature Switch Including Test Procedure
14. Cold Junction Boxes
15. 0_2Analyser
16. SO2 analyzer
17. 0_2 in Hydrogen including Test procedures
18. Pressure and Vacuum Gauge
19. Pressure and Vacuum Switch Including Test procedures
20. Differential Pressure Transmitter including Test Procedures
21. Differential pressure switch including Test procedures
22. Flow indicator (Variable Area)
23. Orifice plate
24. Flow Switch
25. Nozzle
26. Flow Integrator (pneumatic input) including test procedure

27. Flow indicator (Float Operated) Including Test Procedure
28. Venturi (Fluid)
29. Flow Switch (Magnetic Type)
30. Limit Switches
31. Turbine Supervisory Measuring System
32. Position Measurement & Indication Including Test procedures
33. Vibration Measurement
34. Digital Indicator
35. Moving Coil Indicator Including Test Procedures
36. Recorder Including Test procedure
37. Flame Scanner
38. Electrical Auto Manual Control Station
39. Push Button Module
40. Test Procedure for Electronic Modules of DDCMIS
41. Alarm Annunciator Equipment Including Test Procedure
42. Test procedure for Adjustment of Modulating Controller-PID Term
43. Test Procedure Indicating Controller-Electrical Input & Pneumatic Output
44. Density monitors

Note: The items which are not part of this specification may be considered as not applicable.

ANNEXURE-II

BRIEF WRITE UP ON THE CONTENTS OF TESTING SCHEDULE / COMMISSIONING SCHEDULE

Testing Schedules should be designed to ensure that the plant area, equipment or apparatus are tested and commissioned and will operate as per the employer's specifications and good engineering practices.

Testing Schedule/Commissioning Schedule is required to be of a standard format in order to maintain consistency of presentation, content and reporting.

Testing Schedule/Commissioning Schedule should contain the following sections to make the document a self contained one:

1. Plant Details/Design data
2. Testing Objective/Proposals
3. State of the Plant
   a) Erection Status with respect to Mech. Elect and C&I
   b) Availability of the services required
   c) Safety requirements as per Manufacturer's
4. Test method including completion/acceptance criteria
5. Results
6. Appendix
   a) Testing Programme
   b) Mech/Elect/C&I -Plant item completing list
   c) List of Drawing/documents required for carrying out the testing.

ANNEXURE - III

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:

Signature
Head of the Organisation
with date & stamp

CUSTOMER SPECIFICATION: QUALITY ASSURANCE

1.05.00 **TANKS / VESSELS:**

1.05.01 **Atmospheric tanks:**

i) All welds joints shall be DP tested and complete tanks shall be water fill tested.
ii) All atmospheric storage tanks fabricated and erected at site shall be subjected to tests (Hydro, NDT and Vacuum) according to design code as applicable.
iii) Rubber lining shall be tested for hardness and spark test, as applicable.

1.05.02 **Pressure vessels:**

1) NDT on weld joint shall be as per respective code requirements or the minimum as specified as below:

   i) 100% DPT on root run of butt weld, nozzle welds and finished fillet welds.
   ii) 10% DPT on all finished butt welds.
   iii) 10% RT (covering all 'T'/cross joints) of butt welds.

2) Butt welds of dished ends shall be stress relieved and subjected to 100% RT.

3) Each finished vessels shall be hydraulically tested to 150% of the design pressure for a duration of 30 minutes.

1.06.00 **HEAT EXCHANGER/HEATER:**

1.06.01 All material shall be tested for chemical and mechanical properties and NDT as per relevant standard.

1.06.02 NDT on welds and other checks shall be as per relevant code.

1.06.03 Air heaters shall be subjected to dimensional and clearance checks as per standard practice

1.06.04 Lub. oil system, drive system, soot blowing system etc. of Air heaters shall be checked suitably as per standard practice

1.07.00 **PUMPS:**

1.07.01 UT on shaft forgings (greater or equal to 40mm) and MPI/DPT shall be done on shafts and impeller to ensure freedom from defects.

1.07.02 The pump casing shall be hydraulically tested at 200% of pump rated head or at 150% of shut off head, whichever is higher. The test pressure shall be maintained for at least half an hour.

1.07.03 The pump rotating parts shall be subjected to static and dynamic balancing.

1.07.04 All pumps shall be tested at shop for capacity, head efficiency and brake horse power at rated speed as per relevant/applicable standard.

1.07.05 Noise and vibration shall be measured during the performance testing at shop.

LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN									ANNEXURE- V
		ITEM : STRUCTURAL STEEL WORK		QP NO. :		2	PROJECT:	FLUE GAS DESULPHURISATION SYSTEM PACKAGE			
				REV. NO .:		0	PACKAGE:				
		SUB-SYSTEM : FABRICATION & ERECTION		DATE :			CONTRACT NO.				
				PAGE :			MAIN CONTRACTOR				
Sl. No	Activity and operation	Characteristics / instruments		Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks
1	2	3		4	5	6	7	8	9	D*	10
1.00	**MATERIALS**										
i		Structural steel procured from NTPC approved sources-Mechanical (YS, UTS, Elg, UT if specified),,and Chemical properties (CE as per IS)		A	Review	For each batch of each section delivered at site	Technical Specification and Construction Drawings, IS 2062		SR	√	Correlated MTC shall be verified. In the event of non submission of MTC , sample shall be selected by FQA for testing
2.00	**FIT-UP**										
2.01		Marking and Cutting	As agreed / required	B	Visual & Measurement	Each plate/ Section	Tech Specs and Const. Drawings/ Approved cutting plan		SR		
2.02		Match markings for trial assembled components	As agreed / required	B	Physical	Each fit-up	Tech Specs and Const. Drawings		SR		
2.03		Weld Fit Up	As agreed / required	B	Physical	Each fit-up	Tech Specs and Const. Drawings		SR	√	Edge Preparation/ Gap/ Alignment
3.00	**PRE HEATING (wherever applicable)**										
3.01		Pre-Heating Temperature	As agreed / required	B	Measurement	Each pre-heating	Tech Specs and Const. Drawings, Approved WPS		SR	√	
3.02		Post Weld Heat Treatment (PWHT), if required	As agreed / required	A	Time & Temperature	Each PWHT	Tech Specs and Const. Drawings, Approved WPS		SR	√	
4.00	**WELDING REQUIREMENTS**										
4.01		PQR and Welder's Qualification	As agreed / required	A	Physical	Each welder	Approved WPS/ PQR, AWS-D1.1/ASME-IX, Tech Specs and Const. Drawings		Test Report	√	
4.02		Welding consumables	As agreed / required	B	Physical	Random in each shift	Approved WPS/ Owner Rationalized list of Electrodes.		SR	√	
4.03		Sequence of welding	As agreed / required	B	Physical	Random in each shift	Tech Specs and Const. Drawings, Agreed scheme		SR		
4.04		Removal/ grinding of temporary attachments	As agreed / required	B	Measurement	All cleats/ attachments	Tech Specs and Const. Drawings, IS-7215/Approved Drg.		SR		
4.05		Completeness after welding-Dimensions/ distortion	As agreed / required	B	Visual	Each structure component	Tech Specs and Const. Drawings		SR		
5.00	**NON DESTRUCTIVE AND DESTRUCTIVE TESTING**										
5.01	**Fillet Welds**										
5.01.01		Visual	As required/ agreed	B	Visual/ Measurement	Each welded joint	As per technical specifications and construction drawings		SR		As per requirement of Owner Engineer
5.01.02		Macro-Etch Examination	As required/ agreed	B	Physical	Main fillet weld with min one joint per built up beam, columns and crane girders	As per technical specifications and construction drawings		SR	√	

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1	2	3		4	5	6	7	8	9	D*	10
5.01.03		Dye Penetration Test (DPT)	As required/ agreed	B	Physical	25% weld length of tension member of crane girder- For crane girder 5% of Weld length with min. 300mm at each location - Except Crane Girder, for all other Fillet Welds	As per technical specifications and construction drawings		SR	√	
5.02	**Butt Welds**										
5.02.01		Visual	As required/ agreed	B	Visual	Random in each shift	As per technical specifications and construction drawings		SR		
5.02.02		Dye Penetration Test	As required/ agreed	B	Physical	100% DPT after back gouging on all butt welds except for coal bunker bins 10% DPT after back gouging-For coal bunker bins	As per technical specifications and construction drawings		SR		All butt welds to be back gouged before DPT
5.02.03		Mechanical testing on production test coupons	As required/ agreed	A	Physical	Min. one joint per built up beams, coloums and crane girder.	As per technical specifications and construction drawings		SR	√	Test on production test coupons
5.02.04		Radiography Test (RT)	As required/ agreed	A	Physical	100% RT on butt welds of tension flange (bottom flange) of crane girders 5% spot RT on butt welds / at inaccessible locations UT on butt welds- For coal bunker bins 10% RT weld length of each welder on butt welds, except for crane girders and coal bunk	As per technical specifications and construction drawings		SR	√	In case of failure of any welds in SPOT/RT or UT the % of retesting shall be doubled at that particular location. Acceptance criteria of NDT on welds shall be as per AWS D1.1. Wherever RT is not feasible UT to be carried out with the approval of the Engineer
5.03	**Full Penetration Welds (Other than butt welds)**										
5.03.01		Ultrasonic Testing (UT)	As required/ agreed	A	Physical	100% UT on the web to flange joint of crane girder 10% UT on other full penetration joints	As per technical specifications and construction drawings		IR	√	In case of failure of any welds in SPOT/RT or UT the % of retesting shall be doubled at that particular loaction. Acceptance criteria of NDT on welds shall be as per AWS D1.1.

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		ITEM : STRUCTURAL STEEL WORK		QP NO. :		2	PROJECT:	FLUE GAS DESULPHURISATION SYSTEM PACKAGE			
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1	2	3		4	5	6	7	8	9	D*	10
5.04	NON DESTRUCTIVE AND DESTRUCTIVE TESTING FOR CHIMNEY STEEL LINER										
i		Visual examination	As required/ agreed	B	Visual	100%	As per technical specifications and construction drawings, IS 822, AWS D 1.1		SR	√	As per requirement of NTPC Engineer
ii		DPT	As required/ agreed	B	Physical	100%	As per technical specifications and construction drawings, IS 822, AWS D 1.1		IR	√	
iii		RT	As required/ agreed	A	Physical	10% FOR SHOP BUTT WELD AND 15% FOR SITE BUTT WELDS	As per technical specifications and construction drawings, IS 822, AWS D 1.1				
6.00	FOUNDATION CHECKS										
6.01		Dimensions and levels	As agreed / required	B	Physical/ Measurement	Each Foundation	Tech Specs and Const. Drawings		SR	√	Shape, lines (including diagonal checks)
6.02		Foundation Bolts and Embedments	As agreed / required	B	Physical/ Measurement	Each Foundation	Tech Specs and Const. Drawings		SR	√	Measurement of Verticality, Levels, pitch distance
7.00	PRE-ASSEMBLY CHECKS										
7.01		Punch Erection marks and match marks on members	As agreed / required	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings				Markings for - Assembly designation, Part number, Weight, Any other important identifications.
7.02		Pre-assembly as per match mark	As agreed / required	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings				
7.03		Camber, sweep and total length after trial assembly of structure.	As agreed / required	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings		SR	√	
7.04		Control assembly check at shop	As agreed / required	B	Visual/ Physical	Every first and tenth set of identical structure	Tech Specs and Const. Drawings				
8.00	ERECTION CHECKS										
8.01		Alignment, slopes, level, tolerances of erected member	As agreed / required	B	Measurement	Each structural member	Tech Specs and Const. Drawings		SR	√	
8.02		Tightening of bolts including foundation bolts with lock nuts	As agreed / required	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings		SR	√	
8.03		Acceptance of erected structure	As agreed / required	B	Visual/ Physical	Each erected structure	Tech Specs and Const. Drawings, IS 7215 and IS 12843		SR	√	
9.00	INSTALLATION AND ALIGNMENT OF STEEL LINER										
i		Submission of Installation/ Erection Scheme/ methodology for all structures	-	B	Approval	Once prior to erection of each structure	Approved drawings and Technical Specifications		SR	√	
ii		Check for Erection Marks	-	B	Visual	100%	Approved drawings and Technical		SR		
iii		Check for Installation of Steel Liners	As required	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications		SR		
iv		Check for Site Joints	As required	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications		SR		
v		Check for Installation of Inlet Transition Ducts	As required	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications		SR		

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1	2	3		4	5	6	7	8	9	D*	10
vi		Check for Installation of Insulations and Expansion Compensators	As required	B	Visual, Physical, Acceptance	100%	Approved drawings and Technical Specifications		SR		Each layer of expansion Compensator tobe checked at shop for thickness, unit weight, tensile strength & elongation along with temp. withstandability for composite joints
vii		Ensure the Erection of all steel structures along with permissible tolerances and their acceptance	As required	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications		SR		
viii		Check and approval for Dismantling, Modification and Re-erection, if required for any reason	As required	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications		SR		
10.00	**PAINTING SYSTEM**										
10.01		Paining Materials and accessories	As agreed / required	A	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings		SR/MTC	√	Mfr.'s T.C. shall be correlated with the consignment received.
10.02		Surface prepration	As agreed / required	B	Physical /visual	Random in each shift	Tech Specs and Const. Drawings, Relevant code/ standards		SR	√	
10.03		DFT of paint - Over steel surface	As agreed / required	B	Physical	Each surface at random	Tech Specs and Const. Drawings		SR	√	
10.04		Acceptance of painted surfaces	As agreed / required	B	Physical	Each surface at random	Tech Specs and Const. Drawings		SR		
11.00	**PERMANENT BOLTS AND NUTS AND WASHERS**										
11.01		Material	As agreed / required	A	Physical and MTC Review	Once for each lot of delivery	Tech Specs and Const. Drawings		SR/MTC	√	Permanent mild steel Bolts, mild steel Nuts, Mild steel Washers, High strength structural Bolts, Washers-Dimensions, properties, storage along with MTC
11.02		Contact surfaces before bolting	As agreed / required	B	Physical	Random before asembly for bolting	Tech Specs and Const. Drawings, IS 4000		SR		
11.03		Inspection of the assembled bolts	As agreed / required	B	Physical	Randomly in each shift for assembeled bolts	Tech Specs and Const. Drawings, IS 4000		SR		
11.04		Tensioning	As agreed / required	B	Physical	Randomly during snug tight test and after full tensinoning	Tech Specs and Const. Drawings, IS 4000		SR	√	
11.05		Acceptance of installed bolts	As agreed / required	B	Physical	Each bolt	Tech Specs and Const. Drawings		SR		
12.00	**STAINLESS STEEL HAND RAILS**										
12.01		Material	As agreed / required	A	Physical/MTC Review(In case procured by contractor)	Once for each lot of delivery	Tech Specs and Const. Drawings		SR/MTC	√	Also check grade of steel
12.02		DPT for welding	As agreed / required	A	Physical	Random for each fabrication	AWS D1.1 / 'Tech Specs and Const. Drawings		SR/LB	√	WPS shall be submited for Owner approval , electrodes used shall be as specified in WPS

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1	2	3		4	5	6	7	8	9	D*	10
12.03		Acceptance of stainless steel hand rails	As agreed / required	B	Physical	Each installation	Tech Specs and Const. Drawings		SR		
13.00	**PTFE SLIDING BEARINGS AND ELASTOMERIC BEARINGS**										
13.01		Material from approved source	As agreed / required	A	Physical and MTC Review	Once for each lot of delivery	Tech Specs and Const. Drawings		SR/MTC	√	
13.02		Acceptance of installation of bearings	As agreed / required	B	Physical	Each installation	Tech Specs and Const. Drawings		SR		
		LEGEND: D * Records, indentified with "Tick" (√) shall be essentially included by supplier in QA					For Owner USE	**DOC. NO.:**	**REV:** 0		
		Legend to be used: Class # : A = Critical, B=Major, C=Minor; SR, TR, MTC, LB									
Manufacturer/ Sub-supplier	**Main-supplier**	**Categorization Witnessing & Accepting (As per Owner QA&I System)** **Category 'A' FQA Engineer in association with Executing Engineer, Category 'B' Executing Engineer, Category 'C' Executing Engineer ;SR = Site Register , TR= Test Report,MfrTC = Manufacturer's Test Certificate**									
Signature		This document shall be read in conjunction with Owner Tech. Specifications, BOQ, Drawings						**REVIEWED BY**	**APPROVED BY**		**APPROVAL SEAL**

CUSTOMER SPECIFICATION: PAINTING SPECIFICATION

Ramagundam STPS Stage – I & II (3x200 MW + 3x500 MW) FGD PACKAGE

PAINTING SCHEME for FGD SYSTEM, BOOSTER FANS, GATES & DAMPERS

Prepared By	Reviewed & Approved By
21/05/20	21/05/2020
K.S. Gopakumar, Dy Engineer / QA	Venkanna Rupani, Dy Manager / QA

Record of Revision

Rev No	Date	Details Of Revision
00	21/05/2020	First Submission

1. FANS

1	Axial Fan tool & fixtures **(Clause 20.03.00 of Part- C Section VI)**	55 000	Power Tool Cleaning to st3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	40	100
2	Booster Fan foundation material	55 081	Temporary rust preventive fluid application as per PRQA 523 DFT- 20µ; All Threaded and other surfaces of foundation bolt and its materials shall be coated with temporary rust preventive fluid. During execution of civil works the dried film of coating will be removed using Organic Solvents.					
3	Booster Fan Handrails & Insert **(Clause 31.06.00 of Sec.VI, Part-B, Subsection- IV-D)**	55 082	Blast cleaning to Sa 2½/ Acid pickling	Hand rails, Gratings- Hot dip galvanizing to 610gms/sq.m (minimum) and to a coating thickness of 87µm (min).				
4	Booster Fan Handrails & Insert- Structural items other than the above **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	55 082	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	**Primer:** One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ **Intermediate:** One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	**Finish:** Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat **Shade:** Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240

5	Axial booster cooling/ seal fan **(Clause 1.04.00 of Part- A Section VI)**	55 084	Blast cleaning to Sa 2½	**Primer:** Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat **Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	**Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ **Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300
6	Booster fan canopy for motor **(Clause 1.04.00 of Part- A Section VI)**	55 089	Blast cleaning to Sa 2½	**Primer:** Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat **Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	**Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ **Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300
7	Axial booster fan rotor **(Clause 20.03.00 of Part- C Section VI)**	55 287	Power Tool Cleaning to St3 (SSPC-SP3)	Two coats of Epoxy based Zinc phosphate primer (Two pack system) to IS 13238; DFT- 30µ/coat	60	NIL	--	60
8	Axial booster fan stator **(Clause 20.03.00 of Part- C Section VI)**	55 587	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	40	100

9	Axial booster fan coupling **(Clause 1.04.00 of Part- A Section VI)**	55 880	Blast cleaning to Sa 2½	**Primer:** Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat **Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	**Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ **Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ **Shade:** Grey White, RAL9002	75 25	300
10	Booster fan LOS with lubricant **(Clause 1.04.00 of Part- A Section VI)**	55 980	Blast cleaning to Sa 2½	**Primer:** Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat **Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	**Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ **Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ **Shade:** Grey White, RAL9002	75 25	300
11	Booster fan actuator **(Clause 1.04.00 of Part- A Section VI)**	55 983	Blast cleaning to Sa 2½	**Primer:** Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat **Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	**Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ **Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ **Shade:** Grey White, RAL9002	75 25	300

2. FGD SYSTEM

1	Slurry recirculation pump System **(Referred from cl. 7.05.00 of Section-VI, Part-B, Sub section-I-M5)**	FW 212	Power Tool Cleaning to St3 (SSPC-SP3)	**Primer:** Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) **Intermediate:** One coat of Synthetic Enamel intermediate coat to IS 2932; DFT- 50µ	60 50	Two coats of Synthetic Enamel to IS 2932, DFT- 50µ/ coat Shade: Light blue RAL 5012	100	210
2	Absorber System Internals – Structural items **(Clause 1.04.00 of Part- A Section VI)**	FW 213	Blast cleaning to Sa 2½	**Primer:** Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat **Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2, DFT- 100µ	100 100	**Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ **Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213, DFT-25µ **Shade:** Grey White, RAL9002	75 25	300
3	Mist eliminator and accessories, Absorber baffle grating support, Mist eliminator support& Absorber Spray pipe support - Structural items **(Clause 1.04.00 of Part- A Section VI)**	FW 215 FW 216 FW 217 FW 218	Blast cleaning to Sa 2½	**Primer:** Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat **Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	**Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ **Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300

4	Absorber System- Base **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 219	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	**Primer:** One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ **Intermediate:** One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	**Finish:** Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
5	Absorber system structures, Absorber shear plate, Duct supports, Structures for RC pump house& Hook up duct structure **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 220 FW 231 FW 232 FW 233 FW 234 FW 236 FW 238	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	**Primer:** One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ; **Intermediate:** One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	**Finish:** Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat **Shade:** Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240

6	Absorber system casing bottom- Outside surfaces **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)** Inside surfaces are of C276 cladded sheets, hence no paint is envisaged.	FW 221	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	**Primer:** One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ **Intermediate:** One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	**Finish:** Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat **Shade:** Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
7	Absorber system casing top- Outside surfaces **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)** Inside surfaces are of C276 cladded sheets, hence no paint is envisaged.	FW 222	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	**Primer:** One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ **Intermediate:** One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	**Finish:** Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat **Shade:** Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240

8	Absorber system accessories **(Clause 20.03.00 of Part- C Section VI)**	FW 223	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	40	100
9	Emergency Quench water tank- Outside surfaces **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 226	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	**Primer:** One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ **Intermediate:** One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	**Finish:** Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat **Shade:** Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
10	Emergency Quench water tank- Inside surfaces	FW 226	Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50µm	**Primer:** Two coats of Red Oxide Zinc phosphate primer, DFT-30µ/coat; Total-60µ (Primer is only envisaged as lining is given in inside surfaces of the tank)				
11	Emergency quench system, Handling Equipment RC pump **(Clause 20.03.00 of Part- C Section VI)**	FW 227 FW 249	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	60	120
12	Air oxidation system, Viewing ports (Without glass)	FW 230 FW 239	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	40	100

	(Clause 20.03.00 of Part- C Section VI)								
13	Absorber W/D interface, W/D wash system, Slurry distribution system, Oxidation Air distribution system **(Clause 1.04.00 of Part- A Section VI)**		FW 228 FW 229 FW 243 FW 244	Blast cleaning to Sa 2½	**Primer:** Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat **Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	**Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ **Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300
14	Expansion joint between bypass **(Clause 20.03.00 of Part- C Section VI)**	Flue gas swept surface	FW 251	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (two coats)	60	--	--	60
		Insulated surfaces		Power Tool Cleaning to St3 (SSPC-SP3)	HR Aluminium paint to IS 13183 Gr.II (upto 400 deg C)	40	NIL	--	40
15	Expansion joint **(Clause 20.03.00 of Part- C Section VI)**	Flue gas swept surface	FW 252	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	NIL	--	60
		Insulated surfaces		Power Tool Cleaning to St3 (SSPC-SP3)	HR Aluminium paint to IS 13183 Gr.II (upto 400 deg C)	40	NIL	--	40
16	Ducts between bypass duct inlet& booster fan	Flue gas swept surface	FW 255	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	NIL	--	60

	(Clause 20.03.00 of Part- C Section VI)	Insulated surfaces		Power Tool Cleaning to St3 (SSPC-SP3)	HR Aluminium paint to IS 13183 Gr.II (upto 400 deg C)	40	NIL	--	40
17	Ducts between Booster fan& Absorber **(Clause 20.03.00 of Part- C Section VI)**	Flue gas swept surface	FW 256	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	NIL	--	60
		Insulated surfaces		Power Tool Cleaning to St3 (SSPC-SP3)	HR Aluminium paint to IS 13183 Gr.II (upto 400 deg C)	40	NIL	--	40
18	Ducts between Absorber& Stack **(Clause 20.03.00 of Part- C Section VI)**	Flue gas swept surface	FW 257	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	NIL	--	60
		Insulated surfaces		Power Tool Cleaning to St3 (SSPC-SP3)	HR Aluminium paint to IS 13183 Gr.II (upto 400 deg C)	40	NIL	--	40
19	Duct structure between bypass duct& Booster fan **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**		FW 260	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	**Primer:** One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ	70	**Finish:** Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat **Shade:** Grey white, RAL 9002	70	240

				Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	100	With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)		
20	Duct structure between Booster fan& Absorber **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 261	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	**Primer:** One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ; **Intermediate:** One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	**Finish:** Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat **Shade:** Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
21	Duct structure between Absorber & Stack **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 262	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	**Primer:** One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ	70	**Finish:** Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat **Shade:** Grey white, RAL 9002	70	240

				Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	100	With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)		
22	Foundation material for duct structures, Absorber, Elevator, RC pump shed, tanks, Silo Structure, pipe racks	FW 280 FW 281 FW 282 FW 283 FW 740 FW 760 FW 762 FW 763	Temporary rust preventive fluid application as per PRQA 523 DFT- 20µ All Threaded and other surfaces of foundation bolt and its materials shall be coated with temporary rust preventive fluid. During execution of civil works the dried film of coating will be removed using Organic Solvents.					
23	Structures for Emergency Quench water tank Structures for Elevator **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 285 FW 292	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	**Primer:** One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ; **Intermediate:** One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2); DFT- 100µ	70 100	**Finish:** Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat **Shade:** Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240

24	Elevator and accessories **(Clause 20.03.00 of Part- C Section VI)**	FW 293 FW 716	Power Tool Cleaning to st3 (SSPC-SP3	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 **Shade:** Grey white RAL 9002 (Two coats)	60	120
25	Structures for booster fan handling **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 310	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	**Primer:** One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ **Intermediate:** One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	**Finish:** Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat **Shade:** Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
26	Galleries and railings for Stairs, ~~Absorber, Dampers, Ducts~~, Tanks **(Clause 31.06.00 of Sec.VI, Part-B, Subsection- IV-D)** Staircase - Treads and Platforms	FW 214 FW 237 FW 250 FW 610 FW 612 FW 613 FW 712 FW 722	Blast cleaning to Sa 2½/ Acid pickling	Hand rails, Gratings- Hot dip galvanizing to 610gms/sq.m (minimum) and to a coating thickness of 87µm (minimum)				

27	Galleries and railings for Stairs, Absorber, Dampers, Ducts, Tanks – Structures other than the above **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 237 FW 610 FW 612 FW 613 FW 722	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	**Primer:** One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ **Intermediate:** One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	**Finish:** Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat **Shade:** Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
28	Slurry pumps & accessories, Water pumps **(Referred from cl. 7.05.00 of Section-VI, Part-B, Sub section-I-M5)**	FW 701 FW 702	Power Tool Cleaning to St3 (SSPC-SP3)	**Primer:** Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) DFT- 30µ; **Intermediate:** One coat of Synthetic Enamel intermediate coat to IS 2932; DFT- 50µ	60 50	Two coats of Synthetic Enamel to IS 2932, DFT- 50µ/ coat **Shade:** Light blue RAL 5012	100	210
29	Monorail for hoist & cranes **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 710	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	**Primer:** One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ	70	**Finish:** Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat **Shade:** Grey white, RAL 9002	70	240

				Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	100	With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)		
30	Handling Equipment- Hoists& Man hole door **(Clause 20.03.00 of Part- C Section VI)**	FW 713 FW 714 FW 717	Power Tool Cleaning to st3 (SSPC-SP3	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) Idler roller shall be applied with two coats of 70 microns at shop	70	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	60	130
31	Agitator support **Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 721	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	**Primer:** One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ **Intermediate:** One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	**Finish:** Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat **Shade:** Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
32	Limestone silo structures **Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 730	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm	**Primer:** One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust	70	**Finish:** Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2)	70	240

			conforming to ISO 8501-1	composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ **Intermediate:** One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	100	DFT- 35µ/ coat **Shade:** Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)		
33	Limestone Silo- Outside surfaces **Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 731	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	**Primer:** One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ **Intermediate:** One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	**Finish:** Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat **Shade:** Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
34	Lime stone Silo- Inside surfaces (Conical portion)	FW 731	Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50µm conforming to ISO 8501-1	**Primer:** Two coats of Red Oxide Zinc phosphate primer to IS: 12744 (SS lining is inside the Limestone silo conical portion, hence primer is only envisaged; SS lining will be done at shops itself)	60	NIL	--	60

35	Lime stone Silo- Inside surfaces (Cylindrical portion)	FW 731	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	**Primer Coat:** One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 70 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00	70	--	--	70
36	Air cannon silo, Bag filter & Fan assy, Nozzles& Flanges **(Clause 20.03.00 of Part- C Section VI)**	FW 723 FW 724 FW 725	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	40	100
37	Limestone silo approach platform, Platform for Pipe racks& Sub pipe racks **(Clause 31.06.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 733 FW 766 FW 767	Blast cleaning to Sa 2½/ Acid pickling	Hand rails, Ladders, Gratings- Hot dip galvanizing to 610gms/sq. m (minimum) and to a coating thickness of 87µm (minimum)				
38	Limestone silo approach platform, Pipe racks, Sub pipe racks platform- Structures other than the above **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 733 FW 766 FW 767	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	**Primer:** One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ **Intermediate:** One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2)	70 100	**Finish:** Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat **Shade:** Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than	70	240

				DFT- 100µ		30 and colour change less than 2.0Δ E)		
39	Limestone Mill – Outside surfaces **(Clause 1.04.00 of Part- A Section VI)**	FW 735	Blast cleaning to Sa 2½	**Primer:** Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat **Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	**Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ **Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300
40	Lime stone mill- Inside surfaces	FW 735	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	**Primer Coat:** One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 70 µm per coat (min.) Zinc dust composition shall be Type II as per ASTM D520-00	70	**--**	--	70
41	Gypsum belt filter and accessories Structural items **(Clause 1.04.00 of Part- A Section VI)**	FW 738	Blast cleaning to Sa 2½	**Primer:** Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat **Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	**Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ **Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300

42	Lime stone slurry storage tank, Auxiliary absorber tank, Filtrate tank, Wastage water tank, Hydro cyclone waste water tank, Neutralization tank, Process Water tank, Belt filter washing tank, Primary hydro cyclone feed tank, Clarified water tank Outside surfaces **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 742 FW 743 FW 744 FW 745 FW 747 FW 748 FW 785 FW 786 FW 800 FW 802	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	**Primer:** One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ **Intermediate:** One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	**Finish:** Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat **Shade:** Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
43	Lime stone slurry storage tank, Auxiliary absorber tank, Filtrate tank, Wastage water tank, Hydrocyclone waste water tank, Neutralization tank, Process Water tank, Belt filter washing tank, Primary Hydrocyclone feed tank, Clarified water tank, Tank internal structure Inside surfaces	FW 742 FW 743 FW 744 FW 745 FW 747 FW 748 FW 749 FW 800 FW 802	Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50µm	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) (Liner is inside the tank, hence primer is only envisaged; Protection till erection only)	60	For interior surface of process water tanks, belt filter wash tanks and Cake wash(clarified water) tanks, painting(DFT-150) will be applicable. Refer specification under Annexure-8, section-III.	--	60
43A	Under side of bottom plate(in contact with soil) of tank - 2 Coats of High Build Coal Tar Epoxy suitably Pigmented, DFT:80-100 microns each Coat.							

44	Process water pipe accessories, Cooling pipe accessories **(Referred from cl. 7.05.00 of Section-VI, Part-B, Sub section-I-M5)**	FW 751 FW 752	Power Tool Cleaning to St3 (SSPC-SP3)	**Primer:** Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) **Intermediate:** One coat of Synthetic Enamel intermediate coat to IS 2932; DFT- 50µ	60 50	**Finish:** Two coats of Synthetic Enamel to IS 2932, DFT- 50µ/ coat **Shade:** Grey white RAL 9002 Identification Tag: Sea Green Shade no: 217 as per IS 5	100	210
45	Slurry pipe accessories **(Referred from cl. 7.05.00 of Section-VI, Part-B, Sub section-I-M5)**	FW 753	Power Tool Cleaning to St3 (SSPC-SP3)	**Primer:** Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) **Intermediate:** One coat of Synthetic Enamel intermediate coat to IS 2932; DFT- 50µ	60 50	**Finish:** Two coats of Synthetic Enamel to IS 2932, DFT- 50µ/ coat **Shade:** Grey white RAL 9002 Identification Tag: Sea Green Shade no: 217 as per IS 5	100	210
46	Service Air pipe accessories **(Referred from cl. 10.00 .00 of Section-VI, Part-B, Sub section-I-M3)**	FW 754	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coat)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- 30µ/ coat Identification Tag: Sky Blue **Shade no:** 101 as per IS 5	60	120
47	Instrument air pipe accessories **(Referred from cl. 10.00 .00 of Section-VI, Part-B, Sub section-I-M3)**	FW 755	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coat)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- 30µ/ coat Identification Tag: Sky Blue **Shade no:** 101 as per IS 5	60	120

48	All valves (Temp <95 deg C) **(Clause 20.03.00 of Part- C Section VI)**	FW 815 to FW 851	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- 30µ/ coat	60	120
49	Structure for Pipe racks, Sub pipe racks Trestle for pipe racks, Structures inside Gypsum dewatering building & Ball mill building **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 761 FW 765 FW 768 FW 769 FW 787	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	**Primer:** One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ **Intermediate:** One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	**Finish:** Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat **Shade:** Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
50	Supports for cable trays, Air receivers, commissioning& Mandatory spares, Tools & tackles **(Clause 20.03.00 of Part- C Section VI)**	FW 779 FW 798 FW 988 FW 996	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	40	100

3. GATES & DAMPERS

01	**Gates & Dampers** > 95^0 C Insulated Surfaces& Uninsulated surfaces	57 540 57 550 57 583	Power Tool Cleaning to St3 (SSPC-SP3)	HR Aluminium paint to IS 13183 Gr.II (upto 400 deg C)	40	--	--	40
02	Seal air piping	57 141	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coat)	60	Synthetic Enamel to IS 2932 **Shade:** Grey white RAL 9002 (Two coats)-30µ/ coat Identification Tag: Sky Blue Shade no: 101 as per IS 5	60	120
03	Blower with Motor Knife Gate valve Mounting bracket Mandatory spares	57 491 57 497 57 209	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 **Shade:** Grey white RAL 9002 (Two coats)	40	100
04	Ladder, Cage for Ladder Toe Guard Plate Floor Grill, Hand Rails, Hand Rail Post **Clause 31.06.00 of Sec.VI, Part-B, Subsection- IV-D**	57 466 57 566	Blast cleaning to Sa 2½/ Acid Pickling	Hot Dip Galvanizing to 610 gm per sq. Meter (minimum) and to a coating thickness of 87 µm (minimum)				
05	Other Structural Items-Other than sl.no. 3 of above	57 466 57 566	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-	**Primer:** One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum	70	**Finish:** Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2)	70	240

	(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)		60µm conforming to ISO 8501-1	60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ **Intermediate:** One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	100	DFT- 35µ/ coat **Shade:** Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)		

4. PAINTING OF DAMAGED AREAS

For areas where paint has deteriorated badly by erosion and areas where the paint film has lost its adhesion property and where the steel has got rusted appreciably: These areas are to be repainted as per the following procedure:

SL NO	SURFACE LOCATION	SURFACE PREPARATION	PRIMER, INTERMEDIATE & FINISH
1	Paint damaged Components falling under Sl.no. 04,05,06,09,10,11 of Fans, Sl no.02,03,04, 05,06,07, 09, 13,19,20,21,23,25,27, 29, 31,32 33,38,39,41,42, 49 of FGD and Sl no. 5 of GAD.	Hand/ Power Tool cleaning to Bare metal to minimum 6 inches peripheral area adjoining to damaged area	Primer: Epoxy Zinc rich primer to IS 14589, DFT-70µ (If Metal surface exposed) followed by intermediate & finish coat as per respective schemes. If primer is intact- Intermediate & finish as per respective schemes.
2	Paint damaged components failing under other Sl Nos of Fans, FGD& GAD	Power Tool Cleaning to Bare metal	Primer and Finish: As given in respective scheme

GENERAL NOTES

1. No painting is required for Galvanized, non-ferrous & stainless steel items, except as indicated above.
2. Machined items are to be applied with coat of temporary rust preventive oil
3. PGMAs covered in sub-supplier (ie., Purchased) items viz., Agitator / slide bearing and other sub-delivery components etc., are not indicated in the above list. However, the Painting Schedule for all items supplied by all sub-suppliers and BOI under the scope of BHEL shall be same as for main equipment covered in this document.
4. In sub-assy, wherever plates / sheets of thickness less than or equal to 5mm and rods are used, very minor items like clamps, small items etc.- Power Tool or Hand Tool Cleaning to SSPC - SP 3 / SP 2 shall be followed and painting under Sl no:01 of Fans shall be followed.
5. Ground shade/colour of finish paints and identification tag/band for equipment, fans, piping, pipe services, supporting structures and other components is followed as per NTPC doc no: QS-01-DIV-W-4 at site.
6. All components covered under different PGMAs are to be painted. In case any component is left out, the same shall deemed to be included under the relevant section.
7. All threaded and other surfaces of foundation bolts and its materials, insulation pins, Anchor channels, Sleeves 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.
8. Painting requirement for all electrical equipment shall be as per the details identified in specification for the respective equipment.
9. 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.
10. Finish coat to be applied after an interval of min 10 hrs and within 6 months (after completion of intermediate coat).
11. Primer coat on steel shall be applied in shop immediately after blast cleaning by airless spray technique.
12. 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 DFT.

PAINTING SCHEME- DETAILS OF PROCUREMENT & APPLICATION PROCESSES

SL NO	TYPE OF PAINT	SPECIFICATION OF PAINT	NO OF PACK	VOLUME OF SOLIDS (% Min)	MODE OF APPLICATION	MIN. OVER COATING INTERVAL (hours)	SHADE
01	Epoxy Zinc phosphate primer	IS 13238	2	40	Spray	24	Grey
02	Zinc Ethyl silicate primer (% Zn on dry film= 80 (min))	IS 14946	2	60	Airless Spray only At Shop	24	Grey
03	Epoxy High solid-Polyamide cured Epoxy based MIO pigmented intermediate coat	--	2	80	Airless Spray only At Shop	16	Brown
04	Aliphatic isocyanate acrylic polyurethane paint	IS 13213	2	55	Spray At Shop	16	Corresponding shade no
05	Heat resistant aluminum paint	IS 13183 Grade II	1	--	Brush/ Spray	24	--
06	Long oil alkyd Synthetic enamel finish paint	IS 2932	1	35	Brush/ Spray	12	Corresponding shade no
07	Synthetic Enamel Intermediate coat	IS 2932	1	40	Brush/ Spray	12	--
08	Red oxide Zinc phosphate primer	IS 12744	1	--	Brush/ spray	12	--

PGMA Description & Product Details

Sl No	PGMA	PGMA Description	Product /Items Details
01	FW 212	Slurry recirculation pump system	RC Pumps incl Shaft seal, Common Base Plate, Coupling and Guard, Gear Box, Expansion Bellow, Anchor Bolts & Fasteners, Special Tools
02	FW 219	Absorber system base	Absorber tank bottom plate
03	FW 220	Absorber system structures	Absorber tank structure, Absorber tower structure, Spray headers structure
04	FW 221	Absorber system casing bottom	Absorber tank wall casing- bottom
05	FW 222	Absorber system casing top	Absorber Tank wall casing –Top, Mist Eliminator supports, Spray pipe supports, Internal Beam, Shim plates in Absorber area, Internal Struts
06	FW 223	Absorber system accessories	Nozzles and flanges, Inspection doors & Man holes, Viewing ports, Antifoam dosing equipment, Suction strainers- FRP
07	FW 226	Emergency Quench water tank	Base Plate & its supports, Roof, Shell
08	FW 227	Emergency Quench System	Emergency Quenching Spray Pipe, Nozzle for Emergency Pipe, Fasteners, Gaskets
09	FW 230	Air oxidation System	Oxidation Blowers, Common Base Plate, Coupling and Guard, Anchor Bolts & Fasteners, Expansion Bellow, Special Tools, Suction & Discharge Silencers, Acoustic Enclosure, Water Injection cooling system, Pipe, Valves & Instruments
10	FW 244	Oxidation air distribution System	Pipe & Fittings, Flanges, Pipe Hanger, Bottom Elbow, Bottom sliding supports
11	FW 251	Expansion joint between bypass	Expansion joints, Seal Plates & Fasteners
12	FW 252	Expansion joint between scrubbers	Fabric & its fixing fasteners, Sleeves & Flanges, Gaskets
13	FW 255	Ducts between bypass duct inlet & booster fan	Plates & Stiffeners, Guide Vanes
14	FW 256	Ducts between Booster fan & Absorber	Plates & Stiffeners, Guide Vanes
15	FW 257	Ducts between Absorber & stack	Plates & Stiffeners, Guide Vanes
16	FW 260	Duct structure between bypass duct& Booster fan	Duct Supports, Gusset Plate, Divider plate, Internal Struts, Support bearings
17	FW 261 FW 262	Duct structure between booster fan& absorber & Absorber and Stack	Duct Supports, Gusset Plate, Divider plate, Internal Struts, Support bearings
18	FW 292	Structures for Elevator	Columns, Seal Plate, Bracings, Enclosure (Purlin& sheeting)

Sl No	PGMA	PGMA Description	Product /Items Details
19	FW 293	Elevator and accessories	Base Frame, Buffer Spring, Mast Section, Cage, Control Panel & AC, Mandatory Spares
20	FW 310	Structures for booster fan handling	Columns, Beams, Bracings, Seal plate
21	FW 610 FW 722	Galleries & railings for Scrubbers, Tank	Stairs, Handrail, Step treads, Floor grills, Ladders, Foundation bolts, Fasteners
22	FW 701	Slurry pumps & accessories	Slurry Pumps incl Shaft seal, Common Base Plate, Coupling and Guard, Belt & Pulley, Expansion Bellow, Anchor Bolts & Fasteners, Motor & accessories, Sump Pumps incl Shaft seal, Common Base Plate, Coupling and Guard, Belt & Pulley, Anchor Bolts & Fasteners, Motor & accessories
23	FW 710	Monorail for hoist& cranes	Insert Plate, Stiffener plate, Monorail beam
24	FW 721	Agitator support	Channels & Beams
25	FW 730	Limestone silo structures	Columns, Beams, Bracings, Seal plate, Angles, channels
26	FW 731	Limestone silo	Base plate & its supports, Shell, Roof
27	FW 723 FW 724 FW 725	Air cannon Bag filter Nozzles & flanges	Bag filter, Air cannon bin activator, Nozzles & Flanges
28	FW 733	Limestone silo approach platforms	Stairs, Handrail, Step treads, Floor grills, Ladders, Foundation bolts, Fasteners
29	FW 734	Limestone mill	Wet ball mill, Hydro cyclone- Mill area, Mill circuit pump, Mill separator tank with Agitator
30	FW 742	Lime stone slurry storage tank	Base plate & its supports, Shell, Roof
31	FW 743	Auxiliary Absorber tank	Base plate & its supports, Shell, Roof
32	FW 744	Filtrate tank	Base plate & its supports, Shell, Roof
33	FW 745	Wastage water tank	Base plate & its supports, Shell, Roof
34	FW 747	Hydro cyclone waste water tank	Base plate & its supports, Shell, Roof
35	FW 748 FW 785 FW 786	Process Water tank Belt filter washing tank Primary Hydro cyclone feed tank	Base plate & its supports, Shell, Roof
36	FW 751 FW 752	Process water pipe accessories Cooling water pipe accessories	CS/FRP Pipes & Fittings, Sight Glass, R Orifice, Gaskets & Fasteners
37	FW 753	Slurry pipe accessories	CSRL/FRP Pipes & Fittings, Strainer (Cone), Expansion Joint-Rubber, R Orifice, Gaskets & Fasteners

Sl No	PGMA	PGMA Description	Product /Items Details
38	FW 754	Service air pipe accessories	GI Pipes & Fittings, Flexible Hose, Expansion Joint (Metallic), Hose connector, R Orifice, Gaskets & Fasteners
39	FW 755	Instrument air pipe accessories	SS Pipes & Fittings, Strainer(Y Type), Gaskets & Fasteners
40	FW 815 to FW 851	Valves and fittings	Globe valves, Ball Valves, Butterfly Valves, Diaphragm Valves, Gate Valves, Check Valves, Pinch Valves, Knife Gate Valves, Control Valves, Relief Valves
41	FW 761 FW 765	Structures for Pipe racks Structures for Sub pipe racks	Bracings Columns
42	FW 280 FW 281 FW 282 FW 283 FW 740 FW 760 FW 763	Foundation material for duct structure Foundation material for absorber Foundation material for Tanks Foundation material for Pipe racks Foundation material for Elevator Foundation material for RC pump shed	Foundation bolts Template
43	FW 766	Platforms for Pipe rack	Stairs, Handrail, Step treads, Floor grills, Ladders, Foundation bolts, Fasteners
44	FW 768 FW 769	Trestle for Main & sub Pipe racks	Truss, Beams, Supports for all Pipes
45	FW 779	Supports for cable tray	Double Sup Channel & Base plates, Single Sup Channel & Base plates Cantilever Arm, Fasteners & clamps, Brackets
46	FW 996	Tools	Erection , commissioning, special tools
47	FW 798	Air receivers	Instrument Air receivers, Any Instruments/Valves
48	FW 800	Clarified water tank	Base plate & its supports, Shell, Roof
49	FW 802	Neutralization tank & accessories	Base plate & its supports, Shell, Roof
50	FW 988 FW 997 FW 999	Commissioning spares & Mandatory spares	Startup & commissioning spares, Mandatory spares

SECTION-I

SUB-SECTION-D

ANNEXURE-I
LIST OF MAKES OF SUB-VENDOR ITEMS
MISCELLANEOUS TANKS

07/07/15

VIPIN NAUNI

PEM - NOIDA

SUB-VENDORS - MISCELLANEOUS TANKS

S.NO	ITEM	SUB-VENDORS	PLACE	TECHNICAL LIMIT
1	CS PIPES ERW	TISCO	JAMSHEDPUR	UP TO 350 NB
		SAIL	ROURKELA	
		SURYA ROSHNI	BAHADURGARH	UP TO 400 NB
		JINDAL	GHAZIABAD	UP TO 350 NB
		RATNAMANI	KUTCH	UP TO 400 NB
		MAHARASHTRA SEAMLESS	RAIGARH	UP TO 500 NB
		WELSPUN	ANJAR	UP TO 400 NB (IS 3589)
2	CS PIPES SEAMLESS	MAHARASHTRA SEAMLESS	RAIGARH	UP TO 350 NB
		ISMT	AHMEDNAGAR	UP TO 150 NB
		JINDAL SAW	NASHIK	
		REMI METAL GUJRAT LTD	BHARUCH	UP TO 150 NB HOT FINISH & UPTO 100NB COLD FINISH
		ISMT	BARAMATI	UP TO 200 NB
3	SS PIPES	REMI	TARAPUR	
		RATNAMANI	KUTCH	
		APEX TUBES	BEHROR (ALWAR)	
		PRAKASH STEELAGE LTD	MUMBAI	SS SEAMLESS PIPE UPTO 50MM
		SUMITAMO	JAPAN	
4	STRUCTURAL STEEL / MS PLATE	SAIL		
		ESSAR STEEL		
		TISCO		
		RINL		
		JINDAL		
		M/S UTTAM VALUE STEEL (LLOYDS)		
		ISPAT		
		JSW		
		INDIAN IRON & STEEL CO. LTD		
5	GATE, GLOBE AND CHECK (STAINLESS STEEL VALVES)	A.V. VALVES LTD	AGRA	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	
		M/S GM ENGINEERING	RAJKOT	
		INTERVALVE (INDIA) LTD.	PUNE	A) STEEL GATE VALVES: UPTO 50NB, #800 AND 65NB TO 150NB, #150 B) STEEL GLOBE VALVES: UPTO 50NB, #800 AND 65NB TO 100NB, #150 C)SUPPLIER NOT REGISTERED FOR NR VALVES
		LEADER VALVES LTD.	JALANDHAR	
		NITON VALVE INDUSTRIES PVT LTD	MUMBAI	
		NSSL LIMITED.	NAGPUR	
		STEEL STRONG VALVES (I) PVT.LTD.,	MUMBAI	LIMIT AS PER VD FILE AS ATTACHED IN SHEET 2
		VALTECH INDUSTRIES	MUMBAI	CAST CARBON & ALLOY STEEL - VALVE/RATING/SIZE- GV/150/900,GV/300/400, GV/600/300 , GV/GLV/NRV/900/250 , GLV/300/300,GLV/150/350/ , SCNRV/150/700, SCNRV/300/350, SCNRV/600/250.

		V.K. VALVES PVT. LTD.,	JALANDHAR	
		WEIR BDK VALVES	NEW DELHI	
		AUDCO		
		OSWAL INDUSTRIES		
6	**GATE, GLOBE AND CHECK (CS STEEL VALVES)**	A.V. VALVES LTD	AGRA	
		ATAM VALVES PVT. LTD.	JALANDHAR	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	
		M/S GM ENGINEERING	RAJKOT	
		INTERVALVE (INDIA) LTD.	PUNE	A) STEEL GATE VALVES: UPTO 50NB, #800 AND 65NB TO 150NB, #150 B) STEEL GLOBE VALVES: UPTO 50NB, #800 AND 65NB TO 100NB, #150 C)SUPPLIER NOT REGISTERED FOR NR VALVES
		LEADER VALVES LTD.	JALANDHAR	
		NITON VALVE INDUSTRIES PVT LTD	MUMBAI	
		NSSL LIMITED.	NAGPUR	
		STEEL STRONG VALVES (I) PVT.LTD.,	MUMBAI	LIMIT AS PER VD FILE AS ATTACHED IN SHEET 2
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	CC/CSS-GATE-BBT-UPTO600NB CL UPTO300,GATE-PSBT UPTO250NB CL 1500,GLV-BBT-UPTO300NB CL UPTO600,SCNRV-BBT-UPTO600NB CL UPTO150,SCNRV-BBT-UPTO300NB CL 300,SCNRV-PSBT-UPTO150NB CL UPTO900
		VALTECH INDUSTRIES	MUMBAI	CAST CARBON & ALLOY STEEL - VALVE/RATING/SIZE- GV/150/900,GV/300/400, GV/600/300 , GV/GLV/NRV/900/250 , GLV/300/300,GLV/150/350/ , SCNRV/150/700, SCNRV/300/350, SCNRV/600/250.
		V.K. VALVES PVT. LTD.,	JALANDHAR	
		WEIR BDK VALVES	NEW DELHI	
		AUDCO -L&T	CHENNAI / COIMBATORE	
		OSWAL INDUSTRIES		
		HITECH	AHMEDABAD	
		KSB WATER PUMPS / VALVES	COIMBATORE	
		KBL	KONDHAPURI	
		HAWA ENGINEERS	AHMEDABAD	
		BHEL	GOINDWAL	
		FOURESS ENGG	MUMBAI	UPTO 600 NB, CL-300 & 300NB CL-600
		FOURESS ENGG	AURANGABAD	
7	**LEVEL INDIATOR FLOAT AND BOARD TYPE**	FLOW STAR	FARIDABAD	
		SCIENTIFIC DEVICES	MUMBAI	
		GAUGES BOURDEN	PANVEL	
		PUNE TECHTROL	PUNE	
		SBEM	PUNE	
		LEVCON	KOLKATA	
		SIGMA	MUMBAI	

		CHEMTROL		
		DK INSTRUMENT	KOLKATA	
		V AUTOMAT	DELHI	
8	**PAINT**	ASIAN PAINT		
		BERGER		
		KANSAI NEROLAC		
		JOTUN		
		SHALIMAR		
		JENSON & NICHOLSON (I) LTD		
		CDC CARBOLINE (I) LTD.		
		ADDISON PAINTS LTD		
		GRAND POLYCOAT		
		BOMBAY PAINTS		
		HEMPLE PAINTS (SINGAPORE)		
		AKZONOBEL COATINGS		
9	**FITTINGS (MS/SS)**	PIPE FIT ENGINEERS	VADODARA	
		GUJRAT INFRA PIPES	VADODARA	
		MS FITTINGS	KOLKATA	
		TUBE PRODUCT	VADODARA	
		SIDDARTH & GAUTAM	FARIDABAD	
		EBY	MUMBAI	
		NL HAZRA	KOLKATA	
		EXCEL METAL		
		INTERTECH		
		FITTECH		
		METAL LLOYDS	MUMBAI	
		TRUE FORGE	FARIDABAD	
10	**SEAL POT / NAOH BREATHER**	SELF MANUFACTURED ITEM		
	INSPECTION CATEGORIZATION			
	1. CAT I :INSPECTION BY OWNER, BHEL/BHEL NOMINATED TPIA & VENDOR .MDCC WILL BE ISSUED BASED ON INSPECTION REPORT IN LINE ITH APPROVED QAP.			
	2. CAT II:INSPECTION BY BHEL/BHEL NOMINATED TPIA & VENDOR. MDCC WILL BE ISSUED BASED ON INSPECTION REPORT IN LINE ITH APPROVED QAP.			
	3. CAT III: MDCC WILL BE ISSUSED BASED COC & MTC ISSUSD BY VENDOR AND VERIFICATION BY BHEL/OWNER IN LINE WITH APPROVED QAP/CHECK LIST			

The make of Sub-vendor items shall be generally as indicated above which is subject to customer / BHEL approval during detail engineering.

Make of any unlisted items shall be subject to customer / BHEL approval during detail engineering. For such items, bidder to furnish list of sub-vendors during detail engineering stage for Customer / BHEL's review and approval. Bidder shall furnish following supporting documentation within 1 month of placement of LOI. Thereafter no request for additional sub-vendor shall be entertained.

a) Documentation to show that the equipment /system has been supplied for a plant of similar or higher capacity.

b) Documentation in the form of certificate that the equipment/system has been operating satisfactorily for two years as on the scheduled date of bid opening.

The successful bidder will get the makes of all items approved from Customer/ Consultant during detail engineering within two months of placement of LOI. The complete list will be necessarily be submitted within one month of placement of LOI to ensure timely placement of order for BOIs

Bidder to assess the capability of their proposed sub-vendors in terms of preparation of drawings, calculations, documents, quality assurance, supply of material etc. as per project schedule before placing the order on them.

Dealers are not acceptable for any item of the package. Bidder shall procure all items including plates, structural, flanges; counter flanges etc. from approved sub vendor only.

QUALIFYING REQUIREMENTS FOR RUBBER LINING FOR SLURRY TANKS

Rubber Lining for the Wet Limestone based Flue Gas Desulphurisation (FGD) System offered by the Bidder shall be only from such bidders(s) who has previously executed this lining application for coal based thermal power station for Wet Limestone based FGD application or similar corrosive environment of min 2500 Sq.m for atleast 1 project such that the lining should have been in successful operation for a period not less than two (2) year reckoned as on the date of bid opening. Proof of such experience (End user certificate/performance certificate) shall be submitted along with the offer.

ANNEXURE-II

QUALITY PLANS

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-XXX-167-A001	DATE: XX.XX.XX
		CUSTOMER :		QP NO.: PE-QAP-XXX-167-A001(PL)	DATE: 11.02.2020
		PROJECT:		PO NO.: LATER	DATE: XX.XX.XX
		ITEM: MS PLATES	SYSTEM: MISC.TANKS (SITE FABRICATED)	SECTION:	SHEET 1 OF 1

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/ N				D	M	C	N	
1.0 RAW MATERIAL														
1	STEEL PLATES	Chemical composition and Mechanical test	MA	Review of corelated MTC	one/heat		IS:2062	IS:2062	Mfgr. TC	√	P	V	V	Refer Note below
2		Visual and dimensional check	MA	Visual and measurement	100%		Mfg.TC	Mfg.TC IS1852	Mfgr. TC	√	P	** W	** W	
3		Identification/ marking	MA	Corelation establish	100%		As per manufacturing practice	As per manufacturing practice IS 2062	Mfgr. TC	√	P	V	** W	

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,

** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **C**: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **N**: CUSTOMER,

P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE

MA: MAJOR, **MI**: MINOR, **CR:** CRITICAL

NOTE: i) In case material is dispatched directly from Approved sub-vendor plant/stockyard or procured from dealer against co related TC's witnessing by BHEL is waived off and material will be accepted based on MTC of approved sub vendor.

ii) In case material is procured from dealer and co related TC's are not available, check on 100% quantity of plates will be performed on sample drawn from them at NABL certified/approved laboratory for chemical & physical properties, however dimensional check shall be witnessed by BHEL.

iii) BHEL reserves the right for conducting repeat test, if required.

iv) Photographs of packing of material before final dispatch is to submitted.

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:	11-2-2020	S. K. YADAV	Checked by:	11-2-2020	ASHISH PANIGRAHI			Reviewed by:			
Reviewed by:	11.02.2020	SAYAN ROY	Reviewed by:	11/2/2020	R K JAISWAL			Approved by:			

	MANUFACTURER/BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO : PE-TS-XXX-167-A001	DATE: XX.XX.XX
		CUSTOMER :		QP NO.: PE-QAP-XXX-167-A001(PI)	DATE: 11.02.2020
		PROJECT:		PO NO.: LATER	DATE: XX.XX.XX
		ITEM: PIPE FITTINGS ,FLANGES & ACCESSORIES	SYSTEM: MISC.TANKS (SITE FABRICATED)	SECTION:	SHEET 1 OF 1

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	**			
					M	C/ N			*D	M	C	N	
1	Pipes Fittings, Flanges & Accessories	Check for Type, Model No., Tag No.,	MI	Visual	100%		As per Approved Data Sheet/ Tech spec.	As per Approved Data Sheet/ Tech spec.	Inspection Report	P	V	V	
2		Dimensions	MI	Dimensional	100%		As per Approved Data Sheet/ Tech spec.	As per Approved Data Sheet/ Tech spec.	Inspection Report	P	V	V	
3		Physical and chemical Properties	MI	Review of TC	For Lot		As per Approved Data Sheet/ Tech spec.	As per Approved Data Sheet/ Tech spec.	Mfgr. TC	P	V	V	
4		Hydro test	MA	Hydro Test	100%		As per Approved Data Sheet/ Tech spec.	As per Approved Data Sheet/ Tech spec.	Inspection Report	P	V	V	

NOTES:

1. BHEL reserves the right for conducting repeat test, if required.
2. Photographs of packing of material before final dispatch is to submitted.

LEGENDS:
*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,
** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **C**: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **N**: CUSTOMER,
P: PERFORM, **W**: WITNESS, **V**: VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR, **CR**: CRITICAL

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	11.2.2020	S. K. YADAV	Checked by:	11.02.2020	ASHISH PANIGRAHI
Reviewed by:	11.02.2020	SAYAN ROY	Reviewed by:	11/2/2020	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

बी एच ई एल BHEL	CONTRACTOR'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN		PROJECT
		ITEM : RUBBER LINING OF PIPING CONFORMING TO Tech Spec.	Q.P.No:7374QPC01 REV-01	PACKAGE
		BHEL Customer No. : 7374,7391& 7392	Dt- 13.02.2019	CONTRACT No.: MAIN-SUPPLIER

S.No	COMPONENT & OPERATIONS	CHARACTRISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK M	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	D*	AGENCY M	AGENCY C	AGENCY N	REMARKS
1	2	3	4	5	6	7	8	9	10	** 11			12
1.0	**RAW MATERIAL**												
1.1	Rubber Mix	a. Tensile Strength b. % Elongation c. Specific Gravity d. Hardness e. Thickness of Sheet	Major	Verfication	1 sample/lot	As per Tech Spec./Relevant IS , Material Spec.		TC	√	P	V	-	TC - Test Certificate
		f. Resistance to Bleeding #	Major	Chemical	1 sample/lot	Immersion for 24 hours @40 deg C in 10% of H2SO4 and 10% of HNO3	No discoloration and Weight change -0% +4%	TC	√	P	V	-	# TC shall be from NABL approved lab.
2.0	**INPROCESS INSPECTION**												
2.1	Surface Preparation	Cleanliness & Uniformity	Major	Visual	100%	IS 4682 Part I , Sa 2.5 Grade Surface Finish		TC	-	P	V	-	
2.2	Continuity of Lining at Uncured stage	Spark test	Major	Visual	100%	IS 4682 Part I		TC	-	P	V	-	
2.3	Curing of Rubber Lining	Control of Pressure,Temperature & Time	Major	Visual	100%	IS 4682 Part I and Manufacturer's Procedure		Log Book	-	P	V	-	
3.0	**FINAL INSPECTION**												
3.1	Complete Lining	a. Surface Defects	Major	Visual	100%	IS 4682 Part I		IR	√	P	W	-	
		b. Shore Hardness	Major	Measurement	Random	IS 4682 Part I		IR	√	P	W	-	
		c. Spark Test	Critical	Visual	100%	IS 4682 Part I		IR	√	P	W	-	
		d. Rubber lining Thickness	Major	Measurement	Random	IS 4682 Part I		IR	√	P	W	-	
		e. Adhesion Test	Critical	Peel-Off test	One sample per Vulc. Lot	IS 4682 Part I		IR	√	P	W	-	
4.0	**Documentation**	Review of Reports	Major	Verification	100%	All reports required as per QP.				P	V	-	

LEGEND:

* RECORDS, INDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
** M:MANUFACTURER/SUB-SUPPLIER,C: BHEL/BHEL AUTHORISED AGENCY, N: NTPC, P: PERFORM W: WITNESS AND V: VERIFICATION
CHP: NTPC SHALL IDENTIFY IN COLOUM 'N' AS 'W'

PREPARED BY	APPROVED BY	FOR NTPC USE:	REVIEWED BY	APPROVED BY	APPROVAL SEAL
MAIN-SUPPLIER			DOC.NO. 6130-109-QVM-Q-012 Rev 01	CAT...	
SIGNATURE	PAGE 01 OF 02				

	CONTRACTOR'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN		PROJECT :
बी एच ई एल BHEL		ITEM : RUBBER LINING OF PIPING CONFORMING TO IS 4682 PART I. BHEL Customer No. : 7374,7391& 7392	Q.P.No:7374QPC01 REV-01 Dt- 13.02.2019	PACKAGE CONTRACT No.: MAIN-SUPPLIER

S.No	COMPONENT & OPERATIONS	CHARACTRISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	D*	AGENCY			REMARKS
					M					M	C	N	
1	2	3	4	5	6	7	8	9	10	** 11			12

NOTES:

1. **Rubber Lining Vendor's Name & Address

a. M/s Lebracs Rubber Linings Private Limited ; Works Address : No16, Sedrapet, Puducherry-605111

b. M/s Jasmino Polymertech Pvt Ltd ; Works Address : L-61, MIDC Industrial Area, Taloja, Dist-Raigad, Maharashtra -410208

2. NTPC Inspection Category : Cat III
3. Repair, if any, should be carried out by same as per original rubber.
4. Adhesion test coupon shall be as prepared as per governing code.
5. NTPC Surveillance check may be carried out, if required.

		LEGEND: * RECORDS, INDENTIFIED WITH "TICK" (∨) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: MANUFACTURER/SUB-SUPPLIER, C: BHEL / BHEL AUTHORISED AGENCY, N: NTPC, P: PERFORM W: WITNESS AND V: VERIFICATION		DOC.NO. 6130-109-RVM-R-012 REV01.		CAT...
PREPARED BY	APPROVED BY					
MAIN-SUPPLIER						
SIGNATURE	PAGE 02 OF 02		FOR NTPC USE:	REVIEWED BY	APPROVED BY	APPROVAL SEAL

एनटीपीसी NTPC	SYSTEM EQUIPMENT Misc. Tanks	STANDARD FIELD QUALITY PLAN CONFORMING TO CODE: IS:803-1976	QP NO.: 0000-999-QOM – I -001 Rev. No 0 Date 15-02-2005 Page 1 Of 1 VALID UPTO : 14-02-2008	REVIEWED BY: APPROVED BY अनुमोदित APPROVED अनिल गुप्ता ANIL GUPTA अपर महाप्रबंधक (गुणवत्ता आश्वासन) Addl. General Manager (QA) एन टी पी सी लि./NTPC LTD.

SL. NO	ACTIVITY AND OPERATION	CHARACTERISTICS / INSTRUMENTS	CLASS # OF CHECK	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D *	REMARKS
1.	2.	3.	4.	5.	6.	7.	8.	9.		10.
1	**RAW MATERIAL INSPECTION**									
1.1	MS Plates	Mechanical & Chemical	B	Mechanical & Chemical	1 sample per Heat	Appd Drg./ Data Sheet	Relevant Material Specs	TC		In absence of Correlated TCs, Check Testing shall be witnessed by NTPC.
		Surface Defects	B	Visual	100%	No Pitting/ Corrosion	Damaged Plates not to be used	IR		
		Thickness	B	Measure	100%	Appd Drg.	Appd Drg.	IR		
2	**IN PROCESS INSPECTION**									
2.1	Welding	WPS/PQR/WQR	A	Qualification / Verification	100%	ASME Sec-IX	ASME Sec-IX	WPS/ PQR		See Note # 1.
		Marking, Cutting, Rolling, Joint Set-up	C	Visual & Measure	100%	Appd Drg.	Appd Drg.	IR		
		NDT on Back Gauging	B	DPT	100%	ASTM E-165	No Indications	IR		Except for Bottom Plates.
		NDT on Root Run	B	DPT	100%	ASTM E-165	No Indications	IR		For Bottom Plates only.
		NDT on Finished Welds	A	Vacuum Testing	100%	IS:803	No Leakage	IR		For Bottom Plates only.
3	**FINAL INSPECTION**									
3.1	Finished Tank	Finish, Orientation	B	Visual	100%	IS:803 & Appd. Drg.	IS:803 & Appd. Drg.	IR		
		Dimensions including Verticality, Ovality	B	Visual & Measure	100%	IS:803 & Appd. Drg.	IS:803 & Appd. Drg.	IR		
		NDT on Final Welding	A	DPT	100%	ASTM E-165	No Indications	IR		Except for Bottom Plates. See Note # 2.
		Leak Proof ness	A	Water Fill Test	100%	IS:803 & Appd. Drg.	No Leakage	IR		For 24 Hours
3.2	Painting	Surface Preparation	B	Visual	100%	IS:803, Appd. Drg., NTPC Specs	IS:803, Appd. Drg., NTPC Specs	IR		
		Coating Thickness, Colour	B	Visual & DFT	100%	IS:803, Appd. Drg., NTPC Specs	IS:803, Appd. Drg., NTPC Specs	IR		

Note : - 1. Only Qualified Welders are to be used. If Welders qualified by NTPC/ BHEL/ LRQA/ BVQI are available & continuously doing the job, then re-qualification is not necessary.
2. NDT on Finished weld shall also include Spot RT (10%), if Joint efficiency is taken as 0.85, in line with requirements of Code.

LEGEND: * RECORDS, INDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
LEGEND TO BE USED: CLASS #: A = CRITICAL, B = MAJOR, C = MINOR; 'A' SHALL BE WITNESSED BY NTPC FQA, **'B'** SHALL BE WITNESSED BY NTPC ERECTION/ CONSTRUCTION DEPTT AND **'C'** SHALL BE WITNESSED BY MAIN SUPPLIER (A & B CHECK SHALL BE NTPC CHP STAGE)

SECTION-I, SUB-SECTION- D

ANNEXURE-III

INPUT DRAWINGS (GAD OF TANKS)

Tank Sizing Basis(below 10.0 m dia):

Tank size is decided as per the following

LL – Pump LL level m

L – LL + 0.2 m

H - Effective height m

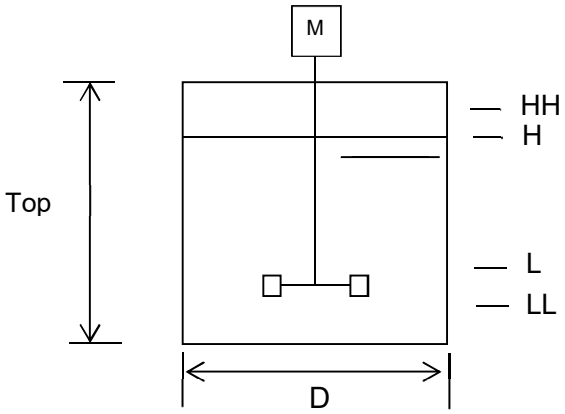
HH - H + 0.2 m

Top - HH + 0.5 m

Effective volume = 3.14 / 4 x Φ ^ 2 x (H-L)

Hold volume = 3.14 / 4 x Φ ^ 2 x (HH)

H/D ratio = ~1.2 (Max)



Tank Sizing basis (Above 10.0 m dia):

Tank size is decided as per the following

LL – Pump LL level m

L – LL + 0.2 m

H - Effective height m

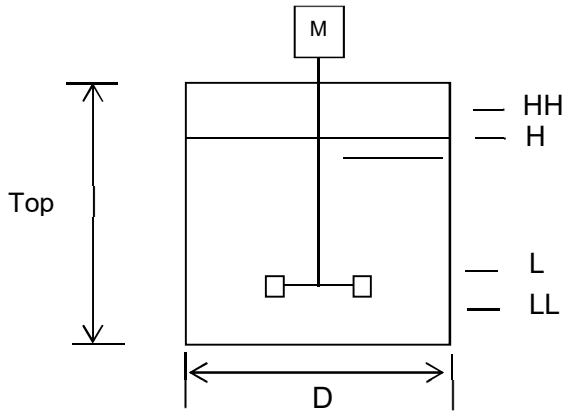
HH - H + 0.2 m

Top - HH + 0.8 m

Effective volume = 3.14 / 4 x Φ ^ 2 x (H)

Hold volume = 3.14 / 4 x Φ ^ 2 x (HH)

H/D ratio = ~1.0 (Max)

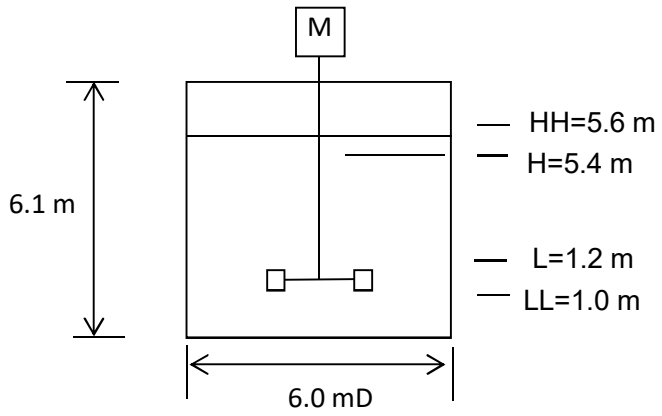


Gas condition for Tank Sizing:

S.No	Gas Condition	Feature
1	VWO Worst coal	FGD Design Point

Tank Sizing:

S. No	Item No	Service	Design Spec	Process Parameter	Design Basis
1	00HTM 03 BB001	Filtrate water Tank	6000 mm D X 6100 mmH Quantity = 1 no. (Common for combine absorber (3 X200 MW) and as well as for all 500 MW units.)	Process Capacity	211.8m3/h (48.15 X 3 + 67.35) (Design point- 3X500MW- Stream No: <402> x 3 Units + Design point 3X200MW - Stream No: <402>)
				Retention Time	0.5 Hr
				Required volume	211.8 m3/h x 0.5 hr =105.9 m3



Tank Level is designated as follows

Top	6.1
HH	5.6
H	5.4
L	1.2*
LL	1.0*

Circular Tank

Effective volume

= 6.0 m Φ ^ 2 / 4 x π x (5.4-1.2) m

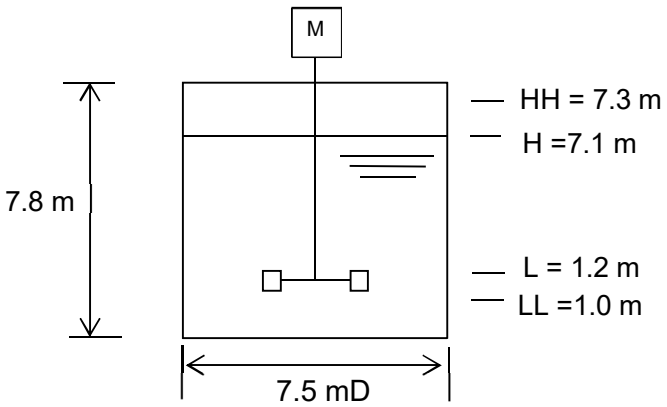
= 118.75 m3>105.91 m3

Hold Volume

= 6.0 m Φ ^ 2 / 4 x π x 5.6 m = 158.3m3

*L and LL level is finalized by vendor's information of filtrate water pump and agitator.

S.No	Item No	Service	Design Spec	Process Parameter	Design Basis
2	00HTM00 BB001	Primary Hydro cyclone feed Tank	7500 mm D X 7800 mmH Quantity = 1 no. (Common for combine absorber (3 X200 MW) and as well as for all 500 MW units.)	Process Capacity	235.45 m3/h (53.94 X 3+ 73.63) (Design point- 3X500MW- Stream No: <201> x 3 Units + Design point 3X200MW - Stream No: <201>)
				Retention Time	1 Hour
				Required volume	235.45 m3/h x 1 hr = 235.45 m3



Tank Level is designated as follows

Top	7.8
HH	7.3
H	7.1
L	1.2*
LL	1.0*

<u>Circular Tank</u>

Effective volume

= 7.5 m Φ ^ 2 / 4 x π x (7.1-1.2) m

= 260.65 m3 > 235.45 m3

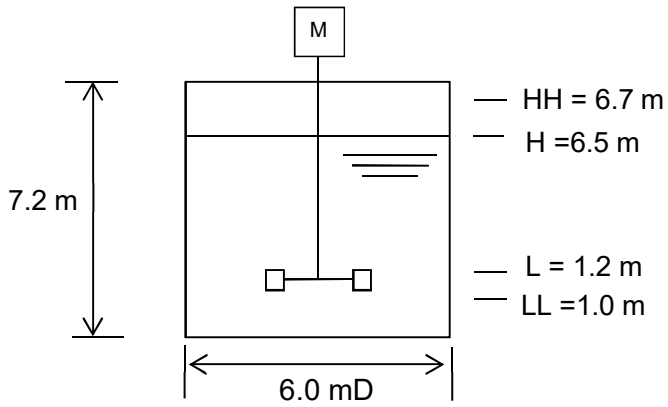
Hold Volume

= 7.5 m Φ ^ 2 / 4 x π x 7.3 m

=322.50 m3

*L and LL level is finalized by vendor's information of Waste water hydro cyclone feed pump and agitator.

S.No	Item No	Service	Design Spec	Process Parameter	Design Basis
3	00HTM04 BB001	Secondary Hydro cyclone feed Tank	6000 mm D X 7200mmH- Quantity = 1 no. (Common for combine absorber (3 X200 MW) and as well as for all 500 MW units.)	Process Capacity	136.03 m3/h (31.17 X3 + 42.52) (Design point- 3X500MW- Stream No: <202> x 3 Units + Design point 3X200MW - Stream No: <202>)
				Retention Time	1 Hours
				Required volume	136.03 m3/h x 1 hr = 136.03 m3



Tank Level is designated as follows

Top	7.2
HH	6.7
H	6.5
L	1.2*
LL	1.0*

<u>Circular Tank</u>

Effective volume

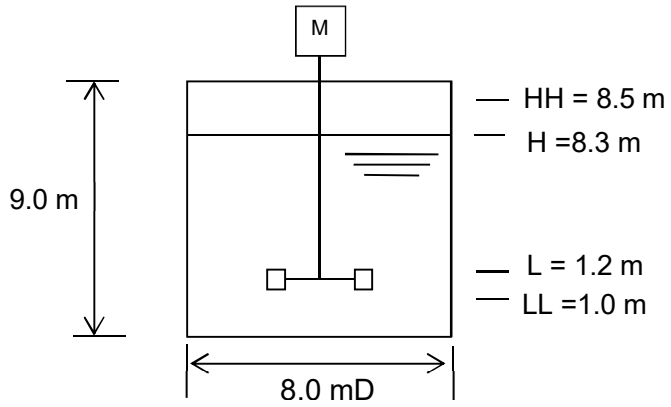
= 6.0 m Φ ^ 2 / 4 x π x (6.5-1.2) m = 149.85 m3>136.03 m3

Hold Volume

= 6.0 m Φ ^ 2 / 4 x π x 6.7 m =189.4 m3

*L and LL level is finalized by vendor's information of Waste water hydro cyclone feed pump and agitator.

S. No	Item No	Service	Design Spec	Process Parameter	Design Basis
4	00HTM 05BB0 01	Waste water storage Tank	8000 mmD X 9000 mmH- Quantity = 1 no. (Common for combine absorber (3 X200 MW) and as well as for all 500 MW units.)	Process Capacity	41.16 m3/h (9.81 X 3 +11.73) (Design point- 3X500MW- Stream No: <205> x 3 Units + Design point 3X200MW - Stream No: <205>)
				Retention Time	8.0 Hours
				Required volume	41.16 m3/h x 8.0 hr = 329.28 m3



Tank Level is designated as follows

Top	9.0
HH	8.5
H	8.3
L	1.2*
LL	1.0*

<u>Circular Tank</u>

Effective volume

= 8.0 m Φ ^ 2 / 4 x π x (8.3-1.2) m

= 356.88 m3> 329.28m3

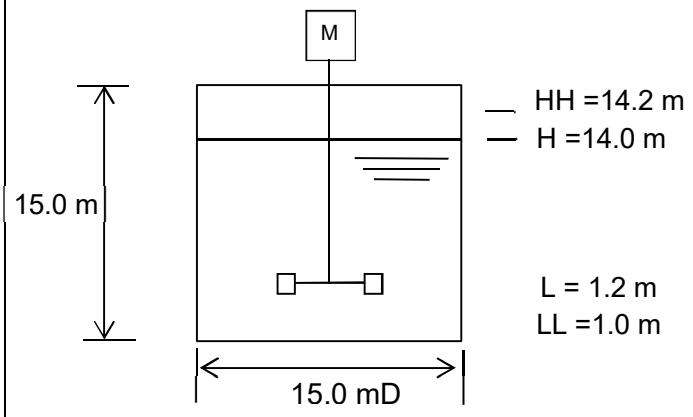
Hold Volume

= 8.0 m Φ ^ 2 / 4 x π x 8.5 m

=427.2 m3

*L and LL level is finalized by vendor's information of Waste water pump and agitator.

S. No	Item No	Service	Design Spec	Process Parameter	Design Basis
5	00HTK03BB001/002	Lime stone slurry storage Tank	15000 mmD X 15000 mmH Quantity = 2 no. (1W+1S) (Common for combine absorber (3 X200 MW) and as well as for all 500 MW units.)	Process Capacity for each tank	a) Limestone required = 40.326 TPH (9.263 x 3 Units + 12.537) (Design point- 3X500MW- Stream No: <501> x 3 Units + Design point 3X200MW - Stream No: <501>) b) 20% (w/w) Limestone slurry = 40.326 TPH / 20% mass flow rate = 201.63 TPH per unit c) 20%(w/w) Limestone slurry density = 1.130 t/m3 d) 20% (w/w) Limestone slurry = 201.63 TPH / 1.130 volume flow rate = 178.44 m3/hr for all the 4 Absorbers.
				Retention Time	12.0 hr
				Required volume	178.44 m3/h x 12 hr = 2141.20 m3



Tank Level is designated as follows

Top	15.0
HH	14.2
H	14.0
L	1.2*
LL	1.0*

<u>Circular Tank</u>

Effective volume

= 15.0 m Φ ^ 2 / 4 x π x (14.0-1.2) m

= 2261.94 m3 > 2141.2 m3

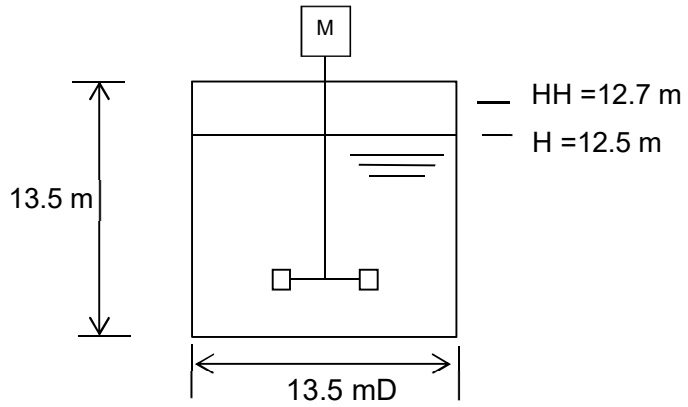
Hold Volume

= 15.0 m Φ ^ 2 / 4 x π x 14.2 m

= 2509.34 m3

*L and LL level is finalized by vendor's information of Limestone slurry Feed pump and agitator.

S. No	Item No	Service	Design Spec	Process Parameter	Design Basis
6	00HTK00BB001	Auxiliary Absorbent Tank	13500mmDX 13500mmH Quantity = 1 no (Common for combine absorber (3 X200 MW) and as well as for all 500 MW units.)	Process Capacity	Absorber Tank Volume = 1760 m3 (with 20 % margin) (3X200MW Absorber tank Size – 26.9mX10.9mX5.0m= 1466.05 m3 20 % margin =1466.05 X 1.2=1760.0 m3)
				Retention Time	Batch Operation
				Required volume	1760 m3



Tank Level is designated to be empty during normal operation. Therefore the volume from bottom to H is considered as hold volume of tank.

Top	13.5
HH	12.7
H	12.5
L	1.2*
LL	1.0*

<u>Circular Tank</u>

Effective volume

= 13.5 m Φ ^ 2 / 4 x π x 12.5 m

= 1789.23 m3>1760 m3

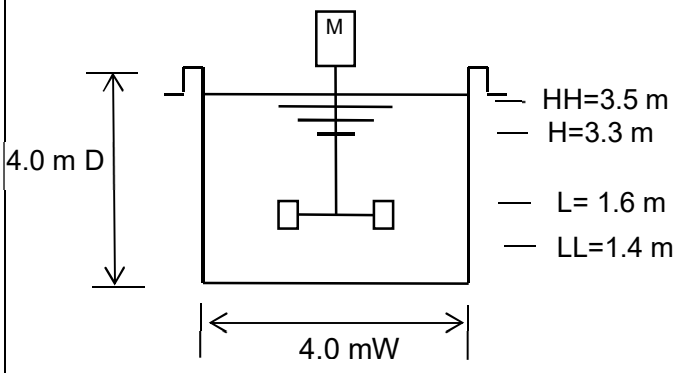
Hold Volume

= 13.5 m Φ ^ 2 / 4 x π x 12.7 m

= 1818 m3

*L and LL level is finalized by vendor's information of Auxiliary Absorbent tank pump and agitator.

S. No	Item No	Service	Design Spec	Process Parameter	Design Basis
7	10/40HTT 00BB001	Absorber Area Drain Sump	4000mmW X 4000mmL X 4000mmH Quantity = 4 nos. (One (1) number for each absorber)	Process Capacity for each Sump	25 m3
				Retention Time	Batch Operation
				Required volume	25 m3



Tank Level is designated as follows

Top	4.0
HH	3.5
H	3.3
L	1.6*
LL	1.4*

<u>Rectangular Tank</u>

Effective volume

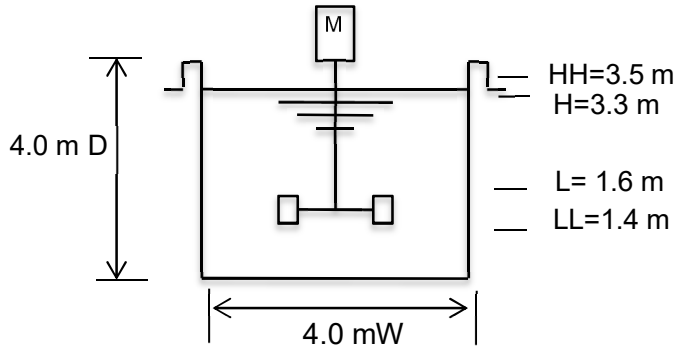
= 4.0 m x 4.0 m x (3.3-1.6) m = 27.2 m3 >25 m3

Hold Volume

= 4.0 m x 4.0 m x 3.5 m = 56 m3

*L and LL level is finalized by vendor's information of Sump pump and agitator.

S. No	Item No	Service	Design Spec	Process Parameter	Design Basis
8	00HTT01 BB001	Gypsum Area Drain Sump	4000mmW X 4000mmL X 4000mmH Quantity = 1 no. (Common for combine absorber (3 X200 MW) and as well as for all 500 MW units.)	Process Capacity	25 m3
				Retention Time	Batch Operation
				Required volume	25 m3



Tank Level is designated as follows

Top	4.0
HH	3.5
H	3.3
L	1.6*
LL	1.4*

<u>Rectangular Tank</u>

Effective volume

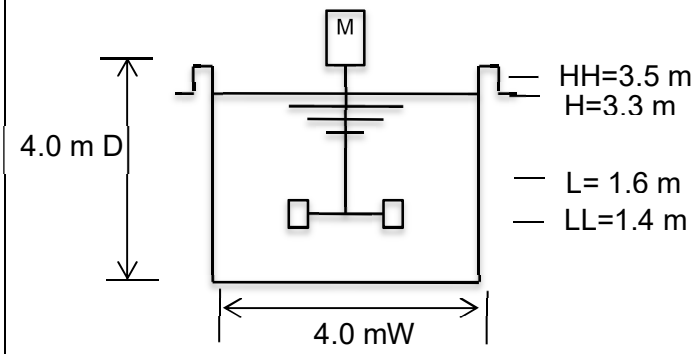
= 4.0 m x 4.0 m x (3.3-1.6) m = 27.2 m3 >25 m3

Hold Volume

= 4.0 m x 4.0 m x 3.5 m = 56 m3

*L and LL level is finalized by vendor's information of Sump pump and agitator.

S. No	Item No	Service	Design Spec	Process Parameter	Design Basis
9	00HTT02 BB001	Lime Stone Area Drain Sump	4000mmW X 4000mmL X 4000mmH Quantity = 1 no. (Common for combine absorber (3 X200 MW) and as well as for all 500 MW units.)	Process Capacity	25 m3
				Retention Time	Batch Operation
				Required volume	25 m3



Tank Level is designated as follows

Top	4.0
HH	3.5
H	3.3
L	1.6*
LL	1.4*

<u>Rectangular Tank</u>

Effective volume

= 4.0 m x 4.0 m x (3.3-1.6) m = 27.2 m3 >25 m3

Hold Volume

= 4.0 m x 4.0 m x 3.5 m = 56 m3

*L and LL level is finalized by vendor's information of Sump pump and agitator.

The above data is basic design data and may vary based on actual piping layout and selected vendor's recommendations.

Reference Documents

- Mass Flow Balance (3X500 MW Design Point + 3X200 MW Design Point) data- 3310-109-PV M-W-002

1. **Gas condition for Water Tank Sizing:**

S.No.	Gas Condition	Feature
1	VWO	Maximum Absorbed SO_2 Condition Maximum Inlet Gas flow condition

2. **Water Tank Sizing Basis**

   Tank size is decided as per the following

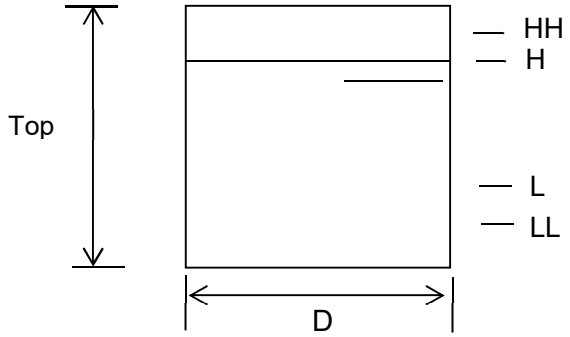
LL – Pump LL level m

L – LL + 0.2 m

H - Effective height m

HH - H + 0.2 m

Top - HH + 0.5 m

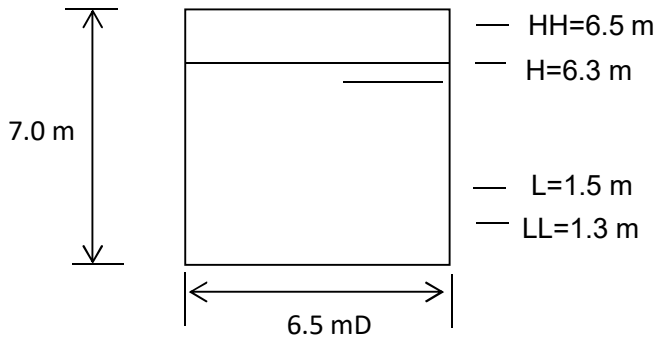


Effective volume = 3.14 / 4 x Φ ^ 2 x (H-L)

Hold volume = 3.14 / 4 x Φ ^ 2 x (HH)

Top/D ratio = 1-1.2

S. No	Item No	Service	Design Spec	Process Parameter	Design Basis
1	00HTQ00BB001/002	Process Water Tank	6500 mmD X 7000 mmH Quantity = 2 nos. (Common for combine absorber (3 X200 MW) and as well as for all 500 MW units.)	Process Capacity	611.14m3/h ((7.60+25.83+0.77+76.18+11.38/2+21.83)X3) + ((9.63 +36.07+0.96 + 113.47 + 15.54/2 +29.54)) (Refer Mass Flow Balance (3X500 MW Design Point) data stream no. (<801> + <802> + <803> + <804> + <805>/2 + <806>) x 3 units) + (Refer Mass Flow Balance (3X200 MW Design Point) data stream no. (<801> + <802> + <803> + <804> + <805>/2 + <806>)).
				Retention Time	0.25 hr
				Required volume	611.14 m3/h x 0.25 hr = 152.79 m3



Tank Level is designated as follows

Top	7.0
HH	6.5
H	6.3
L	1.5
LL	1.3*

Effective volume

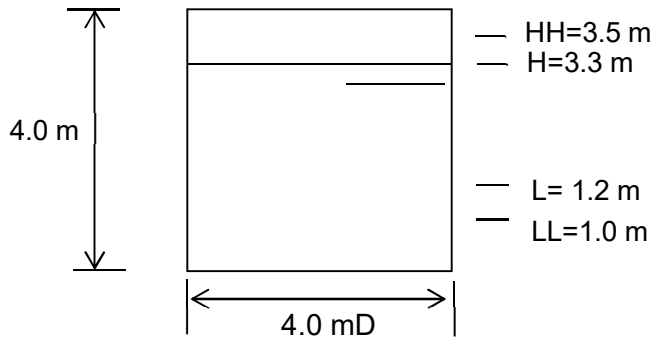
= 6.5 m Φ ^ 2 / 4 x π x (6.3-1.5) m = 159.27 m3>152.79 m3

Hold Volume

= 6.5 m Φ ^ 2 / 4 x π x 6.5 m = 215.69 m3

* LL level will be finalized by vendor's information of Process water pump.

S. No	Item No	Service	Design Spec	Process Parameter	Design Basis
2	00HTQ01BB001/002	Cake wash (Clarified water) Tank	4000 mmD X 4000 mmH Quantity = 2 nos. (Common for combine absorber (3 X200 MW) and as well as for all 500 MW units.)	Process Capacity for each tank	24.84 m3/h (11.38/2X3 + 15.54/2) Refer (Mass Balance (3X500M Design Point data) stream no. (<805>/2) x 3 units) + (Mass Balance (3X200MW Design Point data) stream no. (<805>/2).
				Retention Time	1hr
				Required volume	24.84 m3/h x 1hr = 24.84 m3



Tank Level is designated as follows

Top	4.0
HH	3.5
H	3.3
L	1.2
LL	1.0*

Effective volume

= 4.0 m Φ ^ 2 / 4 x π x (3.3-1.2) m

=26.39 m3 > 24.84 m3

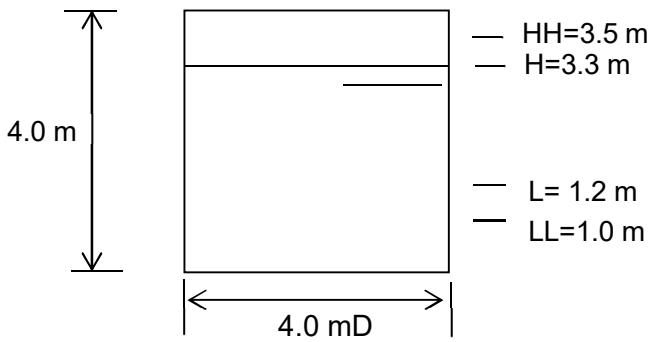
Hold Volume

= 4.0 m Φ ^ 2 / 4 x π x 3.5 m

= 43.98 m3

*LL level is finalized by vendor's information of Cake wash tank pump.

S.No	Item No	Service	Design Spec	Process Parameter	Design Basis
3	00HTM01BB001/002	Belt Filter Wash Tank	4000 mmD X 4000 mmH Quantity = 2 no. (Common for combine absorber (3 X200 MW) and as well as for all 500 MW units.)	Process Capacity for each tank	24.84 m3/h (11.38/2X3 + 15.54/2) Refer (Mass Balance (3X500M Design Point data) stream no. (<805>/2) x 3 units) + (Mass Balance (3X200MW Design Point data) stream no. (<805>/2).
				Retention Time	1hr
				Required volume	24.84 m3/h x 1hr = 24.84 m3



Tank Level is designated as follows

Top	4.0
HH	3.5
H	3.3
L	1.2
LL	1.0*

Effective volume

= 4.0 m Φ ^ 2 / 4 x π x (3.3-1.2) m

=26.39 m3>24.84 m3

Hold Volume

= 4.0 m Φ ^ 2 / 4 x π x 3.5 m

=43.98 m3

*LL level is finalized by vendor's information of belt filter wash tank pump.

Reference Documents

- Mass Flow Balance (3X500 MW Design Point + 3X200 MW Design Point) data- 3310-109-PVM-W-002

SECTION-I, SUB-SECTION- D

ANNEXURE-IV

MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION

DRAWINGS/ DOCUMENTS REQUIRED DURING DETAIL ENGINEERING

The successful bidder shall submit the following drawings / documents during detail engineering for approval / information / reference (as the case may be): -

Sl. No.	BHEL Drawing / Document No.	Title	Schedule Submission Date from LOI	Resubmission after incorporating comments
1	PE-V0-467-167-A001	FABRICATION DRAWING OF MISC. FGD TANK	5 weeks	Within 1 week
2	PE-V0-467-167-A002	DESIGN CALCULATION OF MISC. FGD TANKS INCLUDING ROOF STRUCTURE WITH STAAD CALCULATION	3 weeks	Within 1 week
3	PE-V0-467-167-A003	GA DRAWING OF MISC. FGD TANKS	4 weeks	Within 1 week
4	PE-V0-467-167-A004	DATASHEET & GA DRAWING OF RUBBER LINING & VINYL ESTER GLASS FLAKE FOR MISC. FGD TANKS	6 weeks	Within 1 week
5	PE-V0-467-167-A005	DATASHEET & GA DRAWING OF COMPONENTS FOR MISC. FGD TANKS	6 weeks	Within 1 week
6	PE-V0-467-167-A006	QAP OF RUBBER LINING & VINYL ESTER GLASS FLAKE FOR MISC. FGD TANKS	6 weeks	Within 1 week
7	PE-V0-467-167-A007	QAP OF COMPONENTS FOR MISC. FGD TANKS	6 weeks	Within 1 week
8	PE-V0-467-167-A008	SUB VENDOR LIST WITH INSPECTION CATEGORY FOR MISC. FGD TANKS	3 weeks	Within 1 week
9	PE-V0-467-167-A009	SURFACE PREPARATION AND LINING PROCEDURES FOR MISC. FGD TANKS	7 weeks	Within 1 week
10	PE-V0-467-167-A010	O&M MANUAL FOR RUBBER LINING & VINYL ESTER GLASS FLAKE	8 weeks	Within 1 week
11	PE-V0-467-167-A011	O&M MANUAL FOR MISC. FGD TANKS	8 weeks	Within 1 week

NOTE: Drwg/ Document shall be uploaded by the successful bidder on WRENCH /DMS.Procedure for the same will be informed after award of contract.

COMPANY SEAL

SIGNATURE: _____

NAME: _____

DESIGNATION: _____

COMPANY: _____

DATE: _____

SECTION-II
SUB-SECTION-A

STANDARD TECHNICAL SPECIFICATIONS- MECHANICAL

1.0 **SCOPE**

This specification covers design, engineering, supply of material, fabrication, assembly, inspection and testing at shop as well as at site, erection and commissioning, painting and functional demonstration testing at site.

2.0 **CODES & STANDARDS**

The design, fabrication & assembly, erection & performance of steel tanks shall comply with all latest statutory regulations and safety codes applicable in the locality where the tanks are to be installed. Tanks shall conform to the latest applicable Indian / British / USA standards. The vendor shall not be construed to be relieved of his responsibility by virtue of this specification. The tank in general shall conform to the latest editions, as applicable, out of the following standards.

1. IS-800 Code of practice for use if steel in general building construction

2. IS-803 Code of practice for design, fabrication and erection of vertical mild steel cylindrical welded oil storage tank.

3. IS-804 Specification for rectangular pressed steel tanks

4. IS-805 Code of practice for use of steel in gravity water tank.

5. IS-816 Code of practice for metal arc welding for general construction in MS.

6. IS-817 Code of practice for training and testing for metal arc welder

7. IS-2825 Code of practice for unfired pressure vessel

8. BS-2594 Specification for carbon steel welded horizontal cylindrical storage tank

9. BS-2654 Specification for vertical steel welded storage tanks with butt welded shells for the petroleum industry

12. Indian Factories Act

13. American code for oil tanks API 650

14. Material Specification as per relevant IS / or approved equal

15. American water works association standards (AWWA D100)

3.0 **DESIGN REQUIREMENT**

3.1 General Requirement

3.1.1 All tanks will be mild steel tanks. The tanks will be of welded construction and will be designed to withstand satisfactorily the internal forces due to the liquid which these tanks have to hold as specified and external forces due to wind and seismic forces without

deformation or undue strain. The plates will be cold rolled through plate bending machines by several no. of passes to the curvature.

3.1.2 Tank thickness shall be calculated as per IS803 latest edition. Intermediary wind girder design, Wind Design, Seismic design, anchor bolt design / selection etc. shall be done as per API 650 latest edition, latest addendum available at the time of detail engineering.

3.1.3 All tanks will be designed for the capacities, dimensions and working conditions as specified in **Tank schedule and GA Drawing of tanks**. These tanks will be provided with all necessary connections as specified. The design of tanks will be such as to allow easy inspection, cleaning and repair. Due consideration will be given to wind loading and adequate stiffening will be provided to prevent failure of tank due to buckling when it is empty. A 3.0 mm corrosion allowance for shells, bottom and roofs above and beyond the required thickness / calculated thickness / nominal thickness as specified in the design code shall be provided.

3.1.4 Vessel seams shall be so positioned that they do not pass through nozzle connections on vessel. For vessels consisting of more than two sections, longitudinal seams shall be offset.

3.1.5 The inside seam should be ground smooth, suitable for application of corrosion resistant primer. If the stiffening of shell, bottom and / or roof is necessary, tanks will be stiffened from outside.

3.1.6 Flange faces of all nozzles shall be machined and squared with the vessel center line.

3.1.7 All roofs and supporting structures shall be designed to support dead load plus a uniform live load of not less than 150 kg/m^2 of projected area.

3.1.8 The tanks shall be designed to have all courses truly vertical. Adequate distance between vertical joints in adjacent courses shall be taken so that the distortion is reduced to minimum.

3.1.9 When removing temporary attachments from shell plates, care should be taken that parent plate is not damaged. Holes in plate work to assist in fabrication / erection should be avoided as far as possible. The location of holes and method of filling shall be indicated in the fabrication drawing. Any projection of metal shall be chipped and ground flush with the plate surface. The plate shall not be gouged or torn in process of removing lugs.

3.1.10 In the construction of shell, very care shall be taken to minimize distortion or lack of circularity due to welding or for any other reason.

3.1.11 Material of construction of all tanks shall be mild steel conforms to IS – 2062 grade – B unless otherwise specified in the **Tank schedule and GA Drawing of tanks.**

3.1.10 **Alignment**

3.1.10.1 Plates to be joined by butt-welding shall be matched accurately. Misalignment in completed vertical joints shall not exceed 10% of the plate thickness or 1.5 mm for plates of 20 mm thick and under, whichever is larger.

3.1.10.2 In completed horizontal butt joints, the upper plate shall not project beyond the face of the lower plate at any point by more than 20% of the upper plate thickness with a maximum of

3 mm for plate thickness exceeding 8 mm except that for plate thickness 8 mm and under, the maximum shall be 1.5 mm.

3.1.10.3 Each tank shall be properly constructed ensuring perfect vertical alignment with 5 mm or as specified in the relevant code / standard and tank circularity within 5 mm on diameter or as specified in the relevant code / standard. Local bulging and / or depressions at any location of tank particularly shell shall not be permitted.

3.1.11 **WELDING**

3.1.11.1 Tanks and other attachments shall be welded as per IS-816.

3.1.11.2 Welding sequence shall be so adopted that distortion due to welding shrinkage shall be minimum. Welding procedure specification shall be submitted for approval of BHEL giving details of material, welding position, sequence, type of electrode used, pre-heat & post weld requirement etc as per the code of construction. Brand name of electrodes to be used with proper classification (e.g. E 6013) shall be as per BHEL's approval.

3.1.11.3 Welding shall not be carried out when the surface is wet and during periods of rain and high winds unless the welder and the work are properly shielded which should meet the approval of the purchaser.

3.1.11.4 Inspection of all welds shall be carried out in accordance with the governing code of construction. All material used by the purchaser such as electrodes, gaskets, bolts, nuts etc shall be conforming to relevant standards of repute and approved by the purchaser prior to use.

3.1.12 Each tank shall be complete with access staircase, ladder and safety cage and fittings like drain connection, overflow connection, tank inlet and outlet covers, level gauge glass, fittings with isolation cocks and protection covers, tank vent connection etc. all complete with needed accessories for the completeness of the tanks and as specified in **Tank schedule and GA Drawing of tanks**.

3.1.13 All openings in tank plate shall be well reinforced in approved manner by adding pad plates of adequate size and / or structural sections.

3.1.14 **STAIRCASE / ACCESS LADDER AND HAND RAILING**

3.1.14.1 All cylindrical vertical tanks shall be provided with spiral staircase and shall conform to the requirements specified in design codes / standards unless specified otherwise. All stair treads shall be 32 mm steel fabricated gratings or 8mm thk. chequered plate which will be decided during detail engineering stage. Each tread, if needed, shall be housed in individual steel fabricated frame which shall be adequately supported from the tank outer periphery. The staircase shall have minimum 800 mm clear width.

3.1.14.2 Access ladder, one (1) for each horizontal cylindrical / rectangular tank shall be provided for access to the tank roof. It shall be steel fabricated having minimum 450 mm width. Ladder stringers shall be heavy steel flats or angle section. All rungs shall be minimum 20 mm diameter rods spaced at not more than 30 mm center to center. All ladders shall have steel fabricated safety cage to the approved construction. Safety cage shall be provided about 2.5

m clear height of the ladder. Access ladder's stringers shall be widely spaced at top for free access to the tank roof.

3.1.14.3 All staircase and roofs of vertical cylindrical tanks shall be provided with pipe hand railings of effective height as indicated in the relevant code / standard throughout. Handrails shall be constructed out of 32 mm medium class galvanized steel pipe conforming to IS- 1239: 1968. Handrail posts shall be arranged at spacing not greater than 1850 mm. Two (2) sets of pipes horizontal runners all along the length shall be provided. All welds joints in the handrails shall be ground flush to protect any person getting injured. Steel toe plates of 100 mm flats shall be used. Hand railing shall be fabricated and installed in an approved manner as directed by purchaser in accordance with approved drawings.

3.1.15 Unless otherwise specified, for all flanged connections, vendor shall furnish suitable counter flanges and necessary nuts, bolts and gaskets materials.

3.1.16 Unless otherwise specified, bolts and nuts shall be hexagonal head conforming to bolts and nuts shall be SA 193 & 194 respectively.

3.1.17 Gaskets shall be 3 mm thick full-face rubber or CAF. On completion of hydraulic test / water fill test, contractor shall replace the gaskets used during testing at his own cost.

3.1.18 Float level indicators other than float and arrow type level indicator, gauge glass shall be provided.

3.1.19 During erection of tank, shell plates shall be suitably supported both for outside and inside to avoid buckling / collapsing of tank due to high-speed wind, gust or severe storm, if any, occurring during erection.

3.2 **VERTICAL CYLINDRICAL STORAGE TANKS**

3.2.1 The vertical cylindrical storage (non- pressure) tanks shall be of mild steel welded construction and shall be designed in accordance with codes and standards as specified in the **Tank schedule and GA Drawing of tanks**. The vertical cylindrical storage tanks shall have slightly sloping bottom towards an adequately sized sump inside the tank to enable complete draining of the tank. The tank shall be designed for a wind pressure and seismic coefficient as specified.

3.2.2 Conical roof shall be either self-supported or supporting. The roof shall have a slope as specified in the relevant design code to ensure drainage of rainwater. Needed roof rafters and purlins adequately designed shall be provided.

3.2.3 All plates to be used for fabrication of tank shall be checked and all sides trimmed to make them square.

3.2.4 All bottom plates shall have lap weld joints on all sides with overlap not less than five times the plate thickness.

3.2.5 All shell course plates shall be taken during bending to prevent plate skewing. For butt weld joints, edges shall be prepared which shall be uniform and smooth throughout. To maintain needed root penetration gap at any butt weld joint, sufficient numbers of erection cleats

shall be provided on all sides of outer periphery of each shell plate. Plates for tanks shall be straightened by pressing or by other non-injurious methods.

3.2.6 Each shell course shall be of uniform width throughout longitudinal weld in plates. Make up for the course width shall not be permitted. Shell plates in each course width shall be so arranged that all vertical joints be staggered having a minimum of 600 mm stagger. Shell thickness could be reduced in upper courses depending on design requirements but in no case the plate thickness shall be less than 8 mm.

3.2.7 The tank height shall be completed by the provision of top curb/ angle which shall be butt-welded to the adjacent tank plate courses. The outstanding leg of the curb angle shall be kept outside the tank periphery. All butt weld joints shall be full strength welds but for design of shell plate thickness adequate weld efficiency as recommended by applicable code(s) shall be used.

3.2.8 Tank roof shall be either self-supported or supported over rafters / steel fabricated central column(s). Adequately sized and spaced rafters and purlins shall be provided. All rafters shall have sliding bolted connections at one end and preferably on the tank periphery side. The roof-supporting frame shall have needed tie rods or bracing sets.

3.2.9 Roof plates shall have lap joints with lap not less than 25 mm and lap weld over the top surface only. Roof plates shall have continuous fillet welds around the tank curb angle. No joint of roof plate over the supporting frame shall be made.

3.2.10 Openings needed for mounting various specified accessories shall be well reinforced in accordance with application codes and as approved. Manhole shall the bolted and hinged covers unless otherwise specified.

3.2.11 All inlet pipe nozzles located at the top of tanks shall be provided with internal piping up to 500 mm high above the tank's bottom inside with suitable weir plate at bottom. The inside piping shall be adequately supported and shall be provided with adequately sized vent connection at pipe top.

3.3.0 **RECTANGULAR TANKS**

3.3.1 Rectangular tanks shall be fabricated in steel material and shall be designed to withstand internal hydrostatic pressure. In addition, these shall be checked for a wind pressure and seismic coefficient as specified wherever applicable. While worst of these two shall be considered, the permissible stress shall be increased as per good engineering practice when their effect considered with tank load.

3.3.2 Tank bottom and / or side plates shall be of minimum 8 mm thick plate. Corrosion margin of at least 2 mm shall be provided over the design thickness of bottom and / or side plates.

3.3.3 To support tank plates and to maintain required unsupported plate length, adequately sized and spaced steel structural closed frame shall be provided inside the tank. Longitudinal and / or vertical structural members to connect and adequately support these frames shall be provided at corners. Horizontal diagonal members / sway bracings at corner shall also be provided.

3.3.4 Tank plates cut to size shall be welded on these frames. Plate butt weld joints at other locations shall be eliminated to avoid warping of the plates at free joints. Adequate openings in the structural frames, particularly at the bottom shall be provided to ensure complete unrestricted drainage of tank at one point. Suitable sized drain valve of size minimum 25 NB unless otherwise specified in the **Tank schedule and GA Drawing of tanks** shall be provided below the tank bottom for proper draining of the tank.

3.3.5 Complete assembled tank shall have at its bottom longitudinal steel fabricated bearer beams welded to it. The tank with bearer will rest over number of concrete blocks to be provided by purchaser. The tank shall be adequately bolted / welded to the concrete blocks. Needed inserts / anchor bolts shall be furnished by the bidders. Grouting of tank over concrete blocks in approved manner shall be included in bidder's scope of work, if erection is also awarded to the bidder.

3.3.6 Where rectangular tanks are flushed in dual compartments the inside partition plate shall be well reinforced to withstand hydrostatic test pressure completely on one side throughout the full height.

3.3.7 The rectangular tank shall be designed as per good engineering practice and reference shall be taken from the book named "Theory of plates and shells" by Timoshenko. Design calculation shall be done in accordance with the above mentioned book.

3.3.8 Suitable steel structural e.g. channels shall be provided below the bottom plate so that tank can rest on the foundation / slabs through the structural supports.

3.4 **HORIZONTAL CYLINDRICAL TANK**

3.4.1 The horizontal cylindrical tank with dished ends shall be of mild steel welded construction and shall be designed in accordance with BS – 2594 / IS – 2825 / ASME as specified in the **Tank schedule and GA Drawing of tanks**. The tank shall be designed for a wind pressure and seismic coefficient as specified. While worst of these two shall be considered, the permissible stress shall be increased as per relevant code / standard.

3.4.2 The shell and dished end plate thickness shall be chosen as per design requirement but in no case the dished end and shell plate thickness shall be less than 8 mm.

3.4.3 All seams, longitudinal as well as circumferential, shall be butt-welded. Longitudinal seams should not be situated in the lower third of a tank or on the top center line.

3.4.4 All tank shall be supplied with integral saddle support and shall be designed in accordance with BS- 2594 / IS – 2825 / ASME as specified in the **Tank schedule and GA Drawing of tanks.**

4.0 **TESTING AND INSPECTION AT MANUFACTURERER'S WORKS**

4.1 **General**

4.1.1 The supplier shall provide inspection to establish and maintain quality of workmanship in his works and that of his subcontractors to ensure the mechanical accuracy of components, compliance with drawings identity and acceptability of all materials, parts and equipment. He shall conduct all tests required to ensure that the equipment and material furnished shall

conform to requirements of the acceptable codes. All tests and test procedure proposed by manufacturer shall be submitted to the purchaser for their prior approval.

4.1.2 All materials used for manufacture of the equipment under this specification shall be of tested quality. Relevant test certificates shall be made available to the purchaser before the final shop inspection. In case the relevant correlating test certificates are not available, the supplier shall arrange to carry out the necessary tests required by codes at his own cost.

4.1.3 Alloy cast iron and cast steel components shall be tested for both physical and chemical properties in absence of purchaser's representatives. Test bears shall be either integral or taken from the same ladle of material as the casting they represent.

4.1.4 All materials including valves, instruments, pipings, flanges, counter flanges etc. shall be procured from BHEL approved manufacturer's only. Dealers are not acceptable.

4.2 **TESTING AND INSPECTION FOR TANKS**

4.2.1 The scope of testing and inspection for pressure vessel covered in this specification shall generally comprise of the following:

i) Examination and approval of fabrication drawings to ensure that design, materials and fabrication details meet requirement of code and specifications. Purchaser will review these drawings for interface problems and conformity with the general arrangement drawings and accord their approval.

ii) Examination of materials of construction and identification with material test certificates.

iii) All the plates of thickness 50 mm or more shall be ultrasonically tested to ensure freedom from laminations.

iv) Ensuring the relevant weld procedure and welder qualification tests are in accordance with stipulated code requirements.

v) Inspection of dished end flanges and alloy steel bolting where required.

vi) Inspection during fabrication at appropriate stages including fit ups.

vii) For all butt welds, the root run and final run shall be subjected to dye-penetrate or magnetic particle inspection. For all fillet welds the final run shall be subjected to dye-penetrate / magnetic particle examination.

viii) Examination of radiographs including radiographic techniques, supervision of other non - destructive tests and heat treatment procedure as required by codes and specifications.

ix) Examination of internal cleanliness before final closure.

x) Dimensional examination of completed vessel including axis marking, proof marking, match marking etc.

xi) Witnessing of hydrostatic, pneumatic or vacuum tests or special tests as required by the code and specification. In case of hydrostatic tests, the test pressure must be kept for a minimum of two hours.

xii) Witnessing cleanliness, preservation, packing and marking.

xiii) Stamping of vessel and issue of certificates.

xiv) All tanks under this specification shall be tested as per the relevant design and testing code / standard. Supplier shall submit the detailed testing procedure for the tanks during detail engineering stage for BHEL / customer / consultant's approval and approved document shall be adhered by them and testing shall be done accordingly without any commercial implication.

4.2.2 **NON - PRESSURE TANKS**

The scope of testing and inspection for non-pressure tanks covered in this specification will comprise of the following:

i) Identification of materials to manufacturer's test certificates.

ii) Inspection of plate edges after edge preparation and checking curvature against templates if shell plates sent after rolling.

iii) Checking of dimension and match marking.

iv) Bottom testing

a. After the bottom and bottom course of shell plates have been welded, the bottom shall be tested by pumping air beneath the bottom plates to a pressure just sufficient to lift them off the foundation and in any case not less than 100 mm water gauge. The pressure shall be held by construction of a temporary dam of clay or other suitable material around the tank periphery. Soap suds or other suitable material shall be applied to all joints for detection of leaks.

b. Fuel oil may be used instead of air and soap suds to test for leaks, subject to prior agreement and approval of purchaser.

c. Alternatively, the bottom seams may be tested by vacuum box method subject to prior agreement and approval of the purchaser. The vacuum box used shall comply with IS- 803, 1976 (figure-24)

v) Shell testing

The shell of fixed roof non - pressure tanks shall be tested after completion of roof. Testing shall be done by filling the tank with water to the level of the top leg of the top curb angle and noting any leaks.

vi) Roof testing

The roof of the tank shall be tested by pumping air under the roof plates while the tank is still full of water. In the non - pressure tank, the roof shall be tested to a pressure of 75 mm of water gauge and in case of pressure roof tanks, to a pressure of one and a quarter times the pressure at which the pressure sides of the pressure / vacuum relief valve is designed to open. Soap suds or other suitable material shall be applied to all joints for detection of leaks.

vii) All field-testing shall be performed prior to any painting or coating application.

4.3 REPAIR OF LEAKS

4.3.1 All leaks detected during testing shall be repaired to the satisfaction of the purchaser and on completion retested for leakage as per approved procedure.

4.3.2 In the joints between roof plates only, pin hole leaks may be repaired by mechanical caulking. However, where there is any indication of considerable porosity, the leaks shall be sealed by laying down an additional layer of weld over the porous sections.

4.3.3 In all other joints, whether between shell plates or bottom plates or both, leak shall be repaired only welding and if necessary, after first cutting out the defective part.

4.3.4 When the tank is filled with water for testing, defects in the shell joints shall be repaired with the water level at least 300 mm below the joint being repaired.

4.3.5 No welding shall be done on any tank unless all lines connecting thereto have been completely blanked off. No repairs shall be attempted on tanks while filled with oil, nor any tanks which have contained oil until the tanks have been emptied, cleaned and freed from gas in a safe manner. No repair shall be attempted on a tank which has contained oil except in a manner approved in writing by the purchaser, and in absence of the purchaser's inspector.

SECTION-II

SUB-SECTION-A

GUIDANCE FOR DESIGNING AND FABRICATION OF STEEL CONSTRUCTIONS FOR RUBBERLINING & VE GLASS FLAKE LINING

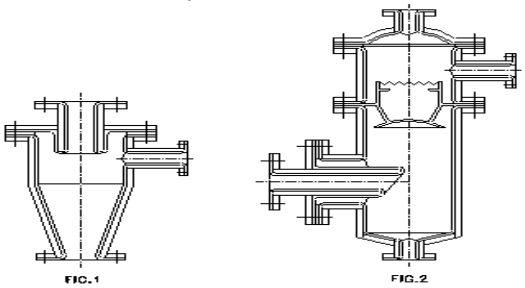
1. INTRODUCTION:

This guidance covers the minimum requirements for the design and fabrication of carbon steel vessels, equipment and pipes for rubber lining and VE Glass Flake lining.

2. GENERAL:

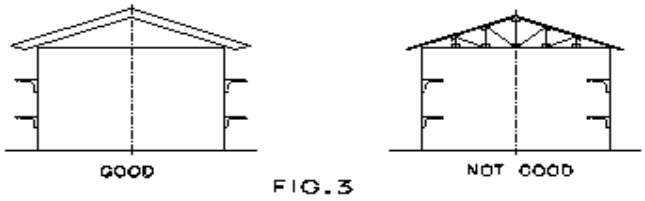
2-1 : Structure of steel constructions should be designed to withstand mechanical shocks under transportation and service. Particularly, hard rubber / VE Glass Flake lined vessels should be paid full attention because these vessels are liable to cause cracks when transported or installed.

2-2 : As the lining process is done manually, any constructions (except pipe) inaccessible by hands should be split into accessible one, as shown in Fig. 1.

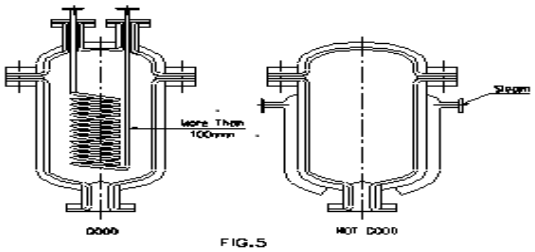


2-3 : The parts tend to wear must be designed to be able to dismount and check or exchange easily as shown in Fig.2

2-4 : All lining surface should be designed as simple as possible and reinforcement must be provided on the side not to be lined as shown in Fig.3.



2-5 : When heating is necessary, care must be taken not to raise the temperature partially too high as shown in Fig.5 (b), or not to contact with rubber directly. It is recommended to design as shown in Fig. 5(a) and keep the hating pipe at least 100 mm apart from the lining.



2-6 : When it is necessary to insert nozzles in vessels special attention should be paid to dimensions securing enough room at overlap of rubber lining as illustrated in Fig. 6.

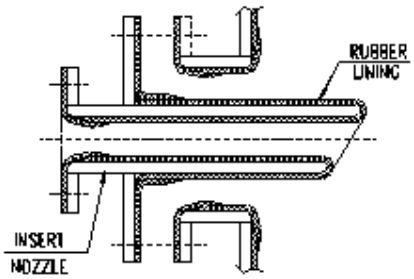


FIG.6

3. WELDING AND FINISHING:

In order to get the optimum adhesion between the base metal and rubber sheet / VE Glass Flake lining, or to prevent pinholes or other defects, designers and manufacturers of pipes, vessels and other steel constructions are requested to give proper consideration to the following points.

3-1 : Welds and flush on the side to be lined shall be ground smoothly and must be free of cracks, undercuts, overlaps, pinholes and blowholes.

3-2 : Butt joint is preferable and overlap joint is not recommended for lining vessels. Welding must be generally made from both sides as shown in Fig. 7.

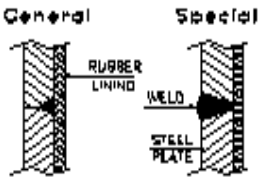


FIG.7

3-3 : All corners should have the curvature of at least 3 mmR for convex surface and at least 10 mmR for concave surface as shown in Fig. 8.

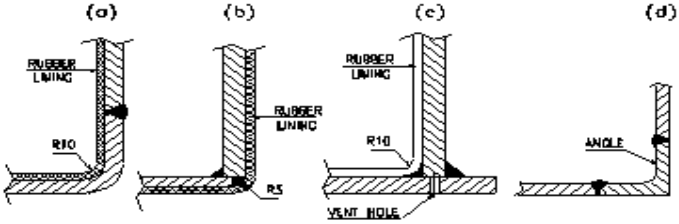


FIG.8

3-4 : All welds for lining vessels should be continuous as shown in Fig. 9.

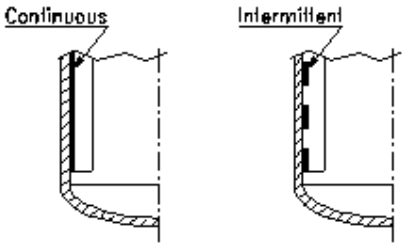


FIG.9

3-5 : When air pocket brought about by continuous welding cannot be avoided, air vent-hole or intermittent weld must be provided as shown in Fig. 10.

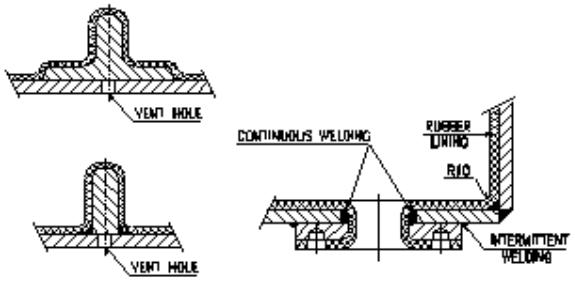


FIG.10

4. PIPES AND FITTINGS:

Pipes and Fittings should have smooth surface on the side to be lined. Lining on surfaces with sharp projection and irregularities should be avoided.

Flat-faced flanges shall be welded on square to pipes or fittings. The weld on the front face should be continuous and ground to a smooth convex surface not less than3 mm in radius.

Pipings should be designed to use standard pipes and fittings and complied with following requirement.

4-1 . STRAIGHT PIPES:

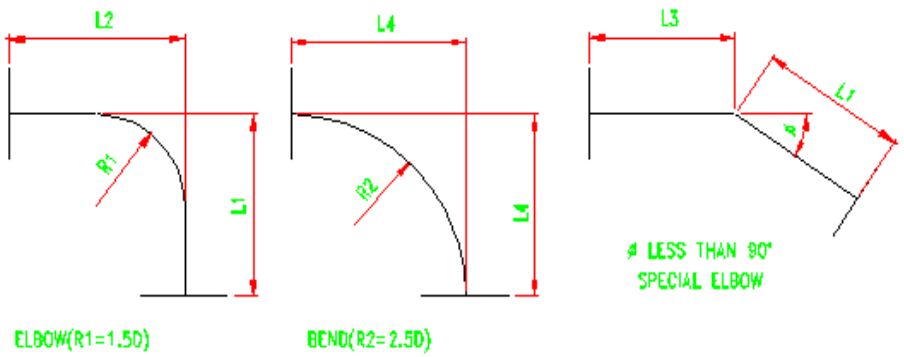
The maximum length of straight pipes, measured between flange face, which can be satisfactorily lined are given below:

Nominal diameter (mm)	Maximum length (mm)
Over 25 to 40	2750
Over 50 to 80	5500
Over 100 to 550	6000
Over 600	12000

4-2. STRAIGHT PIPES:

The dimensions of Elbows and Bends which can be satisfactorily lined are as below:

DIMENSIONS OF BENDS AND ELBOWS (STEEL) FOR RUBBER LINING FEASIBILITY :

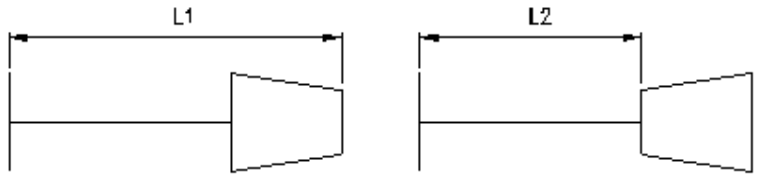


ALL DIMENSIONS IN MILLIMETRES:

NOM DIA.	MAX L1	MAX L2, L3	MAX. L4
25	90	300	175
32	95	300	210
40	100	300	250
50	115	500	280
65	130	2000	325
80	150	3000	400
90	170	3000	450
100	190	3000	500
125	195	3000	
150	230	3000	
200	310	3000	
250	385	3000	
300	465	3000	
350	540	3000	
400	615	3000	
450	692	1000	
500	770	1000	
550	838	5500	
600	912	5500	
650	990	5500	
700	1000	12000	

Note: The above tabulation shows sizes which can be fabricated and rubber lined satisfactorily.

DIMENSIONS OF REDUCING PIPES (STEEL) FOR RUBBER LINING FEASIBILITY of CONCENTRIC AND ECCENTRIC REDUCING PIPES.



REDUCING PIPES

4-3 REDUCING PIPES:

The dimensions of concentric and eccentric reducing pipes which can be satisfactorily lined are given below. Pipes should be reduced by mechanical process or by high-frequency reducers.

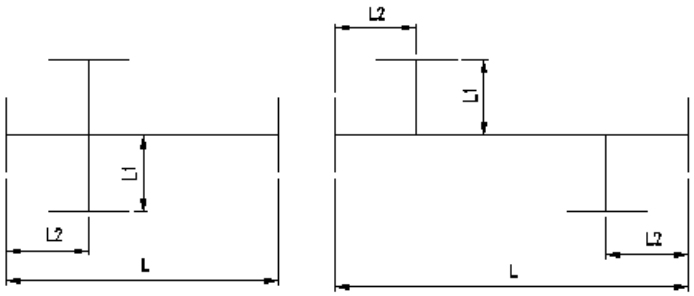
ALL DIMENSIONS IN MILLIMETERS

NOM.DIA	L1 MAX.	L2 MAX.	NOM.DIA	L1 MAX.	L2 MAX.
25	100	2750	200	230	5500
32	120	2750	250	250	5500
40	120	2750	300	300	5500
50	130	5500	350	480	5500
65	150	5500	400	500	5500
80	150	5500	450	530	5500
90	160	5500	500	650	5500
100	160	5500	550	650	5500
125	200	5500	600	650	11000
150	220	5500	700 & above	2000	10000

Note:

- The above tabulation shows sizes which can be fabricated and rubber lined satisfactorily.

DIMENSIONS OF TEES, CROSSES AND BRANCHED PIPES (STEEL) FOR RUBBERLNING FEASIBILITY.



THE DIAMETER OF THE BRANCH(S) SHOULD BE THE SAME OR LESS THAN THAT OF THE STRAIGHT PIPE.

ALL DIMENSIONS IN MILLIMETERS

NOM.DIA	L	L1 MIN.	L2 MAX.
25	2750	80	100
32		85	100
40		90	100
50	5500	100	100
65		115	100
80		125	150
90		135	150
100	5500	145	150
125		165	150
150		190	200
200		225	250
250		270	300
300	5500	310	500
350		340	500
400		370	500
450		410	500
500		450	500
550		490	500
600 & above	12000	see notes below	see notes below

Note: The above tabulation shows sizes which can be fabricated and rubber lined satisfactorily.

5. FLANGES AND GASKETS:

5-1 All branches and outlets of tank should be equipped with flange to allow the rubber lining to over flange face. Typical flanged joints are illustrated in Fig.11.

5-2 Mating flange of sectional tank should be square and plumb, and sections should be made to avoid distortion and when bolted together.

5-3 Normally, soft rubber gaskets should be interposed between lined flanges. If the flange faces have to withstand very high loads, the flanges joint shown in Fig. 11(d) should be used.

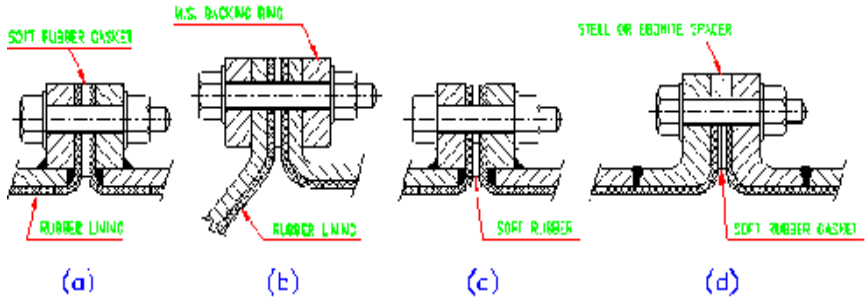


FIG. 11

6. NOTES:

6-1 : Any surface of the base metal to be lined should not be coated with paint or oil.

6-2 : Any surface of the base metal to be lined should not be galvanized.

6-3 : Although it is possible to line on various construction materials, carbon steel is most preferable as substrate. For cast materials special care should be taken to prevent blowholes or cavities.

7. INSPECTION PROCEDURE AND STANDARD FOR LINING PIPES:

Each pipe should be confirmed whether it is ready for rubber lining through checking dimensions, appearances and quality of weld etc. according to the drawings standard for lining.

If any obstacle is detected, repairing should be requested to the fabricator of pipes.

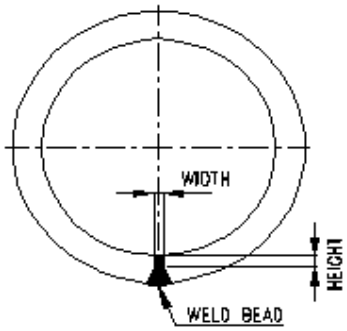
7.1 INSPECTION OF WELD ZONE:

a) Visual inspection:
Weld lines shall be free from weld cavity and spatters shall be completely removed. Under-cut shall be 0.3 mm or less.
Appearance shall be not unsightly.

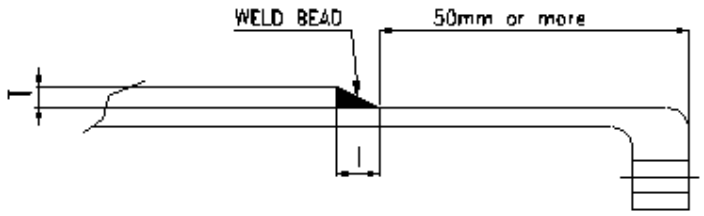
b) Check Curved faces at corner :
Convex shall be 3 mm Radius at least, concave shall be 10 mm Radius at least.

c) Check height and width of weld bead :

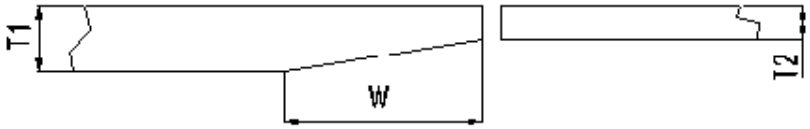
Diameter 550 mm or less :	Diameter 600 mm or larger :
Height - 0.1 ~ 0.2 mm	Height - 1.0 ~ 1.5 mm
Width - 1.5 ~ 2.0 mm	Width - not specified



d) Check finish of bead end:



e) Check butt joint when plates of different thickness is used:



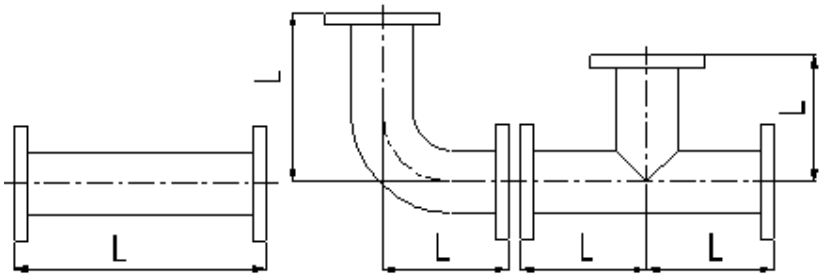
W = ($T_1 - T_2$) x 10 mm or longer

7-2 Visual inspection:

The flange faces to be lined shall be free from disadvantages irregularity.

7-3 Dimensional inspection:

a) Tolerance of length of pipes, bends and tees :



1 = + 0, - 3 (for length of 1000 mm and less)

1 = + 0, - 3 (for length over 1000 mm)

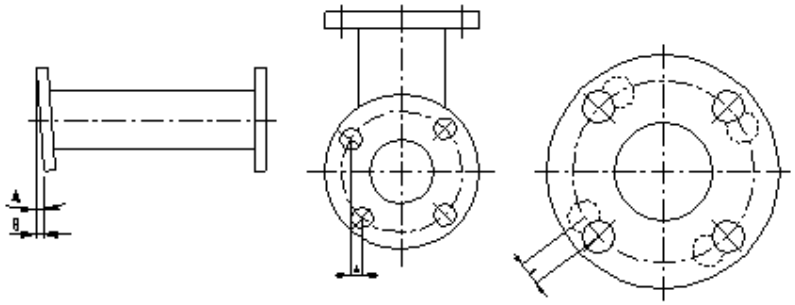
b) Inclination of flange:

A = ± 1/2º

B = max. 5 mm

c) misalignment of bolt holes :

A = ± 1.5 mm



It should be noted that some tanks designed for operation, in vertical position, are to be handled in horizontal position during the various stages of lining. Hence, such vessels should be designed accordingly.

During operation of some rubber lined tanks, such as hydrochloric acid, the fumes / mist emanating out of the tank, tend to corrode the external surface especially at the roof. It may be advisable to provide rubber lining externally especially around the vent nozzles. In such of the tanks, sometimes due to overflow etc. corrosion occurs at the bottom kerbs, also the corrosive medium goes below the surface of the bottom plate. Care must be taken by suitable design to prevent such situations.

In large size tanks, piping, process equipment, suitable lifting lugs should be provided.

If the vessels, pipes require external hot / cold insulation, the steel cleat for holding the insulation should be welded before handing over the fabricated item for rubber lining.

Note:

1. In addition to above, Surface preparation, application including drying & curing of rubber / VE Glass Fake lining, packaging, storage, Inspection etc. shall be as ensured as recommended by OEM's of these lining.

SUB-SECTION-B

FORMAT FOR OPERATION AND MANITENANCE

Format for Operation & Maintenance Manual

Project name :
Project number :
Package Name :
PO reference :
Document number :
Revision number :

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
1.	Cover page				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2.0	Index				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	Description of Plant/System				
3.1	Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 & bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				
3.8	Control philosophy /control write-ups				

4.0	Commissioning Activities (if not covered in separate document i.e. erection manual, commissioning manual)				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	Operation Guidelines for plant personal/user/operator				
5. 1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5. 2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5. 3	Do's & Don't of the equipments.				
5. 4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5. 5	Parameters to be monitored with normal values and limiting values				
5. 6	Trouble shooting with causes and remedial measures				
5. 7	Routine operational checks, recommended logs & records				
5. 8	Changeover schedule if more than one auxiliary for the same purpose is given				
5. 9	Painting requirement and schedule				
5. 10	Inspection, repair , Testing and calibration procedures				
6.0	Maintenance guidelines for plant personal				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				

6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	**Statutory and other specific requirements considerations.**				
8.0	**List of reference documents**				
9.0	**Binding as per requirement**				

SUB-SECTION-C

SITE STORAGE AND PRESERVATION GUIDELINES

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHNANICAL BOPs

(Doc No: PE-DC-SSG-A001 REV.00)

PROJECT ENGINEERING MANAGEMENT, POWER SECTOR

BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

CONTENT

1 SCOPE OF THE DOCUMENT

2 PURPOSE OF STORAGE & PRESERVATION

3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

b) GENERAL PRESERVATION REQUIREMENTS

c) GENERAL INSPECTION REQUIREMENTS

4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT

5. CONCLUSION

6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. ‘No smoking’ signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,

preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.

11. Following preservatives/preservation methods can be used depending upon type of equipment

    a. Rust preventive fluid (RPF)

    b. Rust protective paints

    c. Tarpaulin covers, in case of outdoor storage

    d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –

   - Ingress of moisture and corrosion damages.
   - Damage to protective coating.
   - Open ends in pipes, vessels and equipment -
     - In case any open ends are noticed, same shall be capped.

2. Any damages to equipment / materials.

   - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
   - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere**. (C)

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.

ii **Semi-closed storage**. (S)

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.

iii Open storage (O)

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as “scrap yard” slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.

The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
Raw material /mechanical items like pipes, plates, structure sections etc.)				
1.	Steel pipes (lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage ,	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
Fabricated mechanical items (pressure vessels, tanks etc.)				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
Mechanical components like valves, fittings, cables glands, spares etc.)				
31.	Valves	S	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
32.	Fittings	S	Damage , packing	Provide end cap
33.	Cable glands	C	Damage , packing	
34.	Tools & tackles	C	Damage , packing	
35.	Nut , bolts, washers,	C	Damage , packing	
36.	Gasket & Packings	C	Damage , packing	
37.	Copper tubes	C	Damage , packing, corrosion	Provide end cap
38.	SS tubing	C	Damage , packing	Provide end cap
Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)				
39.	Pumps	S	Damage , packing, corrosion	Shaft rotation
40.	Blowers/Compressors	S	Damage , packing, corrosion	Shaft rotation
41.	Agitators/stirrers/radial launders	C	Damage , packing, corrosion	Shaft rotation
42.	Rollers for chlorine tonner mounting	C	Damage , packing, corrosion	
43.	Centrifuge	S	Damage , packing,	
44.	Gear box	C	Damage , packing, corrosion	
45.	Bearings	C	Damage , packing, corrosion	
46.	Fans	S	Damage , packing, corrosion	
47.	Dosing skids	S	Damage , packing, corrosion	
48.	Pump assemblies	S	Damage , packing, corrosion	
49.	Air washers(INTERNALS)	S	Damage , packing	
50.	Air conditioners (split)	C	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H_2SO_4)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moisture, rain
74.	Alum bricks	C	Damage to packing	Prevent moisture, rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals(powder)	C	Damage, Packing self-life	
77.	Laboratory chemicals(liquid)	C	Damage, Packing self-life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	

Sl. No.	**Description of the equipment**	**Type of Storage**	**Check for**	**Remarks**
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
Electrical and C & I items (motors, cables etc.)				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments(gauges/analysers)	C	Damage	
Special items		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		

5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.

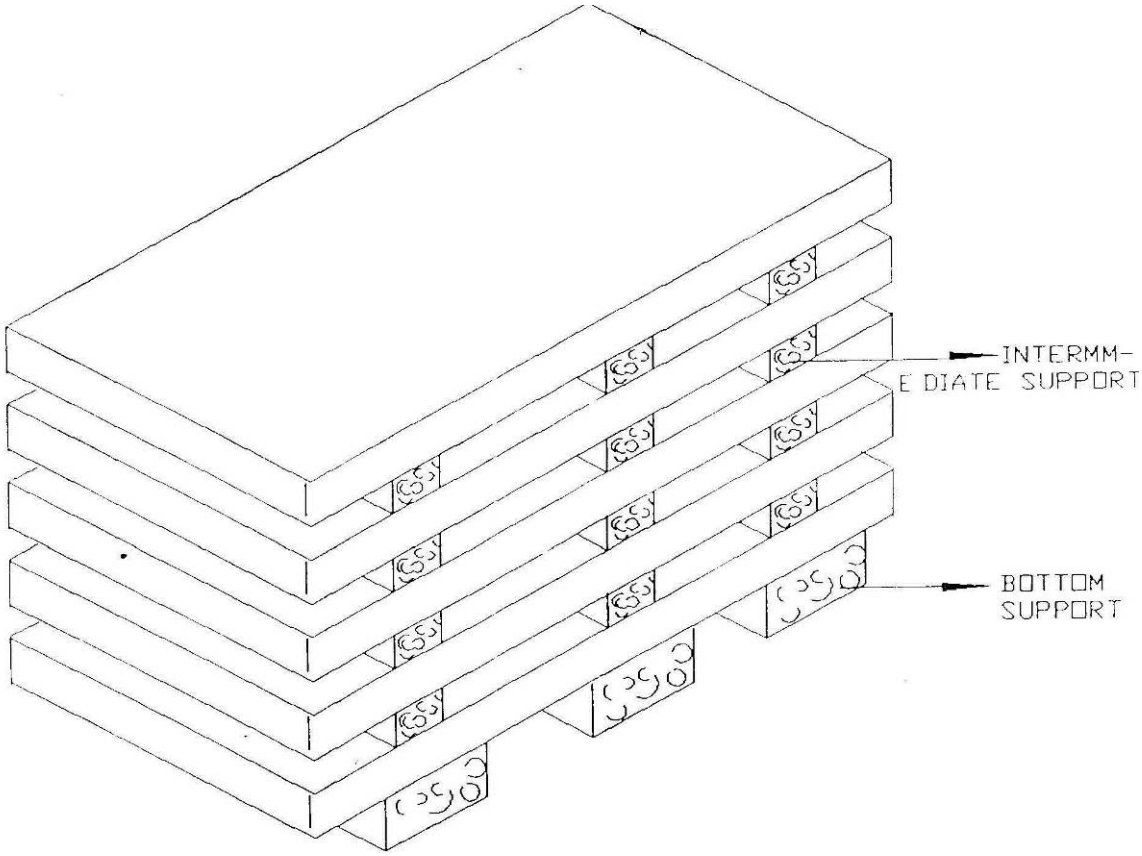


Figure – 1 – PLATE STACKING ARRANGEMENT

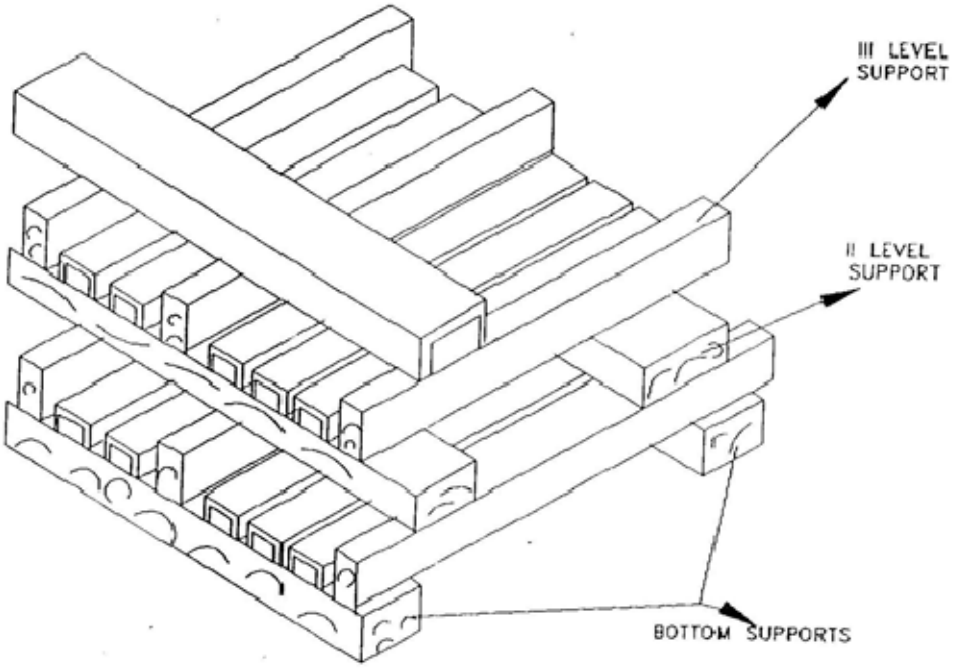


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

BIDDER SHOULD SUBMIT THE SIGNED AND STAMPED COPY OF THE FOLLOWING DOCUMENTS:

1. Compliance cum confirmation certificate (refer annexure-2 of section-III)
2. Pre-bid clarification schedule as per format given under Section-III (Annexure-3), in case of any clarifications.
3. Deviation schedule as per format given under Section-III (Annexure-4), in case of any deviations by bidder.
4. Un priced format for main package (mentioning quoted against each item)
5. Un priced format for Tools and Tackles (mentioning quoted against each item)
6. Un priced format for Commissioning spare (mentioning quoted against each item)
7. List of makes of sub vendor items (refer annexure-6 of section-III)
8. FGD Tanks Schedule & GA Drawing (Typical) with Agitator Platform (refer annexure-8 of section-III)

SECTION-III
ANNEXURE-2

COMPLIANCE CUM CONFIRMATION CERTIFICATE

COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing / stamping this compliance certificate (every sheet) and furnish same with the offer.

a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions, other than those mentioned under "exclusion and those resolved as per 'Schedule of Deviations', with regard to same.

b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'

c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.

d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.

e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL / Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

   For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.

g) All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.

h) Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions

i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site

commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account

j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's / Customer's / Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

k) As built drawings shall be submitted as and when required during the project execution.

l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.

m) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.

n) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

o) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.

SECTION-III
ANNEXURE-3
PRE-BID CLARIFICATION SCHEDULE

PRE-BID CLARIFICATION SCHEDULE

S.No.	Section/Clause/ Page No.	Statement of the referred clause	Clarification required

The bidder hereby certifies that above mentioned are the only clarifications required on the technical specification for the subject package.

SIGNATURE: _____

NAME : _____

DESIGNATION: _____

COMPANY: _____

DATE: _____

COMPANY SEAL

SECTION-III
ANNEXURE-4

SCHEDULE OF TECHNICAL DEVIATION

DEVIATION SHEET (COST OF WITHDRAWL)

TITLE: TECHNICAL SPECIFICATION FOR PACKAGE:- MISC. FGD TANKS
PROJECT: (3X200 MW+3x500 MW) RAMAGUNDAM STAGE-I & II FGD

TECH SPC NO: PE-TS-467-167-A101

TENDER ENQUIRY REFERENCE:-

NAME OF BIDDER:-

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
TECHNICAL DEVIATIONS									
COMMERCIAL DEVIATIONS									

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	**DESIGNATIONS**	**SIGN & DATE**	

NOTES:

1. Cost of withdrawal of deviation will be applicable on the basic price (i.e, excluding taxes, duties & freight) only.
2. All the bidders has to list out all their Technical and Commercial Deviations (if any) in detail in the above format.
3. Any deviation not mentioned above and shown separately of found hidden in offer, will not be taken cognizance of.
4. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable. in the absence of same, such deviation(s) shall not be considered and offer shall be considered in total compliance to NIT
5. Bidder shall furnish price copy of above format along with price bid.
6. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
7. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.
8. For deviations w.r.t. Credit Period, Liquidated damages, Firm prices if a bidder chooses not to give any cost of withdrawal of deviation loading as per **Annexure-VII of GCC, Rev-07** will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.
9. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
10. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in un-priced copy of this format.
11. Cost of withdrawal is to be given separately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.
12. In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.
13.In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.

LIST OF MAKES OF ITEMS

S.N.	ITEM NAME	MANUFACTURER	LOCATION

ANNEXURE-6

LIST OF TOOLS & TACKLES

Bidder shall supply a set of special tools and tackles required either for erection or operation or maintenance of the Tanks units. A list of such tools and tackles shall be submitted along with the offer.

ANNEXURE-7

LIST OF COMMISSIONING SPARES

RAMAGUNDAM STPP- MISC. FGD TANKS PACKAGE

LIST OF COMMISSIONING SPARES (Required for Commissioning of Misc. FGD Tanks)

Break up price for COMMISSIONING SPARES

Sl. no	Description	Qty.	Unit	Unit price	Total Ex-Works Prices duly packed	ED	CST	FREIGHT Inclusive Service Tax	Total price FOR SITE
1	CAF Gasket of each size	2 nos.							
2	Nuts, bolts & washers of each size (nos. of bolts, nuts & washers as required for each nozzle) as per approved Drg.	1 lot							
3	Any other item required for successful commissioning of the tanks including rubber lining (to be specified clearly by bidder)	1 lot							

NOTE -

1. The items indicated in the above list are minimum. Any other spares if required shall be included by bidder in the above list.

2. Bidder shall furnish unit price of commissioning spares in above format alongwith the Bid. Any part even though not mentioned in list furnished but required at later date shall be supplied free of cost.

3.Bidder to note that the items indicated in the above list shall be provided prior to commissioning of the Misc FGD Tanks. Further, items indicated in the list shall be supplied over and above the consummables that is supplied along with the Misc FGD Tanks prior to start up.

ANNEXURE-8

FGD TANKS SCHEDULE

&

GA DRAWING (TYPICAL) WITH AGITATOR PLATFORM

TANK SCHEDULE (Signed and Stamped copy to be sumbmitted with the offer by Bidder)

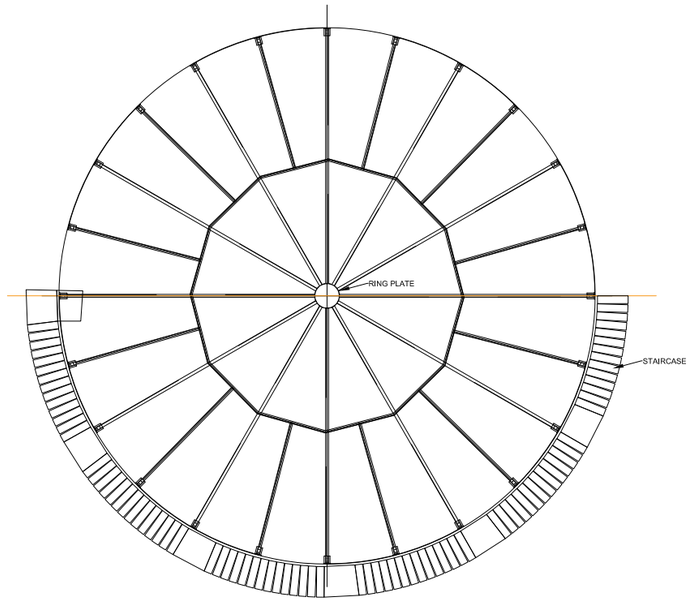
Sl.no.	Description	Primary Hydrocyclone feed tank	Filtrate water tank	Secondary Hydrocyclone feed tank	Waste water Tank	Limestone Slurry Storage tank	Auxiliary Absorbent Tank	Process Water tanks	Belt wash tank	Cake wash tank	Absorber Area Drain Pit	Gypsum Dewatering Area Drain Pit	LIMESTONE AREA DRAIN Pit
1	**Tank Sl No.**	1	2	3	4	5	6	7	8	9	10	11	12
2	**Type of agitator**	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Marine Propeller – Horizontal Type (Side Entry),	Not applicable	Not applicable	Not applicable	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)
3	**Medium to be handled**	Gypsum slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Limestone slurry	Gypsum slurry	Process Water	Process/Clarified Water	Process/Clarified Water	Gypsum slurry	Gypsum slurry	Limestone slurry
4	**Duty**	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Not applicable	Not applicable	Not applicable	Continuous	Continuous	Continuous
5	**Agitator Location**	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Not applicable	Not applicable	Not applicable	Outdoor	Outdoor	Outdoor
6	**Operation**	Continuous	Continuous	Continuous	Continuous	Continuous	Intermittent -Whenever FGD is under maintenance	Not applicable	Not applicable	Not applicable	Intermittent	Intermittent	Intermittent
7	**Pipe Mateial Specification**												
a)	150 Nb & below	SA106 Gr.B (IIR)	SA106 Gr.B (IIR)	SA106 Gr.B (IIR)	SA106 Gr.B (IIR)	SA106 Gr.B (IIR)	SA106 Gr.B (IIR)	SA106 Gr.B (IIR)	SA106 Gr.B (IIR)	SA106 Gr.B (IIR)	SA106 Gr.B (IIR)	SA106 Gr.B (IIR)	SA106 Gr.B (IIR)
b)	Above 150 Nb	IS: 3589 (IIR)	IS: 3589 (IIR)	IS: 3589 (IIR)	IS: 3589 (IIR)	IS: 3589 (IIR)	IS: 3589 (IIR)	IS: 3589 (IIR)	IS: 3589 (IIR)	IS: 3589 (IIR)	IS: 3589 (IIR)	IS: 3589 (IIR)	IS: 3589 (IIR)
8	**Tank details**												
a)	Tank Shape	Vertical cylindrical fixed cone roof	Vertical cylindrical fixed cone roof	Vertical cylindrical fixed cone roof	Vertical cylindrical fixed cone roof	Vertical cylindrical fixed cone roof	Vertical cylindrical fixed cone roof	Vertical cylindrical fixed cone roof	Vertical cylindrical fixed cone roof	Vertical cylindrical fixed cone roof	Rectangular	Rectangular	Rectangular
c)	Tank name	Primary Hydrocyclone feed tank	Filtrate water tank	Secondary Hydrocyclone feed tank	Waste water Tank	Limestone Slurry Storage tank	Auxiliary Absorbent Tank	Process water tanks	Belt wash tank	Cake wash tank	Absorber Area Drain Pit	Gypsum Dewatering Area Drain Pit	Limestone Area Drain Pit
d)	Tank Quantity (in No.)	1	1	1	1	2	1	2	2	2	4	1	1
	Capacity of Tank (in m3)												
e)	Capacity (Hold Volume)	322.50	158.30	189.40	427.20	2261.94	1818.00	215.69	43.98	43.98	56.00	56.00	56.00
f)	Capacity (Effective)	260.65	118.75	149.85	356.88	2509.34	1789.23	159.27	26.39	26.39	27.20	27.20	27.20
	Dimension (in m)												
g)	Diameter	7.5	6.0	6.0	8.0	15.0	13.5	6.5	4.0	4.0	-	-	-
h)	Length	-	-	-	-	-	-	-	-	-	4	4	4
i)	Breadth	-	-	-	-	-	-	-	-	-	4	4	4
j)	Height	7.8	6.1	7.2	9.0	15.0	13.5	7.0	4.0	4.0	4	4	4
2.7	Minimum liquid level in the tank	1.0	1.0	1.0	1.0	1.0	1.0	1.3	1.0	1.0	1.4	1.4	1.4
2.8	Normal liquid level in the tank	7.1	5.4	6.5	8.3	14.0	12.5	6.3	3.3	3.3	3.3	3.3	3.3
2.9	Maximum liquid level in the tank	7.3	5.6	6.7	8.5	14.2	12.7	6.5	3.5	3.5	3.5	3.5	3.5
9	**Quantity of Agitator per tank**	1	1	1	1	1	3 (horizontaly mounted in One tank)	Not applicable	Not applicable	Not applicable	1	1	1
10	**Total quantity of agitators (for two units)**	1	1	1	1	2	3 (horizontaly mounted in One tank)	Not applicable	Not applicable	Not applicable	4	1	1
11 (i)	**Slurry Analysis**												
a)	Slurry to be handled	Gypsum slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Limestone slurry	Gypsum slurry	Water	Water	Water	Gypsum slurry	Gypsum slurry	Limestone slurry
b)	Maximum solid particle size	200 mesh (74 µ)	6-7 mm	200 mesh (74 µ)	200 mesh (74 µ)	200 mesh (74 µ)	200 mesh (74 µ)	-	-	-	6-7 mm	6-7 mm	6-7 mm
c)	Normal solid particle size, d50	325 mesh (44 µ)	6-7 mm	325 mesh (44 µ)	325 mesh (44 µ)	325 mesh (44 µ)	325 mesh (44 µ)	-	-	-	6-7 mm	6-7 mm	6-7 mm
d)	Solid to be handled	gypsum along with Limestone & other impurities	gypsum along with Limestone & other impurities	gypsum along with Limestone & other impurities	gypsum along with Limestone & other impurities	Limestone + impurities	gypsum along with Limestone & other impurities	-	-	-	gypsum along with Limestone & other impurities	gypsum along with Limestone & other impurities	Limestone + impurities
e)	Chloride concentration	max 25000 ppm	max 25000 ppm	max 25000 ppm	max 25000 ppm	max 1000 ppm	max 25000 ppm	-	-	-	max 25000 ppm	max 25000 ppm	max 1000 ppm
f)	Hardness of particle	5-7 mohs scale	5-7 mohs scale	5-7 mohs scale	5-7 mohs scale	5-7 mohs scale	5-7 mohs scale	-	-	-	5-7 mohs scale	5-7 mohs scale	5-7 mohs scale
g)	Slurry concentration, wt%	30 wt%	11%	16.60%	3%	30 wt%	30%	-	-	-	30%	30%	30 wt%
h)	Sp. Gravity of slurry	1.216	1.067	1.023	1.023	1.215	1.216	-	-	-	1.216	1.216	1.215
i)	Sp. Gravity of Lime Stone & Gypsum	2.32(avg)	2.32(avg)	2.32(avg)	2.32(avg)	2.32(avg)	2.32(avg)	-	-	-	2.32(avg)	2.32(avg)	2.32(avg)
j)	Viscosity of Slurry	10 cP	4 cP	4 cP	3 cP	30 cP	10 cP	-	-	-	10 cP	10 cP	30 cP
k)	pH	4 to 8	4 to 8	4 to 8	4 to 8	5 to 8	4 to 8	-	-	-	4 to 8	4 to 8	5 to 8
l)	SiO_2 Content	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	-	-	-	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l
m)	Temperature	Normal -61.4 deg C; Design-70 deg C.	Normal -58 deg C; Design-70 deg C	Normal -61.4 deg C; Design-70 deg C.	Normal -61.4 deg C; Design-70 deg C.	Normal -45 deg C; Design-55 deg C.	Normal -61.4 deg C; Design-70 deg C.	36 deg C	Normal -58 deg C; Design- 70 deg C.	Normal -58 deg C; Design- 70 deg C.	Normal -61.4 deg C; Design-70 deg C.	Normal -61.4 deg C; Design-70 deg C.	Normal -45 deg C; Design-55 deg C.
11(ii)	**Process water Analysis**												
a)	Calcium as CaCO3	-	-	-	-	-	-	104	104	104	-	-	-
b)	Magnesium as CaCO3	-	-	-	-	-	-	88	88	88	-	-	-

c)	Chlorides as CaCO3	-	-	-	-	-	-	54	54	54	-	-	-
d)	Sulphate as CaCO3	-	-	-	-	-	-	46	46	46	-	-	-
e)	Alkalinity as CaCo3	-	-	-	-	-	-	0	0	0	-	-	-
f)	Total Iron as Fe	-	-	-	-	-	-	0.5	0.5	0.5	-	-	-
g)	Total Silica as SiO2	-	-	-	-	-	-	5	5	5	-	-	-
h)	pH	-	-	-	-	-	-	7.0-7.8	7.0-7.8	7.0-7.8	-	-	-
i)	Turbidity as NTU	-	-	-	-	-	-	10	10	10	-	-	-
12	**Inside Lining of tank (Refer Note-3)**												
a)	Lining specification	4MM thick of best quality bromine butyl rubber lining with hardness 55+/-5 (Shore A hardness)	3MM thick Vinyl Ester based flake glass lining	3MM thick Vinyl Ester based flake glass lining	3MM thick Vinyl Ester based flake glass lining	5MM thick of best quality bromobutyl rubber lining with hardness 55+/-5 (Shore A hardness)	4MM thick of best quality bromine butyl rubber lining with hardness 55+/-5 (Shore A hardness)	Epoxy lining minimum three coats of 150 microns thickness	Epoxy lining minimum three coats of 150 microns thickness	Epoxy lining minimum three coats of 150 microns thickness	3MM thick Vinyl Ester based flake glass lining	3MM thick Vinyl Ester based flake glass lining	3MM thick Vinyl Ester based flake glass lining
13	**MATERIAL SPECIFICATION**												
a)	Shell, Roff, Base and Baffle Plate	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	NA	NA	NA
b)	Structures	IS:2062 E250 GRADE A/BR	IS:2062 E250 GRADE A/BR	IS:2062 E250 GRADE A/BR	IS:2062 E250 GRADE A/BR	IS:2062 E250 GRADE A/BR	IS:2062 E250 GRADE A/BR	IS:2062 E250 GRADE A/BR	IS:2062 E250 GRADE A/BR	IS:2062 E250 GRADE A/BR	IS:2062 E250 GRADE A/BR	IS:2062 E250 GRADE A/BR	IS:2062 E250 GRADE A/BR
c)	Stairways & Platforms	IS:2062 E250 GRADE A/BR	IS:2062 E250 GRADE A/BR	IS:2062 E250 GRADE A/BR	IS:2062 E250 GRADE A/BR	IS:2062 E250 GRADE A/BR	IS:2062 E250 GRADE A/BR	IS:2062 E250 GRADE A/BR	IS:2062 E250 GRADE A/BR	IS:2062 E250 GRADE A/BR	NA	NA	NA
d)	Manhole	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	NA	NA	NA
e)	Nozzle	A106 Gr B	A106 Gr B	A106 Gr B	A106 Gr B	A106 Gr B	A106 Gr B	A106 Gr B	A106 Gr B	A106 Gr B	NA	NA	NA
f)	Nozzle Flanges	DN25 - DN600: IS 2062 Gr.B (plate) SO FF ASME B 16.5 Cl.150 DN650 - DN1800: IS 2062 Gr.B (plate) SO FF AWWA-C207 Cl.D	DN25 - DN600: IS 2062 Gr.B (plate) SO FF ASME B 16.5 Cl.150 DN650 - DN1800: IS 2062 Gr.B (plate) SO FF AWWA-C207 Cl.D	DN25 - DN600: IS 2062 Gr.B (plate) SO FF ASME B 16.5 Cl.150 DN650 - DN1800: IS 2062 Gr.B (plate) SO FF AWWA-C207 Cl.D	DN25 - DN600: IS 2062 Gr.B (plate) SO FF ASME B 16.5 Cl.150 DN650 - DN1800: IS 2062 Gr.B (plate) SO FF AWWA-C207 Cl.D	DN25 - DN600: IS 2062 Gr.B (plate) SO FF ASME B 16.5 Cl.150 DN650 - DN1800: IS 2062 Gr.B (plate) SO FF AWWA-C207 Cl.D	DN25 - DN600: IS 2062 Gr.B (plate) SO FF ASME B 16.5 Cl.150 DN650 - DN1800: IS 2062 Gr.B (plate) SO FF AWWA-C207 Cl.D	DN25 - DN600: IS 2062 Gr.B (plate) SO FF ASME B 16.5 Cl.150 DN650 - DN1800: IS 2062 Gr.B (plate) SO FF AWWA-C207 Cl.D	DN25 - DN600: IS 2062 Gr.B (plate) SO FF ASME B 16.5 Cl.150 DN650 - DN1800: IS 2062 Gr.B (plate) SO FF AWWA-C207 Cl.D	DN25 - DN600: IS 2062 Gr.B (plate) SO FF ASME B 16.5 Cl.150 DN650 - DN1800: IS 2062 Gr.B (plate) SO FF AWWA-C207 Cl.D	NA	NA	NA
g)	Nozzle Reinforcement	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	NA	NA	NA
h)	Nozzle Necks	IS:1239	IS:1239	IS:1239	IS:1239	IS:1239	IS:1239	IS:1239	IS:1239	IS:1239	NA	NA	NA
i)	Hand Railing	IS 1239 (MEDIUM), GALVANIZED	IS 1239 (MEDIUM), GALVANIZED	IS 1239 (MEDIUM), GALVANIZED	IS 1239 (MEDIUM), GALVANIZED	IS 1239 (MEDIUM), GALVANIZED	IS 1239 (MEDIUM), GALVANIZED	IS 1239 (MEDIUM), GALVANIZED	IS 1239 (MEDIUM), GALVANIZED	IS 1239 (MEDIUM), GALVANIZED	IS 1239 (MEDIUM), GALVANIZED	IS 1239 (MEDIUM), GALVANIZED	IS 1239 (MEDIUM), GALVANIZED
j)	Gaskets	BUTYL RUBBER	BUTYL RUBBER	BUTYL RUBBER	BUTYL RUBBER	BUTYL RUBBER	BUTYL RUBBER	BUTYL RUBBER	BUTYL RUBBER	BUTYL RUBBER	IS: 1367 CLASS 4.4	IS: 1367 CLASS 4.4	IS: 1367 CLASS 4.4
k)	Bolts & Nuts	SA 193 GR B7 & SA 194 GR 2H	SA 193 GR B7 & SA 194 GR 2H	SA 193 GR B7 & SA 194 GR 2H	SA 193 GR B7 & SA 194 GR 2H	SA 193 GR B7 & SA 194 GR 2H	SA 193 GR B7 & SA 194 GR 2H	SA 193 GR B7 & SA 194 GR 2H	SA 193 GR B7 & SA 194 GR 2H	SA 193 GR B7 & SA 194 GR 2H	SA 193 GR B7 & SA 194 GR 2H	SA 193 GR B7 & SA 194 GR 2H	SA 193 GR B7 & SA 194 GR 2H
l)	Fittings	DN25 - DN50: SW A234-WPB ASME-B16.11 DN65 - DN500: BW A234-WPB ASME-B16.9 DN550 & above: IS 2062 Gr.B (plate formed) ASME-B16.9	DN25 - DN50: SW A234-WPB ASME-B16.11 DN65 - DN500: BW A234-WPB ASME-B16.9 DN550 & above: IS 2062 Gr.B (plate formed) ASME-B16.9	DN25 - DN50: SW A234-WPB ASME-B16.11 DN65 - DN500: BW A234-WPB ASME-B16.9 DN550 & above: IS 2062 Gr.B (plate formed) ASME-B16.9	DN25 - DN50: SW A234-WPB ASME-B16.11 DN65 - DN500: BW A234-WPB ASME-B16.9 DN550 & above: IS 2062 Gr.B (plate formed) ASME-B16.9	DN25 - DN50: SW A234-WPB ASME-B16.11 DN65 - DN500: BW A234-WPB ASME-B16.9 DN550 & above: IS 2062 Gr.B (plate formed) ASME-B16.9	DN25 - DN50: SW A234-WPB ASME-B16.11 DN65 - DN500: BW A234-WPB ASME-B16.9 DN550 & above: IS 2062 Gr.B (plate formed) ASME-B16.9	DN25 - DN50: SW A234-WPB ASME-B16.11 DN65 - DN500: BW A234-WPB ASME-B16.9 DN550 & above: IS 2062 Gr.B (plate formed) ASME-B16.9	DN25 - DN50: SW A234-WPB ASME-B16.11 DN65 - DN500: BW A234-WPB ASME-B16.9 DN550 & above: IS 2062 Gr.B (plate formed) ASME-B16.9	DN25 - DN50: SW A234-WPB ASME-B16.11 DN65 - DN500: BW A234-WPB ASME-B16.9 DN550 & above: IS 2062 Gr.B (plate formed) ASME-B16.9	NA	NA	NA
m)	Earthing Lugs	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	NA	NA	NA
n)	Anchor Bolt	IS 1367 PART 3, CLASS 4.4	IS 1367 PART 3, CLASS 4.4	IS 1367 PART 3, CLASS 4.4	IS 1367 PART 3, CLASS 4.4	IS 1367 PART 3, CLASS 4.4	IS 1367 PART 3, CLASS 4.4	IS 1367 PART 3, CLASS 4.4	IS 1367 PART 3, CLASS 4.4	IS 1367 PART 3, CLASS 4.4	NA	NA	NA
o)	Fasteners used in wetted condition	ALLOY 926 or BETTER MATERIAL	ALLOY 926 or BETTER MATERIAL	ALLOY 926 or BETTER MATERIAL	ALLOY 926 or BETTER MATERIAL	ALLOY 926 or BETTER MATERIAL	ALLOY 926 or BETTER MATERIAL	ALLOY 926 or BETTER MATERIAL	ALLOY 926 or BETTER MATERIAL	ALLOY 926 or BETTER MATERIAL	ALLOY 926 or BETTER MATERIAL	ALLOY 926 or BETTER MATERIAL	ALLOY 926 or BETTER MATERIAL
14	**DESIGN DATA**												
a)	Design Code	IS:803 1976 (REAFFIRMED 2013) or latest	IS:803 1976 (REAFFIRMED 2013) or latest	IS:803 1976 (REAFFIRMED 2013) or latest	IS:803 1976 (REAFFIRMED 2013) or latest	IS:803 1976 (REAFFIRMED 2013) or latest	IS:803 1976 (REAFFIRMED 2013) or latest	IS:803 1976 (REAFFIRMED 2013) or latest	IS:803 1976 (REAFFIRMED 2013) or latest	IS:803 1976 (REAFFIRMED 2013) or latest	NA	NA	NA
b)	Roof Slope	5°	5°	5°	5°	5°	5°	5°	5°	5°	NA	NA	NA
c)	Design Pressure	Hydrostatic Head	Hydrostatic Head	Hydrostatic Head	Hydrostatic Head	Hydrostatic Head	Hydrostatic Head	Hydrostatic Head	Hydrostatic Head	Hydrostatic Head	NA	NA	NA
d)	Operating Pressure	Atmospheric	Atmospheric	Atmospheric	Atmospheric	Atmospheric	Atmospheric	Atmospheric	Atmospheric	Atmospheric	NA	NA	NA
e)	Hydro Testing	Water filled head upto overflow nozzle	Water filled head upto overflow nozzle	Water filled head upto overflow nozzle	Water filled head upto overflow nozzle	Water filled head upto overflow nozzle	Water filled head upto overflow nozzle	Water filled head upto overflow nozzle	Water filled head upto overflow nozzle	Water filled head upto overflow nozzle	NA	NA	NA
f)	Joint Efficiency	As per IS	As per IS	As per IS	As per IS	As per IS	As per IS	As per IS	As per IS	As per IS	NA	NA	NA
g)	Radiography	As per IS	As per IS	As per IS	As per IS	As per IS	As per IS	As per IS	As per IS	As per IS	NA	NA	NA
h)	Corrosion Allowance	1.5 MM for Shell & Bottom plate	1.5 MM for Shell & Bottom plate	1.5 MM for Shell & Bottom plate	1.5 MM for Shell & Bottom plate	1.5 MM for Shell & Bottom plate	1.5 MM for Shell & Bottom plate	1.5 MM for Shell & Bottom plate	1.5 MM for Shell & Bottom plate	1.5 MM for Shell & Bottom plate	NA	NA	NA
i)	Wind Code	As per specification	As per specification	As per specification	As per specification	As per specification	As per specification	As per specification	As per specification	As per specification	NA	NA	NA
j)	Seismic Code	As per specification	As per specification	As per specification	As per specification	As per specification	As per specification	As per specification	As per specification	As per specification	NA	NA	NA
k)	Roof Plate Thichness	8	8	8	8	8	8	8	8	8	NA	NA	NA

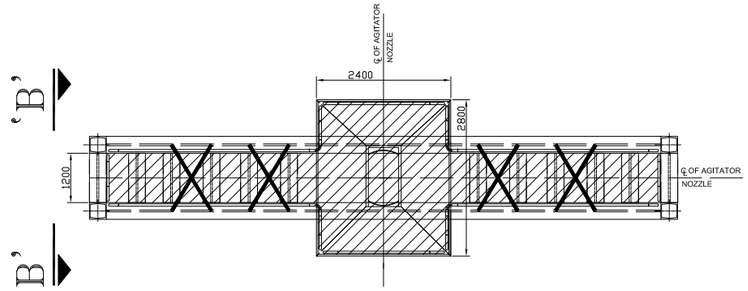
l)	Shell Plate Thichness	As per design code, min. 6 mm	As per design code, min. 6 mm	As per design code, min. 6 mm	As per design code, min. 6 mm	As per design code, min. 14 mm for 1st & 2nd coarse of shell,12 mm for 3rd coarse, 10 mm for 4th coarse and 6 mm min. for other coase of shell	As per design code, min. 12 mm for 1st coarse,10 mm for 2nd coarse of shell and 8 mm min. for other coase of shell	As per design code, min. 6 mm	As per design code, min. 6 mm	As per design code, min. 6 mm	NA	NA	NA
m)	Bottom Plate Thichness	8	8	8	8	8	8	8	8	8	NA	NA	NA
n)	Insulation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
15	**Agitators load**												
15.1	Static Load (kg)	2274	1280	1280	2274	10768	7000	Not applicable	Not applicable	Not applicable	500	500	500
15.2	Dynamic load (Kg)	4548	2560	2560	4548	21536	14000	Not applicable	Not applicable	Not applicable	1100	1100	1100
16	**Nozzles Details**												
16.1	Sizes & Qty.	**500 NB**	**500 NB**	**500 NB**	**500 NB**	**700NB**	**200NB**	Not applicable	Not applicable	Not applicable	**150NB**	**150NB**	**150NB**
17	**Size and Number of Anchor Bolts per tank**	M24 x 16 nos	M20 x 12 nos	M24 x 12 nos	M30x 16 nos	M42 x 40 nos	M42 x 32 nos	M24x 12 nos	M20 x 4 nos	M20 x 4 nos	Not applicable	Not applicable	Not applicable

Notes	
1	The absorber area Drain Pit, Gypsum dewateriag area Drain Pit, Limestone area Drain Pit is exluded from bidder scope of work. However, the supply, erection and commissioning of the VE Glass Flake lining within the pit shall be in bidder's scope. Further the erection of the agitators within the mentioned pits shall be in bidder's scope of work. The agitator shall be free issued by BHEL, however the agitator mounting structure and access platform is in bidder's scope of supply. BHEL shall also arrange the supervision of Erection and commisssioning activity.
2	The loading details of agitator is for estimation purpose only. Bidder shall not claim any additional cost on account of change in agitator loading during detail endineering.
3	For detailed scope of work refer the technical specification.
4	For nozzle details for each type of tank, bidder to refer annexure- 10 nozzle schedule of tanks. Bidder shall not claim any additional cost on account of change in nozzle dimensions & quantity during detail endineering.
5	Outside nozzle projection is 200mm unless otherwise specified.
6	Nozzle reinforcements shall be as per is:803.
7	Nozzle projections are measured from tank shell inner to the flange face as applicable.
8	All reinforcement pads shall be provided with 6mm telltale hole.
9	Nozzle and flange details shall be as per is:803.
10	All bolt holes shall straddle vertical centerlines on shell and radial on roof.
11	All protrusions, sharp edges and spatter, etc. Shall be removed from the surface and all welds ground smooth without any cavities and imperfection before lining.
12	Hydro test shall be as per is803. Lining shall be carried-out after hydro test.
13	All longitudinal joints shall be staggered.
14	Bottom plate shall uniformly rest on the foundation.
15	The minimum size of weld shall be equal to the thickness of thinner member joint unless specified otherwise.
16	Earthing lug shall be welded to tank body at site to suit site requirement.
17	Painting shall be as per approved painting schedule.

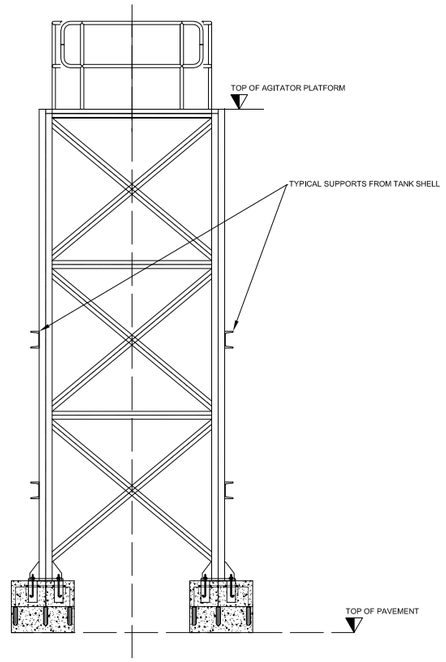
DRAWING NO. 3-FW-000-00-505



PLAN



DETAILS OF PLATFORM FOR AGITATORS



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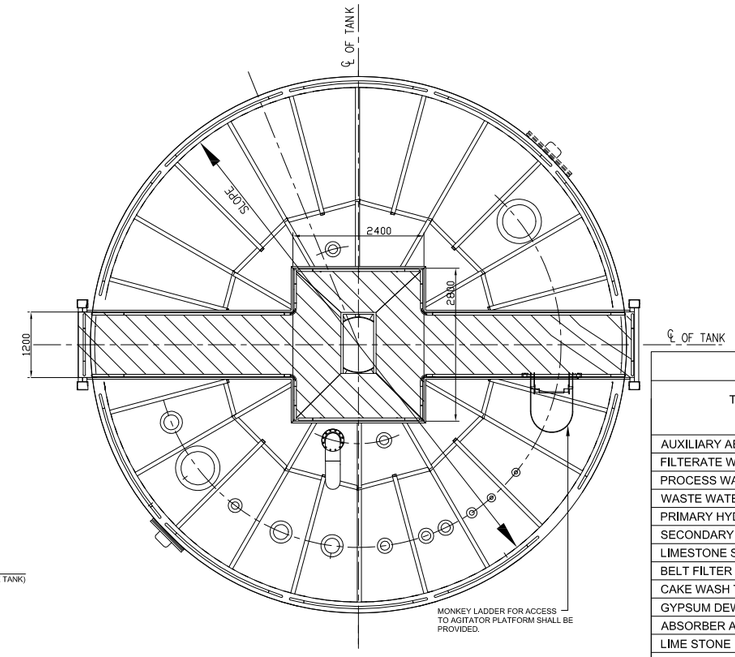

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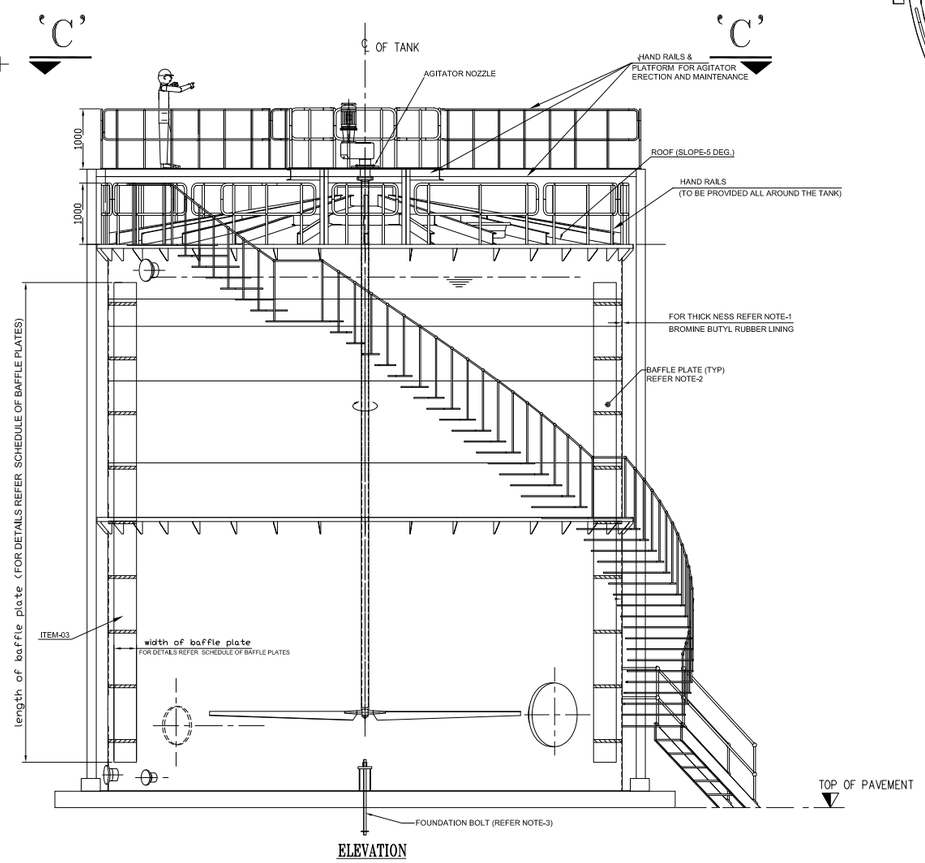
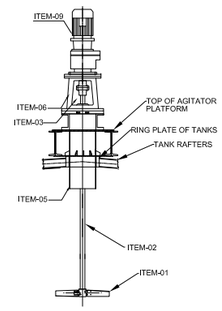


ELEVATION

SCHEDULE OF BAFFLE PLATES

TANK NAME	TANK DIA.(in M)	TANK HT.(in M)	BAFFLE PLATE DETAILS (All Dimensions in MM) (*)				REMARKS
			NOS./TANK	APPROX. LENGTH	APPROX. WIDTH	APPROX. THK.	
AUXILIARY ABSORBER TANK	13.5	13.5	-	-	-	-	BAFFLE PLATES NOT APPLICABLE
FILTERATE WATER TANK	6.0	6.1	04	4625	450	16	
PROCESS WATER TANK	6.5	7.0	-	-	-	-	AGITATOR/BAFFLE PLATES NOT APPLICABLE
WASTE WATER TANK	8.0	9.0	04	7175	650	16	
PRIMARY HYDROCYCLONE TANK	7.5	7.8	04	6050	600	16	
SECONDARY HYDROCYCLONE TANK	6.0	7.2	04	4625	450	12	
LIMESTONE SLURRY STORAGE TANK	15	15	04	11708	1200	32	
BELT FILTER WASH TANK	4.0	4.4	-	-	-	-	AGITATOR/BAFFLE PLATES NOT APPLICABLE
CAKE WASH TANK	4.0	4.4	-	-	-	-	AGITATOR/BAFFLE PLATES NOT APPLICABLE
GYPSUM DEWATERING AREA DRAIN PIT	4 (L) X 4 (W) X 4 (H)		-	-	-	-	BAFFLE PLATES NOT APPLICABLE
ABSORBER AREA DRAIN PIT	4 (L) X 4 (W) X 4 (H)		-	-	-	-	BAFFLE PLATES NOT APPLICABLE
LIME STONE AREA DRAIN PIT	4 (L) X 4 (W) X 4 (H)		-	-	-	-	BAFFLE PLATES NOT APPLICABLE

(*) THERE MAY BE A (+/-)10% VARIATION IN THE DIMENSIONS . EXACT DIMENSIONS SHALL BE DECIDED DURING DETAIL ENGINEERING.



NOTES:

1. FOR THICKNESS AND SPECIFICATION OF RUBBER LINING, REFER TECHNICAL SPECIFICATION.
2. THE MINIMUM NO. OF FOUNDATION BOLTS HAVE BEEN SPECIFIED IN TANK SCHEDULE. THE FINAL QUANTITY SHALL BE DECIDED DURING DETAIL ENGINEERING.
3. ALL DIMENSIONS, UNLESS OTHERWISE MENTIONED, SHALL BE IN MM.
4. FOR TANK SCHEDULE, REFER ANNEXURE -8, SECTION-III OF TECHNICAL SPECIFICATION .
5. 8MM THICK CHEQUERED PLATES SHALL BE CONSIDERED ON ALL AGITATOR PLATFORMS.
6. THE LOCATION AND ORIENTATION OF PLATFORM/STAIRCASE ARE REPRESENTATIVE ONLY. FINAL LOCATION AND ORIENTATION SHALL BE DECIDED DURING DETAIL ENGINEERING BASED ON THE ACTUAL LAYOUT.
7. THE NOZZLES SHOWN IN THE DRAWING IS INDICATIVE ONLY.
8. FOR SIDE MOUNTED AGITATORS MOUNTING ON AUXILARY ABSORBER TANK, REFER SKETCH-002
9. DRAWING TO BE READ IN CONJUNCTION WITH TANK SCHEDULE
10. THIS IS TYPICAL DRAWING FOR VERTICAL AGITATOR MOUNTING IN CYLINDERICAL TANKS.
11. FOR TANKS DIA(D) AND HEIGHT(H), BIDDER SHALL REFER TECHNICAL SPECIFICATION.

S.NO	ITEM	SUPPLY	E&C	REMARKS
1	Impeller Blades	BHEL	BIDDER	SUPERVISION OF ERECTION OF AGITATORS BY AGITATOR SUPPLIER (SHALL BE ARRANGED BY BHEL), COMMISSIONING BY AGITATOR SUPPLIER
2	Shafts	BHEL	BIDDER	
3	Coupling arrangement (Flexible)	BHEL	BIDDER	
4	Gland Packing, Seals, O Rings, Glands	BHEL	BIDDER	
5	Shaft Sleeve	BIDDER	BIDDER	
6	Lantern Stools (Bearing Housing), Safety Guard	BHEL	BIDDER	
7	Bearings	BHEL	BIDDER	
8	AGITATOR Mounting Flanges with gaskets and fasteners	BIDDER	BIDDER	
9	Drive Motor(IE3) with gearbox arrangement	BHEL	BIDDER	
10	Mating Flange for Supporting on Slurry Tank Roof	BIDDER	BIDDER	
11	Baffle plate (Min 04 nos per tank)	BIDDER	BIDDER	

NTPC DRG. No.

PROJECT: (3X200 MW+3x500 MW) RAMAGUNDAM STAGE-I & II FGD (SYSTEM : FLUE GAS DESULPHURIZATION)

CUSTOMER: NTPC

BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA

DEPT CODE		NAME	SIGN	DATE
M	DRN			
	CHD			
	APPD			

TITLE: TYPICAL ARRANGEMENT OF VERTICAL MOUNTED AGITATOR AND AGITATOR PLATFORM, BAFFLE PLATES

SCALE : NTS

DRAWING NO. SKETCH-001

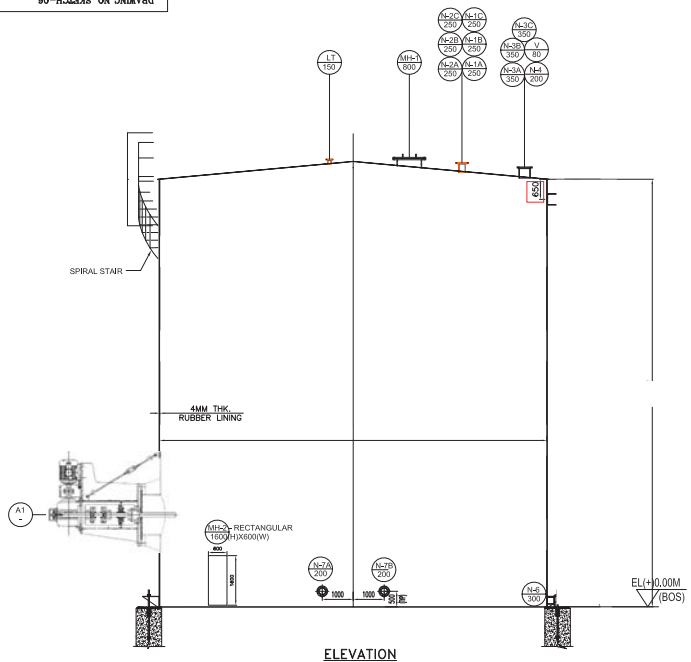
SH 01 OF 02

REV. 00

Size A1

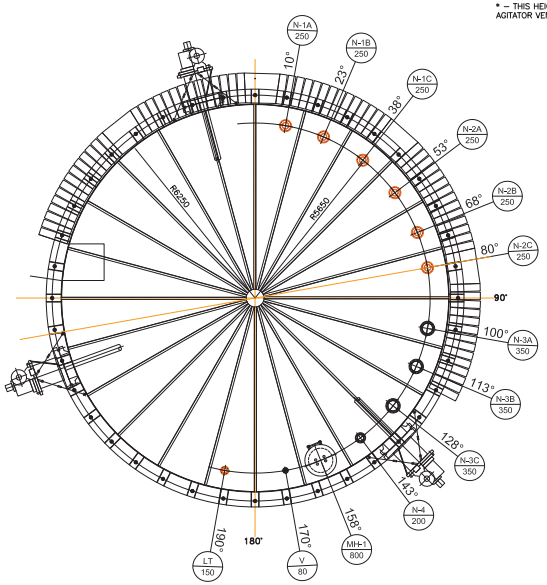
CAUTION: THE DRAWING IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LTD. AND IS NOT TO BE REPRODUCED OR USED TO FURNISH ANY INFORMATION FOR MAKING OF DRAWINGS OF APPARATUS EXCEPT WHERE PROVIDED FOR AGREEMENT WITH SAID COMPANY.

DRAWING NO. SKETCH-06



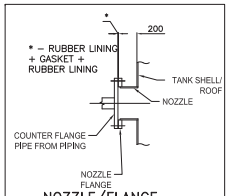
ELEVATION

* – THIS HEIGHT WILL BE DECIDED BASED ON AGITATOR VENDOR RECOMMENDATION



PLAN

** AGITATOR SHOWN ARE INDICATIVE WILL BE FINALIZED DURING DETAIL ENGINEERING.
*** NOZZLE LOCATION SHOWN IN DRAWING ARE INDICATIVE WILL BE FINALIZED DURING DETAIL ENGINEERING.



NOZZLE/FLANGE CONNECTION (TYPICAL)

NOTE
1) All supporting arrangement along with the mounting flange shall be in bidders scope.
2) The erection of the agitator shall be in bidder's scope. The agitators shall be provided as free issue item by BHEL. Further the supervision of the erection shall be arranged by BHEL.
3)Commissioning of agitator is excluded from the scope of bidder.
4) There shall be minimum 3nos. of agitator for the absorber tank

REV.	DATE	ALTD	CKD.	APPD.
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CAUTION: THIS DRAWING IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LTD.,AND IS NOT TO BE REPRODUCED OR USED TO FURNISH ANY INFORMATION FOR MAKING OF PURCHASE OR AGENCY PURCHASE WITHOUT PRIOR WRITTEN AGREEMENT WITH SAID COMPANY.

PROJECT: (3X200 MW+3x500 MW) RAMAGUNDAM STAGE-I & II FGD
(SYSTEM : FLUE GAS DESULPHURIZATION)

CUSTOMER: NTPC LIMITED. (A GOVERNMENT OF INDIA ENTERPRISE)

BHARAT HEAVY ELECTRICALS LIMITED. UNIT: BOILER AUXILIARIES PLANT. HARIDWAR-852 408.

DEPT CODE		NAME	SIGN	DATE
M	DRN			
	CHD			
	APPD			

TITLE: GENERAL ARRANGEMENT AND DATA SHEET OF AUXILIARY ABSORBENT (STORAGE) TANK

SCALE : NTS

DRAWING NO.

REV.00

Size A1

SECTION-III

ANNEXURE-9

MATERIAL OF CONSTRUCTION

PROJECT : (3X200 MW+3x500 MW) RAMAGUNDAM STAGE-I & II FGD			
ANNEXURE-9			
Material of construction			
Item	**Size**	**Thickness**	**Standard & Specification**
PIPING	DN25 - DN50	Heavy	IS 1239 SML SW
	DN65 - DN150	Heavy	IS 1239 ERW BW
	DN200 - DN300	SCH20	IS 3589 Gr.410 ERW BE
	DN350 - DN500	SCH10	IS 3589 Gr.410 ERW BE
	DN550 - DN1000	7.9T	IS 3589 Gr.410 ERW BE
	DN1100 - DN1200	9.5T	IS 3589 Gr.410 ERW BE
	DN1350 - DN1500	11.9T	IS 3589 Gr.410 ERW BE
	DN1600 - DN1800	12.7T	IS 3589 Gr.410 ERW BE
FITTING	DN25 - DN50	Suit to PIPE	SW A234-WPB ASME-B16.11
	DN65 - DN500	Suit to PIPE	BW A234-WPB ASME-B16.9
	DN550 & above	Suit to PIPE	IS 2062 Gr.B (plate formed) ASME-B16.9
FLANGES	DN25 - DN600	-	IS 2062 Gr.B (plate) SO FF ASME B 16.5 Cl.150
	DN650 - DN1800	-	IS 2062 Gr.B (plate) SO FF AWWA-C207 Cl.D
MS PLATES	-		IS 2062 GR.B
STRCUTURE (ANGLE, CHANNEL, BEAM, BAR,FLAT ETC.)	-		IS 2062 GR.A /B
HANDRAIL	-		IS 1239 (MEDIUM), GALVANIZED
GASKETS	-		BUTYL RUBBER
ANCHOR BOLTS FOR FOUNDATION	-		IS 1367 PART 3, CLASS 4.4
BOLTS & NUTS	-		SA 193 GR B7 & SA 194 GR 2H
FASTENERS USED IN WETTED CONDITION	-		ALLOY 926 or BETTER MATERIAL

SECTION-III

ANNEXURE-10

TANKS NOZZLE SCHEDULE

PROJETCT: (3X200 MW+3x500 MW) RAMAGUNDAM STAGE-I & II FGD				
ANNEXURE- 10				
1.PRIMARY HYDRO CYCLONE FEED TANK				
S.N.	**NOZZLE MARK**	**SIZE (NB)**	**QTY (NOS)**	**SERVICE**
1	N1 A/B/C	100	3	INLET TO TANK ON ROOF
2	N2	125	1	INLET TO TANK ON ROOF
3	A1	300	1	AGITATOR NOZZLE ON ROOF
4	MH1/MH2	800	2	MANHOLE ON SHELL AND ROOF
5	N3	400	1	TANK OVERFLOW
6	LT-1/LT-2	80	2	LEVEL TRANSMITTER ON ROOF
7	V1	80	1	VENT ON ROOF
8	N4	125	1	TANK DRAIN TO OVERFLOW
8	N6	125	1	TANK DRAIN
9	N5 A/B	300	2	PUMP SUCTION (OUTLET)
2.FILTERATE WATER TANK				
S.N.	**NOZZLE MARK**	**SIZE (NB)**	**QTY (NOS)**	**SERVICE**
1	N1 A/B	300	2	INLET TO TANK ON ROOF
2	N2 A/B	350	2	INLET TO TANK ON ROOF
3	N3 A/B	250	2	INLET TO TANK ON ROOF
4	N4	100	1	INLET TO TANK ON ROOF
5	N5	125	1	INLET TO TANK ON ROOF
6	A1	300	1	AGITATOR NOZZLE ON ROOF
7	MH1/MH2	800	2	MANHOLE ON SHELL AND ROOF
8	N6	400	1	TANK OVERFLOW
9	LT-1/LT-2	80	2	LEVEL TRANSMITTER ON ROOF
10	V1	80	1	VENT ON ROOF
11	N7	400	1	TANK DRAIN TO OVERFLOW
12	N8	150	1	TANK DRAIN
13	N9 A/B	300	2	PUMP SUCTION (OUTLET)
3.SECONDARY HYDRO CYCLONE FEED TANK				
S.N.	**NOZZLE MARK**	**SIZE (NB)**	**QTY (NOS)**	**SERVICE**
1	N1 A/B	350	2	INLET TO TANK ON ROOF
2	N2	200	1	INLET TO TANK ON ROOF
3	A1	300	1	AGITATOR NOZZLE ON ROOF
4	MH1/MH2	800	2	MANHOLE ON SHELL AND ROOF
5	N3	350	1	TANK OVERFLOW
6	LT-1/LT-2	80	2	LEVEL TRANSMITTER ON ROOF
7	N4	200	1	TANK DRAIN
8	N5 A/B	250	2	PUMP SUCTION (OUTLET)
9	V1	80	1	VENT ON ROOF

4. WASTE WATER TANK				
S.N.	**NOZZLE MARK**	**SIZE (NB)**	**QTY (NOS)**	**SERVICE**
1	N1 A/B	300	2	INLET TO TANK ON ROOF
2	N2	100	1	INLET TO TANK ON ROOF
3	N3	100	1	INLET TO TANK ON ROOF
4	A1	350	1	AGITATOR NOZZLE ON ROOF
5	MH1/MH2	800	2	MANHOLE ON SHELL AND ROOF
6	N4	300	1	TANK OVERFLOW
7	LT-1/LT-2	80	2	LEVEL TRANSMITTER ON ROOF
8	AT-1/AT-2	80	2	ANALYSER TRANSMITTER ON ROOF
9	V1	80	1	VENT ON ROOF
10	N5	200	1	TANK DRAIN TO OVERFLOW
11	N6 A/B	200	1	PUMP SUCTION (OUTLET)
12				
5. LIMESTONE SLURRY STORAGE TANKS - 2 NOS				
S.N.	**NOZZLE MARK**	**SIZE (NB)**	**QTY (NOS)**	**SERVICE**
1	N1 A/B	350	2	INLET TO TANK ON ROOF
2	N2 A/B/C/D	125	4	INLET TO TANK ON ROOF
3	A1	700	1	AGITATOR NOZZLE ON ROOF
4	MH1/MH2	800	2	MANHOLE ON SHELL AND ROOF
5	N3	250	1	TANK OVERFLOW
6	LT-1/LT-2	80	2	LEVEL TRANSMITTER ON ROOF
7	DT-1/DT-2	80	2	DENSITY TRANSMITTER ON ROOF
8	V1	80	1	VENT ON ROOF
9	N4	200	1	TANK DRAIN TO OVERFLOW
10	N5	200	1	TANK DRAIN
11	N6 A/B	250	2	PUMP SUCTION (OUTLET)
6. AUXILIARY ABSORBENT TANK				
S.N.	**NOZZLE MARK**	**SIZE (NB)**	**QTY (NOS)**	**SERVICE**
1	N1 A/B/C/D/E	350	5	INLET TO TANK ON ROOF
2	N2 A/B/C/D/E/F/J/H/I/J	150	10	INLET TO TANK ON ROOF
3	A1 / A2 / A3	300	3	AGITATOR NOZZLE ON SHELL
4	MH1/MH2	800	2	MANHOLE ON SHELL AND ROOF
5	N3	250	1	TANK OVERFLOW
6	LT-1	80	1	LEVEL TRANSMITTER ON ROOF
7	V1	80	1	VENT ON ROOF
8	N54	200	1	TANK DRAIN
9	N5 A/B	250	2	PUMP SUCTION (OUTLET)

7. PROCESS WATER TANKS - 2 NOS				
S.N.	**NOZZLE MARK**	**SIZE (NB)**	**QTY (NOS)**	**SERVICE**
1	N1	300	1	INLET TO TANK ON ROOF
2	N2 A/B/C/D	80	4	INLET TO TANK ON ROOF
3	N3 A/B/C/D	100	4	INLET TO TANK ON ROOF
4	MH1/MH2	800	2	MANHOLE ON SHELL AND ROOF
5	N4	250	1	TANK OVERFLOW
6	LT-1/LT-2	80	2	LEVEL TRANSMITTER ON ROOF
7	N5	80	1	VENT ON ROOF
8	N6	125	1	TANK DRAIN
9	N7	250	1	PUMP SUCTION (OUTLET)
10	N8	350	1	PUMP SUCTION (OUTLET)
8. BELT FILTER WASH TANKS - 2 NOS				
S.N.	**NOZZLE MARK**	**SIZE (NB)**	**QTY (NOS)**	**SERVICE**
1	N1	50	1	INLET TO TANK ON ROOF
2	N2	80	1	INLET TO TANK ON ROOF
3	MH1/MH2	800	2	MANHOLE ON SHELL AND ROOF
4	N3	150	1	TANK OVERFLOW
5	LT-1/LT-2	80	2	LEVEL TRANSMITTER ON ROOF
6	V1	50	1	VENT ON ROOF
7	N4	80	1	TANK DRAIN
8	N5 A/B	80	2	PUMP SUCTION (OUTLET)
9. CAKE WASH (CLARIFIED WATER) TANKS - 2 NOS				
S.N.	**NOZZLE MARK**	**SIZE (NB)**	**QTY (NOS)**	**SERVICE**
1	N1	65	1	INLET TO TANK ON ROOF
2	N2 A/B	125	2	INLET TO TANK ON ROOF
3	MH1/MH2	800	2	MANHOLE ON SHELL AND ROOF
4	N3	200	1	TANK OVERFLOW
5	LT-1/LT-2	80	2	LEVEL TRANSMITTER ON ROOF
6	V1	50	1	VENT ON ROOF
7	N4	80	1	TANK DRAIN
8	N5 A/B	125	2	PUMP SUCTION (OUTLET)
Notes				
1: The above shown sizes and number of nozzles are indicative and for estimation purpose only. Final number and sizes of nozzles shall be furnihsed during detailed engineering.				