

4 X 250 MW NABINAGAR TPP

**TECHNICAL SPECIFICATION
FOR
MISCELLANEOUS FGD TANKS**

SPECIFICATION NO.: PE-TS-463-167-A101



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, INDIA**



4 X 250 MW NABINAGR TPP

SPECIFICATION No:PE-TS-463-167-A101

MISC. FGD TANKS

SECTION

TECHNICAL SPECIFICATION

DATE

MAY 2020

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TECHNICAL SPECIFICATION FOR
MISCELLANEOUS FGD TANKS

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SECTION I, SUB-SECTION-A

REVISION 00

DATE: MAY 2020

INTENT OF SPECIFICATION

	4 X 250 MW NABINAGAR TPP TECHNICAL SPECIFICATION FOR MISCELLANEOUS FGD TANKS	SPECIFICATION NO. PE-TS-463-167-A101	
		SECTION I, SUB-SECTION-A	
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1.0 **SCOPE OF ENQUIRY/ INTENT OF SPECIFICATION**

- 1.1 This specification includes, but not limited to Supply part, Services part comprising of design (i.e. Preparation and submission of drawing /documents including “As Built” drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles(as applicable) along with spares for erection, start up and commissioning as required, forwarding, proper packing, shipment and delivery at site, unloading, handling, transportation & storage at site, in-site transportation, assembly, erection & commissioning, Rubber/ Glass flake lining, final painting at site, minor civil work and carrying out Performance guarantee / Functional / Demonstration tests at site (as applicable) and handover in flawless condition of Miscellaneous FGD Tanks turnkey package specified above for **4 X 250 MW NABINAGAR FGD Project** complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.
- 1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve them of the responsibility of providing such facilities to complete the supply, erection and commissioning, performance and guarantee/demonstration testing of **Miscellaneous FGD Tanks** within quoted price.
- 1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment / system shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.
- 1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing. Similarly, the extent of supply also includes all items required for completion of the system for its safe, efficient, reliable and trouble free operation and maintenance shall also be in supplier's scope unless specifically excluded and notwithstanding that they may have been omitted in drawings / specifications or schedules.
- 1.5 Items though not specifically mentioned but needed to make the system complete as stipulated under these specifications are also to be furnished unless otherwise specifically excluded.
- 1.6 The general terms and conditions, instructions to tenderer and other attachment referred to elsewhere are hereby made part of the tender specifications. The equipment / material and works covered by this specification is subject to compliance to all the attachments referred in the specification. The tenderer shall be responsible for adherence to all requirements stipulated herein.
- 1.7 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the

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specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under specification within 10 days of receipt of tender documents. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser/Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

- 1.8 Deviations, if any, should be very clearly brought out clause by clause in the enclosed schedule, otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification.
- 1.9 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- 1.10 Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder/vendor and Customer/Purchaser/Employer will mean BHEL and/or Customer as interpreted by BHEL in the relevant context. Please refer GCC/SCC for better clarity.
- 1.11 The equipment covered under this specification shall not be dispatched unless the same have been finally inspected, accepted and dispatch release issued by BHEL/Customer.
- 1.12 BHEL's Customer's representative shall be given full access to the shop in which the equipment's are being manufactured or tested and all test records shall be made available to him.
- 1.13 Various codes and standards to be used shall be as indicated in various parts of the specification. In case bidder uses any standard other than those indicated in the specification, the onus of establishing equivalence of the same with the specified standards will rest with the bidder and acceptance of the same shall be sole prerogative of customer. The bidder will also arrange for BHEL a copy of the standards in ENGLISH language. The cost of such service will be deemed to have been included by the bidder in the total cost of the package. BHEL will not entertain any additional cost on account of the same.
- 1.14 All text/ numeric in the document / drawings to be generated by the successful bidder will be in English language only.
- 1.15 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.

Note:

Bidder to note that BHEL reserves the right for drawing/document submission through web based Document Management System. Bidder would be provided access to the DMS for drawing/document approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end.

- Internet explorer version – Minimum Internet Explorer 7.
- Internet speed – 2 mbps (Minimum preferred).
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked.
- Vendor's internal proxy setting should not block DMS application's link (<http://dmsserver.bhelpeem.com/Wrench%20Web%20Access/Login.aspx>).



TITLE:
4 X 250 MW NABINAGAR TPP
TECHNICAL SPECIFICATION FOR
MISC. FGD TANKS

SPECIFICATION No: PE-TS-463-167-A101

SECTION-I, SUB-SECTION-B

REV. 00

DATE: MAY 2020

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PROJECT INFORMATION WITH WIND AND SEISMIC DESIGN CRITERIA

CLAUSE NO.	PROJECT INFORMATION 		
1.04.00	COAL and WATER, Utility details: (i) Coal Quality Parameters and Fuel Oil Characteristics Source: Pachra and Pachra south blocks in North Karanpura coalfields Requirement: 5 MTPA The Coal quality parameters and Fuel Oil Characteristics are enclosed at Table-1, & Table-2A & 2B of this Sub-Section. Water data (ii) Process water: Process water quality based on COC in Table-3. (iii) Clarified water: Clarified water quality is indicated in Table-3. (iv) DM water for Equipment cooling water system. DM water quality is indicated in Table-4. 1.05.00 Steam Generator and ESP data: refer Table-5 1.06.00 Drawings are enclosed as per Table-6 for initial overview to the Bidder. 2.00.00 NOT USED 3.00.00 RAILWAY SIDING For bringing the equipment and material to the power house through rail, railway siding is proposed to be constructed from nearest railway station. 4.00.00 METEOROLOGICAL DATA Meteorological data of the nearest observatory Dehri station is enclosed as Annexure-II to this subsection. 5.00.00 CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT All structures and equipment shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS:1893 (Part 1 to Part 4). Pending finalization of Part 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for embankments. A site specific seismic study has been conducted for the project site. The peak ground horizontal acceleration for the project site, the site specific acceleration spectral coefficients (in units of gravity acceleration 'g') in the horizontal direction for		
LOT-IA PROJECTS FLUE GAS DE-SULPHURIZATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-II-A11 PROJECT INFORMATION NABINAGAR TPP	PAGE 3 OF 29

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	the various damping values and the multiplying factor (to be used over the spectral coefficients) for evaluating the design acceleration spectra are as given at Appendix-I. Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values. The site specific design acceleration spectra shall be used in place of the response acceleration spectra, given at figure-2 in IS:1893 (Part 1) and Annex B of IS:1893 (Part 4). The site specific acceleration spectra along with multiplying factors specified in Appendix-I includes the effect of the seismic environment of the site, the importance factor related to the structures and the response reduction factor. Hence, the design spectra do not require any further consideration of the zone factor (Z), the importance factor (I) and response reduction factor (R) as used in the IS:1893 (Part 1 to Part 4). Damping in Structures The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for: <table><tr><td>Steel structures</td><td>2%</td></tr><tr><td>Reinforced Concrete structures</td><td>5%</td></tr><tr><td>Reinforced Concrete Stacks</td><td>3%</td></tr><tr><td>Steel stacks</td><td>2%</td></tr></table> Method of Analysis Since most structures in a power plant are irregular in shape and have irregular distribution of mass and stiffness, dynamic analysis for obtaining the design seismic forces shall be carried out using the response spectrum method. The number of vibration modes used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass and shall also meet requirements of IS:1893 (Part 1). Modal combination of the peak response quantities shall be performed as per Complete Quadratic Combination (CQC) method or by an acceptable alternative as per IS:1893 (Part 1). In general, seismic analysis shall be performed for the three orthogonal (two principal horizontal and one vertical) components of earthquake motion. The seismic response from the three components shall be combined as specified in IS:1893 (Part 1).				Steel structures	2%	Reinforced Concrete structures	5%	Reinforced Concrete Stacks	3%	Steel stacks	2%
Steel structures	2%											
Reinforced Concrete structures	5%											
Reinforced Concrete Stacks	3%											
Steel stacks	2%											
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	The spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the structure falls to the left of the peak in the spectral acceleration curve. For buildings, if the design base shear (V_B) obtained from modal combination is less than the base shear ($\bar{V}_B$) computed using the approximate fundamental period (T_a) given in IS:1893:Part 1 and using site specific acceleration spectra with appropriate multiplying factor, the response quantities (e.g. member forces, displacements, storey forces, storey shears and base reactions) shall be enhanced in the ratio of $\bar{V}_B / V_B$. However, no reduction is permitted if $\bar{V}_B$ is less than V_B. For regular buildings less than 12m in height, design seismic base shear and its distribution to different floor levels along the height of the building may be carried out as specified under clause 7.5, 7.6 & 7.7 of IS:1893 (Part 1) and using site specific design acceleration spectra. The design horizontal acceleration spectrum value (A_h) shall be computed for the fundamental natural period as per clause 7.6 of IS:1893 (Part 1) using site specific spectral acceleration coefficients with appropriate multiplying factor given in Appendix-I. Design/Detailing for Ductility for Structures The site specific design acceleration spectra is a reduced spectra and has an in-built allowance for ductility. Structures shall be engineered and detailed in accordance with relevant Indian/International standards to achieve ductility.		
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	APPENDIX – I <u>SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT</u> The various site specific seismic parameters for the project site shall be as follows: 1) Peak ground horizontal acceleration : 0.16g 2) Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra a) for ordinary moment resisting steel frames designed and detailed as per IS:800 : 0.04 b) for braced steel frames designed and detailed as per IS:800 : 0.03 c) For special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 : 0.024 d) for RCC chimney : 0.08 e) for Liquid retaining tanks : 0.048 f) for Steel chimney, Absorber tower : 0.06 g) for design of structures not covered under 2 (a) to 2 (f) above and under 3 below : 0.04 3) Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted : 0.08 Note: g = Acceleration due to gravity The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages.		
LOT-IA PROJECTS FLUE GAS DE-SULPHURIZATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-II-A11 PROJECT INFORMATION NABINAGAR TPP	PAGE 6 OF 29

APPENDIX – I

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
In units of 'g' for New Nabinagar project

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
0.000	1.000	1.000	1.000
0.030	1.000	1.000	1.000
0.050	1.750	1.607	1.443
0.100	3.737	3.060	2.374
0.104	3.904	3.174	2.443
0.123	3.904	3.401	2.753
0.150	3.904	3.401	2.753
0.200	3.904	3.401	2.753
0.250	3.904	3.401	2.753
0.300	3.904	3.401	2.753
0.350	3.904	3.401	2.753
0.400	3.904	3.401	2.753
0.450	3.904	3.401	2.753
0.500	3.904	3.401	2.753
0.516	3.904	3.401	2.753
0.550	3.662	3.401	2.753
0.600	3.357	3.142	2.753
0.607	3.320	3.105	2.753
0.670	3.006	2.813	2.493
0.700	2.877	2.693	2.386
0.750	2.685	2.513	2.227
0.800	2.518	2.356	2.088
0.850	2.369	2.218	1.965
0.900	2.238	2.094	1.856
0.950	2.120	1.984	1.758
1.000	2.014	1.885	1.670
1.050	1.918	1.795	1.590
1.100	1.831	1.714	1.518
1.150	1.751	1.639	1.452
1.200	1.678	1.571	1.392
1.250	1.611	1.508	1.336

APPENDIX – I

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
In units of 'g' for New Nabinagar project

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
1.300	1.549	1.450	1.285
1.350	1.492	1.396	1.237
1.400	1.439	1.346	1.193
1.450	1.389	1.300	1.152
1.500	1.343	1.257	1.113
1.550	1.299	1.216	1.077
1.600	1.259	1.178	1.044
1.650	1.221	1.142	1.012
1.700	1.185	1.109	0.982
1.750	1.151	1.077	0.954
1.800	1.119	1.047	0.928
1.850	1.089	1.019	0.903
1.900	1.060	0.992	0.879
1.950	1.033	0.967	0.856
2.000	1.007	0.943	0.835
2.050	0.982	0.920	0.815
2.100	0.959	0.898	0.795
2.150	0.937	0.877	0.777
2.200	0.915	0.857	0.759
2.250	0.895	0.838	0.742
2.300	0.876	0.820	0.726
2.350	0.857	0.802	0.711
2.400	0.839	0.785	0.696
2.450	0.822	0.769	0.682
2.500	0.806	0.754	0.668
2.550	0.790	0.739	0.655
2.600	0.775	0.725	0.642
2.650	0.760	0.711	0.630
2.700	0.746	0.698	0.619
2.750	0.732	0.685	0.607
2.800	0.719	0.673	0.596

APPENDIX – I

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
In units of 'g' for New Nabinagar project

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
2.850	0.707	0.661	0.586
2.900	0.694	0.650	0.576
2.950	0.683	0.639	0.566
3.000	0.671	0.628	0.557
3.050	0.660	0.618	0.548
3.100	0.650	0.608	0.539
3.150	0.639	0.598	0.530
3.200	0.629	0.589	0.522
3.250	0.620	0.580	0.514
3.300	0.610	0.571	0.506
3.350	0.601	0.563	0.499
3.400	0.592	0.554	0.491
3.450	0.584	0.546	0.484
3.500	0.575	0.539	0.477
3.550	0.567	0.531	0.470
3.600	0.559	0.524	0.464
3.650	0.552	0.516	0.458
3.700	0.544	0.509	0.451
3.750	0.537	0.503	0.445
3.800	0.530	0.496	0.439
3.825	0.527	0.493	0.437
3.850	0.523	0.490	0.434
3.900	0.516	0.483	0.428
3.950	0.510	0.477	0.423
4.000	0.504	0.471	0.418

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6.00.00	<u>CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT</u> All structures shall be designed for wind forces in accordance with IS:875 (Part-3) and as specified in this document. See Annexure – B for site specific information. Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind Speed method as defined in the standard. Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor Method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method. Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than “5” and/or if the fundamental frequency of the structure is less than 1 Hz. Susceptibility of structures to across-wind forces, galloping, flutter, ovalling etc. should be examined and designed/detailed accordingly following the recommendations of IS:875(Part-3) and other relevant Indian standards. It should be estimated if size and relative position of other structures are likely to enhance the wind loading on the structure under consideration. Enhancement factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects. Damping in Structures The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for: <table><tr><td>a) Welded steel structures</td><td>: 1.0%</td></tr><tr><td>b) Bolted steel structures</td><td>: 2.0%</td></tr><tr><td>c) Reinforced concrete structures</td><td>: 1.6%</td></tr><tr><td>d) Steel stacks</td><td>: As per IS:6533 & CICIND Model Code whichever is more critical.</td></tr></table>				a) Welded steel structures	: 1.0%	b) Bolted steel structures	: 2.0%	c) Reinforced concrete structures	: 1.6%	d) Steel stacks	: As per IS:6533 & CICIND Model Code whichever is more critical.
a) Welded steel structures	: 1.0%											
b) Bolted steel structures	: 2.0%											
c) Reinforced concrete structures	: 1.6%											
d) Steel stacks	: As per IS:6533 & CICIND Model Code whichever is more critical.											
LOT-IA PROJECTS FLUE GAS DE-SULPHURIZATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-II-A11 PROJECT INFORMATION NABINAGAR TPP	PAGE 10 OF 29								

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	<u>ANNEXURE-B</u> <u>SITE SPECIFIC DESIGN PARAMETERS</u> The various design parameters, as defined in IS: 875 (Part-3), to be adopted for the project site shall be as follows: a) The basic wind speed “V_b” at ten metres above the mean ground level : 47 metres/second b) The risk coefficient “K₁” : 1.07 c) Category of terrain : Category-2 7.00.0 FOUNDATION SYSTEM AND GEOTECHNICAL DATA 7.00.01 Geotechnical data and foundation system for the respective project are enclosed at annexure-III. The corresponding bore logs are enclosed at annexure-IV. 7.00.02 The available soil data is of vicinity of proposed structures, therefore, bidder shall carryout his own detailed soil investigation for facilities under this package and shall be as per the scheme approved by owner. The scheme for geotechnical investigation shall be as given at Clause 7.07.00 and shall be approved by owner before execution. Geotechnical investigation work shall got executed by the Contractor through the agencies as mentioned in Clause No. 7.07.03. However, no time extension shall be given on account of soil investigation carried out by the Bidder. The geotechnical investigation report shall be prepared with detailed recommendations regarding type of foundation and allowable bearing pressure for various structures/ facilities and other soil parameters. The report shall be submitted for Owner's approval prior to commencement of design of foundation. 7.00.03 The Bidder should note that nothing extra whatsoever on account of variation between soil data collected by Owner and that found by the Bidder during geotechnical investigation by him or during execution of works, shall be payable. 7.00.04 Tank Foundations a) The tanks shall rest on flexible tank pad foundation, resting on sand with concrete ring wall to retain sand. Base of the concrete ring wall shall not rest on the expansive soil, if any. b) Entire loose/ soft soil inside the concrete ring wall shall be removed and shall be filled with sand. Sand for filling shall be clean and well graded conforming to IS 383 with grading Zone I to III. c) Sand shall be spread in layers not exceeding 30cm compacted thickness over the area. Each layer shall be uniformly compacted by mechanical means like plate vibrators, small vibratory rollers, etc to achieve a relative density of not less than 80%. d) Other requirements of tank foundations shall be as per IS 803 and as specified elsewhere in the specifications.			
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7.02.02	Open Foundations In case open foundations are adopted, following shall be adhered to. a) The minimum width of foundation shall be 1.0 m. b) Minimum depth of foundation shall be 1.0m below Ground Level. c) It shall be ensured that all foundations of a particular structure/ buildings/ facility shall rest on one bearing stratum. d) Wherever the intended bearing sub-strata is virgin soil stratum but the actual stratum encountered during foundation excavation consists of filled up soil at founding level, under such cases either the foundation shall be lowered completely into the virgin stratum or the filled up soil upto the virgin layers shall be removed and built up through PCC (1:4:8) up to designed foundation level.			
7.02.03	Pile Foundations – (a.) In case piles are adopted, following shall be adhered to : i) The pile foundation shall be of RCC, Cast-in-situ bored piles as per IS:2911. Pile boring shall be done using Rotary Hydraulic Rigs/conventional tripod rig. Two stage flushing of pile bore shall be ensured by airlift technique duly approved by the Employer. If required, temporary or permanent MS liner may be provided for piling. ii) The minimum diameter of pile shall be 600 mm. The allowable load capacity of the pile in different modes (vertical compression, lateral and pullout) shall be as per approved geotechnical report & as enclosed in relevant annexure: iii) Only straight shaft piles shall be used. Minimum cast length of pile above cutoff level shall be 1.0 m. iv) The contractor shall furnish design of piles (in terms of rated capacity, length, diameter, termination criteria to locate the founding level for construction of pile in terms of measurable parameter, reinforcement for job as well as test piles, pile load test arrangement, locations of initial test piles etc.) for Engineer's approval. v) The piling work shall be carried out in accordance with IS:2911 (Relevant part) and accepted construction methodology. The construction methodology shall be submitted by the Contractor for Engineer's approval. vi) Number of initial load tests to be performed for each diameter and rated capacity of pile shall be subject to minimum as under. Vertical Lateral Minimum of 2 Nos. in each mode. Uplift vii) The initial pile load test shall be conducted with test load upto three times the estimated pile capacity. In case of vertical compression test (initial test) the method of loading shall be cyclic as per IS:2911 (relevant part).			
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	viii) Load test shall be conducted at pile Cut-off Level (COL). If the water table is above the COL the test pit shall be kept dry throughout the test period by suitable de-watering methods. Alternatively the vertical load test may be conducted at a level higher than COL. In such a case, an annular space shall be created to remove the effect of skin friction above COL by providing an outer casing of suitable diameter larger than the pile diameter. ix) Number of routine pile load tests to be performed for each diameter/allowable capacity of pile shall be as under : i) Vertical : 0.5% of the total number of piles provided. ii) Lateral : 0.5% of the total number of piles provided. x) The routine tests on piles shall be conducted upto test load of one and half times the allowable pile capacity. Piles for routine load tests shall be approved by the Employer. xi) In case, routine pile load test shows that the pile has not achieved the desired capacity or pile(s) have been rejected due to any other reason, then the Contractor shall install additional pile(s) as required and the pile cap design shall accordingly be reviewed and modified, if required. xii) Testing of piles and interpretation of pile load test results shall be carried out as per IS:2911 (Part-4). Contractor shall ensure that all the measuring equipment and instruments are properly calibrated at a reputed laboratory / institute prior to their use. Settlement / movement of the pile top shall be made by Linear Variable Differential Transducers (LVDT) having a least count of 0.01mm. xiii) The test load on initial test piles shall be applied by means of reaction from anchor piles / rock anchors alone or combination of anchor piles / rock anchors and kentledge with concrete blocks.			
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7.03.00 7.03.01	xiv) Low Strain Pile Integrity test shall be conducted on all test piles and job piles. This test shall be used to identify the routine load test and not intended to replace the use of static load test. This test is limited to assess the imperfection of the pile shaft and shall be undertaken by an independent specialist agency to be approved by Engineering department of Owner. The test equipment shall be of TNO or PDI make or equivalent. The process shall confirm to ASTM. xv) High Strain Dynamic Load Test may be carried out for routine load testing of working piles. However, at least two numbers of static routine vertical load tests shall be carried out on pile on which high strain dynamic load test has already been carried out for establishing the correlation between the two tests. In case of discrepancy if any between dynamic and static vertical load tests, then additional static routine vertical load tests shall be conducted as decided by the Engineer and the results of static routine vertical load shall prevail. Number of routine vertical pile load tests as per clause 7.02.03 (ix) shall be total of static routine vertical load test and high strain dynamic load tests. The procedure to carryout the test shall be submitted to the Engineer. The test and equipment shall conform to ASTM D4945-00. The test shall be conducted by an experienced independent test agency approved by the owner. Field data shall be submitted to the site engineer and shall include force velocity curves, pile capacity, simulated static load test curve, net and total pile displacement, pile integrity. A (Case pile wave analysis) CAPWAP or equivalent software analysis shall be conducted on the field data for correct capacity estimation and to evaluate end bearing and skin friction components of the pile. xvi) From load considerations, single pile may be used under a column/tower. In that case, pile shall be connected with tie beams at pile cut off level in both directions. xvii) Contribution of frictional resistance of filled up soil if any, shall not be considered for computation of frictional resistance of piles. xviii) Reinforcement for job piles shall be designed as following: (a) Compression + bending piles: For these piles, the allowable safe pile capacities in compression and bending shall be considered. (b) Tension + bending piles: For these piles, the actual pile forces to be considered. However, maximum 3 types of combinations for varying percentage of tension capacity + bending case may be designed & adopted by contractor for the entire scope of work under this package. Special Requirements Details of treatment for foundations / underground structures required to counteract soil / water chemical environment shall be as per detailed geotechnical investigation to be carried		
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	out by contractor. Contractor shall carry out chemical analysis during detailed geotechnical investigation and required treatment shall be provided accordingly.			
7.04.00	Excavation, Filling and Dewatering			
7.04.01	For excavation works, comprehensive dewatering with well point or deep wells arrangement if required, shall be adopted. Scheme for dewatering and design with all computations and back up data for dewatering shall be submitted for the owner's information. The water table shall be maintained at 0.5m below the founding depth.			
7.04.02	Excavation for shallow foundations shall be covered with PCC immediately after reaching the founding level. In case of any local loosening of soil or any loose pockets are encountered at founding level during excavation the same shall be removed and compensated by PCC M7.5. The final layer of about 300 mm thickness above the founding level shall be excavated by suitable means, so as to avoid disturbance to founding stratum.			
7.04.03	Backfilling around foundations, pipes, trenches, sumps, pits, plinths, etc. shall be carried out with approved material in layers not exceeding 300 mm compacted thickness (higher thickness of layers upto 500mm with heavy mechanical compacting equipment) and each layer shall be compacted to 90% of standard proctor density for cohesive soils and to 80% of relative density for non-cohesive soils			
	Rock pieces having size less than 150 mm and interstices filled with soil may be used for backfilling around foundation, plinths etc. and shall be compacted to minimum of 85% of original stack of material after filling the interstices.			
7.04.04	Founding level for trenches/channels shall be decided as per functional requirement. The bottom of excavation shall be properly compacted prior to casting of bottom slab of trenches / channels.			
7.04.05	CBR tests for pavement/road design shall be carried out by the Contractor after earth filling (if applicable) has been completed upto the formation level.			
7.04.06	The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding of material or article from any bank or side of such excavation which is more than one and a half meter above the 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.			
7.05.00	EXCAVATION IN ROCK			
	Excavation in rock shall be carried out by mechanical means and if blasting is required for founding of some of the structures under this package, control blasting only shall be carried out.			
7.05.01	Controlled blasting shall be done by a specialised agency duly approved by Engineer. All controlled blasting shall be done by using time delay detonators (i.e. excel type).			
7.05.02	a) Contractor shall engage an agency expert in blasting such as, NIRM (National Institute of Rock Mechanics), CMPDIL, Central Institute of Mining and Fuel Research Dhanbad, Dept. of Mining of Govt. Institutions etc. to design detailed blasting scheme and get the same approved from Engineer before carrying out the blasting			
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	operation. All blasting shall be done as per the approved blasting scheme & initial blasting operations shall be done under the supervision & guidance of the representative of the blasting expert. b) All the statutory laws, (Explosives Act etc.) rules, regulations, Indian Standards, etc. pertaining to the acquisition, transport, storage, handling and use of explosives, etc. shall be strictly followed. c) The Contractor shall obtain Licenses from Competent Authorities for undertaking blasting work as well as for procuring, transporting to site and storing the explosives as per explosives act. The Contractor shall be responsible for the safe transport, use, custody and proper accounting of the explosive Materials. d) The Contractor shall be responsible and liable for any accident and injury / damage which may occur to any person or property of the project or public on account of any operations connected with the storage, transportation, handling or use of explosive and blasting operations.			
7.06.00	Sheeting & Shoring The contractor shall ascertain for himself the nature of materials to be excavated and difficulties, if any, likely to be encountered in excavation while executing the work. Sheet piling, sheeting and shoring, bracing and maintaining suitable slopes, drainage, etc. shall be provided and installed by the Contractor, to the satisfaction of the Engineer.			
7.07.00	Geotechnical Investigation The Contractor shall carry out detailed geotechnical investigation in the areas under his scope for establishing the sub-surface conditions and to decide type of foundations for the structures envisaged, construction methods, any special requirements/treatment called for remedial measures for sub-soil/ foundations etc. in view of soft sub-soils, aggressive sub-soils and water, expansive/swelling soils etc. prior to commencement of detailed design/drawings. The Contractor shall obtain the approval for the field testing scheme proposed by him from the Owner before undertaking the geotechnical investigation work.			
7.07.01.00	Scheme of geotechnical Investigation			
7.07.02.01	Field test shall include but not be limited to the following: Boreholes, Standard Penetration Test (SPT), Dynamic Cone Penetration Test (DCPT), collection of disturbed samples (DS) and undisturbed soil samples (UDS), Trial Pits (TP), Plate Load Tests (PLT), Electrical Resistivity Test (ERT), In situ field permeability tests, collection of water samples, etc.			
7.07.02.02	The diameter of borehole shall be minimum 150 mm in soil and 76 mm in rock. The diameter of UDS sampler shall be 100 mm minimum. Core drilling in rock shall be done by using hydraulically feed rotary drill & double tube core barrel with diamond bit.			
7.07.02.03	The minimum tests are indicated in Clause No. 7.08.00. Adequate number of tests shall be conducted up to sufficient depth for complete determination of subsoil conditions. The depth of boreholes shall be as specified in Appendix A. SPT shall be carried out in all types of soil deposits and in all rock formations with core recovery up to 20%, met within a borehole. This test shall be conducted at every 3.0 m interval or at change of strata, up to the final depth. SPT 'N' of 100 and above shall be referred as refusal. UDS shall be collected at every 3.0 m interval or at change of strata up to depth of borehole. UDS may be replaced by additional SPT, if SPT'N' value in the strata is above 50.			
7.07.02.04	Laboratory tests shall be done as per relevant IS codes. The laboratory tests, not be limited to the following shall be conducted on disturbed and undisturbed soil samples, rock samples & water samples collected during field investigations in sufficient numbers.			
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7.07.02.05	Laboratory Tests on Soil Samples														
	Laboratory tests shall be carried out on disturbed and undisturbed soil samples for Grain Size Analysis, Hydrometer Analysis, Atterberg Limits, Triaxial Shear Tests (UU), Natural Moisture Content, Specific Gravity and Bulk Unit Weight, Consolidation Tests, Unconfined Compression Test, Free swell Index, Shrinkage Limit, Swell Pressure Test, Chemical Analysis test on soil and water samples to determine the carbonates, sulphates, chlorides, nitrates, pH, organic matter and any other chemicals harmful to concrete and reinforcement steel.														
	Laboratory Tests on Rock Samples														
	Moisture content, porosity & density, Specific Gravity, Hardness, Soundness, Slake durability index, Unconfined compression test (Both at saturated and in-situ water content), Point load strength index and deformability test (Both at saturated and in-situ water content) shall be carried out on rock samples.														
7.07.03.00	Geotechnical investigation (field & laboratory) shall be carried out in accordance with the provisions of relevant Indian Standards.														
7.08.00	On completion of all field & laboratory work, geotechnical investigation report shall be submitted for Owner’s review/approval. The Geotechnical investigation report shall contain geological information of the region, procedure adopted for investigation, field & laboratory observations/ data/ records, analysis of results & recommendations on type of foundation for different type of structures envisaged for all areas of work with supporting calculations. Recommendations on treatment for soil, foundation, based on subsoil characteristics, soft soils, aggressive chemicals, expansive soils, etc.														
	Recommendations on foundation system and the net allowable bearing pressures and pile capacity shall be based on the conservative values of geotechnical investigation data.														
	Geotechnical investigation work shall be got executed by the Contractor through the following agencies.														
	1. C.E.TESTING COMPANY Pvt. Ltd, Kolkata 2. CengrsGeotechnica Pvt. Ltd, New Delhi 3. M.K. Soil Testing Laboratory, Ahemdabad 4. SECON Pvt Ltd, Bangalore 5. Soil Engineering Consultants, New Delhi 6. Orbital Infrastructure Consultancy & Research Pvt. Ltd. Cuttack 7. KCT Consultancy Services, Ahemdabad 8. ARKITECHNO Consultants (India) Pvt. Ltd. Bhubaneswar														
7.08.00	Geotechnical Investigation Scheme														
	a) Boreholes (Minimum)														
	<table><tr><th>S.N</th><th>Structure</th><th>Spacing/Number of borehole</th><th>Depth of borehole</th><th>Remarks</th></tr><tr><td>1</td><td>FGD</td><td>Minimum 14 Nos.</td><td>Depth of boreholes shall be 25m to 35m.</td><td>Depth of</td></tr></table>					S.N	Structure	Spacing/Number of borehole	Depth of borehole	Remarks	1	FGD	Minimum 14 Nos.	Depth of boreholes shall be 25m to 35m.	Depth of
S.N	Structure	Spacing/Number of borehole	Depth of borehole	Remarks											
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	2	Crusher House	Minimum 2 Nos.	Depth of boreholes shall be 25m to 35m.	boreholes shall be as mentioned in column "Depth of Borehole" or 5m continuous in rock with RQD > 25% whichever is earlier.	
	3	Gypsum and Lime storage area	Minimum 10 Nos.	Depth of boreholes shall be 15m to 25m		
	4	Other Structure/Facility	Minimum 2 Nos. boreholes under each area / facility	15 to 20 m		
	5	Chimney	Minimum 2 Nos.	30 to 35m		
	b) Other Field Tests (Minimum)					
	1	Cyclic Plate Load Test (CPLT)	3nos	Test Depth from 2 to 4 m		
	2	Trial Pit (TP)	5 Nos.	Depth - 3 m		
	3	In Situ Permeability Test In Boreholes	In minimum 3 Nos. of boreholes	Tests shall be conducted at depths of 1.0m, 3.0m, 5.0m, 8.0m and 12.0m.		
	4	ERT	Minimum 10 Nos.			
	• Depth and location of Boreholes and other field tests (PLT, ERT, field permeability tests etc.) shall be approved by Owner before execution of geotechnical investigation work. • Investigation in any other building / structure / facilities / trestles which are not mentioned above shall also be carried out, if required, by the bidder for the facilities under his scope.					
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	Annexure-III																					
	SOIL DATA AND FOUNDATION SYSTEM																					
	Employer has carried out geotechnical investigation in the areas near to this package. Logs of representative boreholes to be used for bidder’s information in the vicinity of proposed area are enclosed with this Annexure-II. The bidder is required to carry out geotechnical investigation as per the clause no. 7.07.00 and ascertain the pile capacity and bearing capacity. The onus of correct assessment / interpretation and understanding of the existing subsoil condition / data is on the Bidder. Ground water table is encountered at a depth of about 11.0 to 13.0m below natural ground level (NGL) at the time of investigation. Fluctuation may occur in ground water table due to seasonal variation. The natural ground level is varying as per enclosed contour/spot level drawing.																					
	a)	The foundation system to be adopted for different structures shall be as given in Table – i below																				
	Table – i: Net Allowable Bearing Pressure <table><tr><th>STRUCTURE</th><th>TYPE OF FOUNDATION TO BE ADOPTED</th></tr><tr><td>FGD and related structures</td><td>Open/Piles</td></tr></table>			STRUCTURE	TYPE OF FOUNDATION TO BE ADOPTED	FGD and related structures	Open/Piles															
STRUCTURE	TYPE OF FOUNDATION TO BE ADOPTED																					
FGD and related structures	Open/Piles																					
b)	During design the Allowable Bearing Pressure shall be as furnished in Table-ii. Bidder is required to carry out geotechnical investigation in this area. The allowable bearing pressure shall be adopted after approval of geotechnical investigation report by owner. However, the maximum allowable bearing pressure shall be as per the approved geotechnical report and shall be limited to the values as furnished in Table-ii.																					
Table – ii: Net Allowable Bearing Pressure <table><tr><th rowspan="3">Structure</th><th rowspan="3">Founding Level in RL</th><th colspan="3">Net Allowable Bearing Pressure T/m²</th></tr><tr><th colspan="2">Isolated / Strip</th><th rowspan="2">Rafts (width > 6m) for 75mm settlement</th></tr><tr><th>width upto 6 m for 25mm settlement</th><th>Width upto 6m for 40mm settlement</th></tr><tr><td rowspan="2">FGD and related structures</td><td>2.5 m below NGL</td><td>8.0</td><td>9.0</td><td>10.0</td></tr><tr><td>3.5 m</td><td>10.0</td><td>12.0</td><td>14.0</td></tr></table>				Structure	Founding Level in RL	Net Allowable Bearing Pressure T/m ²			Isolated / Strip		Rafts (width > 6m) for 75mm settlement	width upto 6 m for 25mm settlement	Width upto 6m for 40mm settlement	FGD and related structures	2.5 m below NGL	8.0	9.0	10.0	3.5 m	10.0	12.0	14.0
Structure	Founding Level in RL	Net Allowable Bearing Pressure T/m ²																				
		Isolated / Strip				Rafts (width > 6m) for 75mm settlement																
		width upto 6 m for 25mm settlement	Width upto 6m for 40mm settlement																			
FGD and related structures	2.5 m below NGL	8.0	9.0	10.0																		
	3.5 m	10.0	12.0	14.0																		
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		below NGL				
		4.5 m below NGL	12.0	15.0		17.0
	The net allowable bearing pressure higher than above mentioned values shall not be permitted. At intermediate levels the bearing capacity shall be same as the net allowable bearing pressure corresponding to the immediate shallower level mentioned above.					
	c)	Permissible Settlement of Foundations: For open foundations, the total permissible settlement and differential settlement shall be governed by IS: 1904 and from functional requirements whichever is more stringent. However, total settlement shall be restricted to the following:				
	Isolated, Strip & Raft (Mill foundations/machine foundation)		25 mm			
	Isolated & Strip (Other than Mill foundations/machine foundation)		40 mm			
	Raft (widths greater than 6 m) (Other than Mill foundations/machine foundation)		75 mm			
	In case the total permissible settlement is to be restricted to less than as above specified from functional requirements, then the net allowable bearing pressure shall be reduced after review in consultation with Engineer.					
	d)	The diameter of pile, minimum length and maximum allowable capacity of piles shall be as given below:				
	Area/ Location		Pile Diameter (mm)	Minimum Length of Bored Pile Below Cut-off Level (m)	Safe Load Capacity in	
				Vertical Comp. (MT)	Pullout (MT)	Lateral (MT)
FGD and related structures		600	18.0	140.0	45.0	7.0
		760	19.0	250	75.0	12.5
- Cut off Level (COL) is assumed at 3.0 m below FGL (RL(+) 127.0m). If the COL is shallower than the assumed COL, then the length of the pile shall be increased accordingly.						
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	TABLE-1						
	COAL CHARACTERISTICS						
	Sl. No.	Description	Symbol	Design Coal	Worst Coal	Best Coal	Range of Adequacy Coal
	1	2	3	4	5	6	7
	A. PROXIMATE ANALYSIS (As received basis)						
	1.	Total Moisture	%	15.00	17.00	12.00	12.00-17.00
	2.	Ash	%	43.00	47.00	38.00	36.00-49.00
	3.	Volatile matter	%	20.00	18.00	22.00	25.00-15.00
	4.	Fixed carbon	%	22.00	18.00	28.00	37.00-17.00
	B. ULTIMATE ANALYSIS (As received basis)						
	1.	Carbon	C%	30.77	25.97	39.08	41.11-24.35
	2.	Hydrogen	H2%	3.4	2.85	3.5	3.60-2.87
	3.	Nitrogen	N2%	0.7	0.45	0.55	0.55-0.40
	4.	Oxygen (By difference)	O2%	6.2	5.6	6.07	6.1-5.5
	5.	Sulphur	S%	0.4	0.50	0.36	0.30-0.50
	6.	Carbonates	CO3%	0.50	0.60	0.40	0.30-0.35
	7.	Phosphorous	P2%	0.03	0.03	0.04	0.04-0.03
	8.	Total Moisture	H2O%	15.00	17.00	12.00	12.00-17.00
	9.	Ash	%	43.00	47.00	38.00	36.00-49.00
	10.	Gross Calorific Value	KCal/Kg	3300	2800	4000	4200–2700
	11.	Hard grove index		55	50	60	45-65
	C. ASH ANALYSIS						
	1.	Silica	(SiO2)%	59.79	61.30	56.70	62-56
	2.	Alumina	(Al2O3)%	25.36	28.00	23.50	28-23
	3.	Iron Oxide	(Fe2O3)%	7.20	6.00	10.00	6-10
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	Sl. No.	Description	Symbol	Design Coal	Worst Coal	Best Coal	Range of Adequacy Coal	
	1	2	3	4	5	6	7	
	4.	Titania	(TiO2)%	1.2	1.00	1.50	1-1.7	
	5.	Phosphoric Anhydride	(P2O5)%	2.6	1.5	3	1-3	
	6.	Lime	(CaO)%	0.88	0.5	1.50	0.5-1.7	
	7.	Magnesia	(MgO)%	0.55	0.4	1	0.4-1.1	
	8.	Sulphuric Anhydride	(SO3)%	1.2	0.5	1.4	0.5-1.7	
	9.	Alkalies (By Difference)	(Na2O+K2O)%	1.22	0.8	1.4	0.6-0.8	
	Note: Na2O content in the above shall not be more than 0.1%							
	D.	ASHFUSION RANGE (Under reducing atmosphere)						
	a)	Initial Deformation Temperature (IDT)	°C	1150	1200	1100	1100-1200	
	b)	Hemispherical temperature	°C	1350	1450	1300	1300-1400	
c)	Flow temperature	°C	1400	1400	1400	1400-1450		
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	TABLE -2A FUEL OIL CHARACTERISTICS <table border="1"> <thead> <tr> <th>Sl. No.</th><th>Characteristics</th><th>Heavy Furnace Oil grade HV (HFO) IS-1593-1982</th><th>Low Sulphur Heavy Stock (LSHS) IS-11489-1985</th><th>Heavy Petroleum stock (HPS) IS-11489-1985</th></tr> </thead> <tbody> <tr><td>1.</td><td>Total sulphur content</td><td>4.5% Max.</td><td>1.0% Max.</td><td>4.5% Max.</td></tr> <tr><td>2.</td><td>Gross calorific value (KCal/kg)</td><td>of the order of 10,000</td><td>of the order of 10,000</td><td>of the order of 10,000</td></tr> <tr><td>3.</td><td>Flash Point (Min)</td><td>66 deg C</td><td>76 deg C</td><td>66 deg C</td></tr> <tr><td>4.</td><td>Water content by volume (Max)</td><td>1.0%</td><td>1.0%</td><td>1.0%</td></tr> <tr><td>5.</td><td>Sediment by weight (Max)</td><td>0.25%</td><td>0.25%</td><td>0.25%</td></tr> <tr><td>6.</td><td>Asphaltene content by weight (Max.)</td><td>2.5%</td><td>2.5%</td><td>2.5%</td></tr> <tr><td>7.</td><td>Kinematic viscosity in Centistokes</td><td>370 at 50deg C</td><td>100 at 100deg C</td><td>100 at 100deg C</td></tr> <tr><td>8.</td><td>Ash Content by weight (Max.)</td><td>0.1%</td><td>0.1%</td><td>0.1%</td></tr> <tr><td>9.</td><td>Acidity (inorganic)</td><td>Nil</td><td>Nil</td><td>Nil</td></tr> <tr><td>10.</td><td>Pour Point (Max.)</td><td>57 deg C</td><td>66 deg C</td><td>72 deg C</td></tr> <tr><td>11.</td><td>Sodium content</td><td>—</td><td>—</td><td>100 ppm</td></tr> <tr><td>12.</td><td>Vanadium content</td><td>25 ppm</td><td>25ppm</td><td>25 ppm</td></tr> <tr><td>13.</td><td>Specific heat below pour point (KCal/Kg °C)</td><td></td><td>0.65</td><td></td></tr> </tbody> </table>				Sl. No.	Characteristics	Heavy Furnace Oil grade HV (HFO) IS-1593-1982	Low Sulphur Heavy Stock (LSHS) IS-11489-1985	Heavy Petroleum stock (HPS) IS-11489-1985	1.	Total sulphur content	4.5% Max.	1.0% Max.	4.5% Max.	2.	Gross calorific value (KCal/kg)	of the order of 10,000	of the order of 10,000	of the order of 10,000	3.	Flash Point (Min)	66 deg C	76 deg C	66 deg C	4.	Water content by volume (Max)	1.0%	1.0%	1.0%	5.	Sediment by weight (Max)	0.25%	0.25%	0.25%	6.	Asphaltene content by weight (Max.)	2.5%	2.5%	2.5%	7.	Kinematic viscosity in Centistokes	370 at 50deg C	100 at 100deg C	100 at 100deg C	8.	Ash Content by weight (Max.)	0.1%	0.1%	0.1%	9.	Acidity (inorganic)	Nil	Nil	Nil	10.	Pour Point (Max.)	57 deg C	66 deg C	72 deg C	11.	Sodium content	—	—	100 ppm	12.	Vanadium content	25 ppm	25ppm	25 ppm	13.	Specific heat below pour point (KCal/Kg °C)		0.65	
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CLAUSE NO.	PROJECT INFORMATION		एनटीपीसी NTPC																								
	TABLE -2B LIGHT DIESEL OIL CHARACTERISTICS AS PER IS 1460-2000 <table><tr><th>Characteristics</th><th>LDO</th></tr><tr><td>1. Pour Point (max)</td><td>21 deg.C& 12°C for Summer and Winter respectively</td></tr><tr><td>2. Kinematic viscosity in centistokes at 40 deg.C</td><td>2.5 to 15.7</td></tr><tr><td>3. Sediment percent by mass (max)</td><td>0.10</td></tr><tr><td>4. Total sulphur percent by mass (max)</td><td>1.8</td></tr><tr><td>5. Ash percentage by mass (max)</td><td>0.02</td></tr><tr><td>6. Carbon residue (Rans bottom) percent by pass (max.)</td><td>1.50</td></tr><tr><td>7. Acidity in organic</td><td>Nil</td></tr><tr><td>8. Flash point(Min.) - Pensky Martens</td><td>66 deg.C</td></tr><tr><td>9. Copper strip corrosion for 3 hours at 100°C</td><td>Not worse than No. 2</td></tr><tr><td>10. Water content, % by volume(max)</td><td>0.25</td></tr><tr><td>11. GCV (Kcal/kg)</td><td>10,000</td></tr></table>			Characteristics	LDO	1. Pour Point (max)	21 deg.C& 12°C for Summer and Winter respectively	2. Kinematic viscosity in centistokes at 40 deg.C	2.5 to 15.7	3. Sediment percent by mass (max)	0.10	4. Total sulphur percent by mass (max)	1.8	5. Ash percentage by mass (max)	0.02	6. Carbon residue (Rans bottom) percent by pass (max.)	1.50	7. Acidity in organic	Nil	8. Flash point(Min.) - Pensky Martens	66 deg.C	9. Copper strip corrosion for 3 hours at 100°C	Not worse than No. 2	10. Water content, % by volume(max)	0.25	11. GCV (Kcal/kg)	10,000
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LOT-IA PROJECTS FLUE GAS DE-SULPHURIZATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-II-A11 PROJECT INFORMATION NABINAGAR TPP																								
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Table-3

DESIGN CLARIFIED WATER ANALYSIS

S.No	Constituent	As	mg/l (except pH & turbidity)
1.	Calcium	CaCO ₃	131
2.	Magnesium	CaCO ₃	52
3.	Sodium + Potassium	CaCO ₃	65
4.	Total Cations	CaCO ₃	248
5.	Chloride	CaCO ₃	20
6.	Sulphate	CaCO ₃	93
7.	Nitrate	CaCO ₃	10
8.	Alkalinity	CaCO ₃	125
9.	Total Anions	CaCO ₃	248
10.	Iron(total)	Fe	0.3
11.	Total Silica	SiO ₂	22
12.	pH value	---	7.0-8.2
13.	Turbidity	NTU	10

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

Table-4

ANALYSIS OF DM WATER

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

CLAUSE NO.	PROJECT INFORMATION		एनटीपीसी NTPC	
2.00.00	Table-5			
	STEAM GENERATOR DATA			
	1.	Location	Outdoor	
	2.	Operation	Base load	
	3.	Type	Pulverised coal fired	
	4.	Maximum Continuous Rating	810 Tons/hr.	
	5.	Steam pressure at SH outlet	155 Kg/cm ² (a)	
	6.	Steam temperature at SH outlet	540°C	
	7.	Oil for start up and flame stabilization	Heavy Oil/LSHS/HPS/LDO	
	8.	Fuel oil system sizing	30% of Boiler MCR for Heavy oil/LSHS/HPS (7.5% for LDO)	
	9.	Pulverised coal size and 99% thru 50 mesh	Minimum 70% through 200 Mesh	
	10.	Type of pulveriser	Vertical spindle mills	
	11.	Type of oil burners	Steam atomised, (Air atomised for LDO)	
	12.	No. of air heaters	Two (2) nos. of Tri-sector type	
	13.	No. of ID Fans	Two (Radial type, both working)	
	ESP DATA			
	1.	Location:	Downstream side of Air preheaters	
	2.	Operation:	Base load	
3.	Type:	Rigid Discharge frame		
4.	Rapping:	Intermittent		
LOT-IA PROJECTS FLUE GAS DE-SULPHURIZATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI, PART-A BID DOCUMENT NO.: CS-0011-109(1A)-2	SUB-SECTION-II-A11 PROJECT INFORMATION NABINAGAR TPP	PAGE 28 OF 29

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	TABLE-6 List of Drawings enclosed in this sub-section: <table><tr><th>Sl.No.</th><th colspan="3">Drawing Description</th><th colspan="3">Drawing No.</th></tr><tr><td>1.</td><td colspan="3">General Layout Plan</td><td colspan="3">Enclosed</td></tr><tr><td>2.</td><td colspan="3">Topographical Survey</td><td colspan="3">Enclosed</td></tr><tr><td>3.</td><td colspan="3">Equipment Layout Plan</td><td colspan="3">Enclosed</td></tr><tr><td>4.</td><td colspan="3">ID system-Elevation & Plan</td><td colspan="3">Enclosed</td></tr><tr><td>5.</td><td colspan="3">Pipe Cable Trestle Layout</td><td colspan="3">Not located near FGD area</td></tr><tr><td>6.</td><td colspan="3">Pipe Cable Trestle Foundation</td><td colspan="3">Not located near FGD area</td></tr><tr><td>7.</td><td colspan="6"><u>Chimney foundation details</u></td><td></td></tr><tr><td></td><td></td><td>Chimney shell outer diameter at ground level (m)</td><td>Chimney foundation outer diameter (m)</td><td>Type of foundation</td><td>Level of Top of foundation (m)</td><td>Level of Bottom of foundation (m)</td></tr><tr><td></td><td>Unit #1&2</td><td>28</td><td>42.1</td><td>Raft supported on piles</td><td>RL(+) 126.00</td><td>RL(+) 122.25</td></tr><tr><td></td><td>Unit #3&4</td><td>28</td><td>42.1</td><td>Raft supported on piles</td><td>RL(+) 126.00</td><td>RL(+) 122.25</td></tr></table>							Sl.No.	Drawing Description			Drawing No.			1.	General Layout Plan			Enclosed			2.	Topographical Survey			Enclosed			3.	Equipment Layout Plan			Enclosed			4.	ID system-Elevation & Plan			Enclosed			5.	Pipe Cable Trestle Layout			Not located near FGD area			6.	Pipe Cable Trestle Foundation			Not located near FGD area			7.	<u>Chimney foundation details</u>									Chimney shell outer diameter at ground level (m)	Chimney foundation outer diameter (m)	Type of foundation	Level of Top of foundation (m)	Level of Bottom of foundation (m)		Unit #1&2	28	42.1	Raft supported on piles	RL(+) 126.00	RL(+) 122.25		Unit #3&4	28	42.1	Raft supported on piles	RL(+) 126.00	RL(+) 122.25
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TITLE:

**4 X250 MW NABINAGAR TPP
TECHNICAL SPECIFICATION FOR
MISCELLANEOUS FGD TANKS**

SPECIFICATION No: PE-TS-463-167-A101

SECTION-I, SUB-SECTION-C1

REV. 00

DATE: MAY 2020

SPECIFIC TECHNICAL REQUIREMENT – MECHANICAL



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS FGD TANKS
4X250 MW NABINAGAR TPP**

SPECIFICATION NO. PE-TS-463-167-A101

SECTION –I, SUB SECTION –C1A

REVISION 00

DATE: MAY 2020

SUB SECTION-C1A

SPECIFIC TECHNICAL REQUIREMENTS - TANKS

	TECHNICAL SPECIFICATION FOR MISCELLANEOUS FGD TANKS 4X250 MW NABINAGAR TPP	SPECIFICATION NO. PE-TS-463-167-A101	
		SECTION –I, SUB SECTION –C1A	
		REVISION 00	DATE: MAY 2020

1.0 SCOPE OF SUPPLY

- 1.1 Steel tanks fabricated and supplied at site under this specification shall be as per enclosed FGD Tank schedule (Section-III, Annexure-8) and SIZING CALCULATION , SELECTION PARAMETER FOR ALL TANKS (Annexure-III, sub Section-D, Section-I). Modifications may be made by the bidder to suit good engineering practice to the satisfaction of the customer. The customer, however, reserves the right to reject any modifications.
- 1.2 General design, selection of rubber/glass flake lining materials, construction features, manufacturing, shop inspection, testing at manufacturer's works, surface preparation, lining, inspection & testing of the lined surface at site. For detail specification of rubber/glass flake lining refer Sub Section-C1-B/C1-C, section-I.
- 1.3
 - a) The connections and accessories which are required to be supplied with each tank by the bidder shall be as indicated in the enclosed FGD Tank schedule (Section-III, Annexure-8) and SIZING CALCULATION , SELECTION PARAMETER FOR ALL TANKS (Annexure-III, sub Section-D, Section-I).
 - b) The piping material inside the tank shall be supplied by the bidder. All inlet piping shall be extended up to the bottom of the tank and the clearance between the bottom of the tank and the edge of the inlet piping shall be kept as 500 mm (maximum).
The inlet pipes for slurry storage tanks shall be lined with replaceable wear resistant natural rubber lining of minimum 6 mm thickness from inside. Additional thickness of 2 mm in rubber lining shall be provided at bends. The contractor can provide slurry pipe of size lower than 300 NB made up of FRP material (silicon carbide coating on slurry exposed surface) if it/sub-supplier has previous experience of providing the same.
 - c) The inside piping shall be adequately supported and shall be provided with adequately sized vent(anti-siphoner) connection at pipe top.
 - d) Weir plates of adequate thickness (minimum 8 mm) shall be provided for all inlet piping.
 - e) Pad plates on the tanks for supporting outside piping shall be provided by the bidder. Details of the pad plates (sizes, quantity etc.) shall be informed to bidder during detail engineering.
 - f) Fabrication and supply of all flanges and counter flanges for all nozzles of tank connections shall be included in the scope of work of the bidder. Necessary bolts, nuts and gaskets for these connections shall also be supplied by the bidder. **Further, rubber lining of these nozzles** including flanges, counter-flanges shall be in bidder's scope of work.
 - g) The manhole shall be of hinged and bolted type with nuts, bolts and gaskets in bidder's scope of supply. The size of the manhole shall be minimum 800 mm if not specified in the specification.
 - h) Void.
- 1.4 The scope of works shall also include supply and installation of special accessories including agitator supporting arrangements, agitator platform, baffle plates etc. as indicated in FGD Tank schedule (Section-III, Annexure-8). The necessary fixtures and other accessories for mounting these special accessories shall be included in the scope of work of the bidder.

	TECHNICAL SPECIFICATION FOR MISCELLANEOUS FGD TANKS 4X250 MW NABINAGAR TPP	SPECIFICATION NO. PE-TS-463-167-A101	
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- 1.5 Baffle plates for the agitators shall be mounted on the tank. The supply and erection of the baffle plates shall be in bidder's scope of work. The minimum no. of baffle plates and minimum dimension of the baffle plates have been indicated in the drawing attached with the tank schedule (Section-III, Annexure-8). The final quantity and dimensions of the baffle plates shall be decided during detail engineering.
- 1.6 Void.
- 1.7 Pipes, fittings, nozzles, flanges and counter flanges **along with the rubber lining** shall be supplied by the bidder. The minimum requirement like quantity, size, type, MOC etc. are indicated in the FGD Tank schedule (Section-III, Annexure-8) and may undergo change during detail engineering stage and these shall be supplied by the bidder as per the approved drawings / documents for which no commercial implication shall be entertained by BHEL.
- 1.8 The minimum number of anchor bolts along with the minimum size has been specified in tank schedule (Section-III, Annexure-8). However, any additional anchor bolts of higher size if found applicable during detailed Engineering shall be provided by bidder without any commercial implication. The material of construction for anchor bolts shall be IS 1367 Part-3.
- 1.9 Painting of the tanks is included in bidder's scope of work. Painting specifications of storage tanks are given under Painting schedule in Sub Section-C2-C, section-1. Painting requirement specified under Painting schedule are minimum requirement. Any modification in painting requirement found applicable during detained engineering, shall be under bidder's scope without any commercial implication.
- 1.10 Commissioning spares as required for commissioning of the tanks are in bidder's scope.
- 1.11 Platforms, inter-connecting platforms, platforms for agitator maintenance, monkey ladder inside tank, staircase, hand railing, knee guard and toe guard (in stair case, agitator platform and all along the periphery of roof of the tank), as per the relevant design code / good engineering practice shall be included in bidder's scope of work. All staircase treads and platforms shall be 32 mm steel fabricated gratings. Gratings shall be galvanized as given for handrails in painting specification.

2.0 SCOPE OF SERVICES

Services shall include but not be limited to the followings:

- 2.1 Design, engineering, preparation of detailed fabrication drawings, GA drawings, design calculation, bill of material, tag and piece numbers, welding procedures etc. Stiffeners and other structural framing for supporting the tank shall be designed by the fabricator and properly shown in the fabrication drawings.
- 2.2 Erection & Commissioning of Tanks.
- 2.3 Erection & Commissioning of rubber/glass flake lining.
- 2.4 Erection of the agitators, agitator mounting arrangement, agitator supporting arrangements etc, shall be in bidder scope. The Agitator shall be provided by BHEL as a free issue item.

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2.5 Erection of all foundation bolts / anchor bolts etc. as required for any equipment/ foundation /concrete. 2.6 Minor civil work like chipping of foundation, grouting below base plate for all structures, equipment, grouting of pockets. Supply of grouting material is under bidder’s scope. 2.7 Inspection & testing and carrying out demonstration test of tanks. 2.8 Inspection & testing and carrying out demonstration test for the rubber/glass flake lining of tanks. 2.9 Painting of tank and other equipment within the battery limit. 2.10 Any other services as required to make the installation complete in all respects shall be deemed to be included in bidder’s scope of work whether mentioned above or not. 3.0 <u>DESIGN CONSIDERATIONS</u> 3.1 The successful bidder shall furnish design calculations to BHEL during detailed engineering stage for approval along with the Xerox copies of relevant pages of authentic supporting literature e.g. Code, Hand book, National / international Standards etc. Calculation shall be necessarily done in SI UNITS only for the followings: - a) Tanks shall be designed as per IS – 803 / API – 650 / AWWA – D 100 / IS –2825 / BS – 2594 / Good engineering practice as applicable and referred code shall be of latest edition. b) Weight calculation of plates, appurtenances, platforms & structures separately shall be included in the Design calculation. c) Design of roof and roof structures for vertical storage tanks along with agitators & agitator platforms shall be designed based on guidelines given in the book titled “Process equipment design” by Brownell and Young. Further, roof structure shall preferably be constructed on external side of roof. d) Tank stability calculation (wind load / seismic / overturning stability) considering static and dynamic loads of Agitator and its platforms and supporting arrangement shall be done as per API – 650/IS-803, latest edition. However, factors / coefficients as required for the design of tank shall be obtained from BHEL by the bidder after placement of order. d) Vent sizing calculation shall be done as per API – 2000, latest edition e) Void. 3.2 The successful bidder shall indicate references of all the clauses indicating their page number from respective standard in the design calculation during detail engineering stage. All steps including formulas and abbreviations shall be clearly shown in the calculation. All inputs / assumptions shall be indicated in the first sheet of the calculation. 3.3 a) Bottom plate shall be 8.0 mm thick (minimum). Minimum 6 mm (excluding tolerance on plate as per relevant IS) thick plates including corrosion allowance shall be provided for shell plates and minimum			

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	TECHNICAL SPECIFICATION FOR MISCELLANEOUS FGD TANKS 4X250 MW NABINAGAR TPP	SPECIFICATION NO. PE-TS-463-167-A101	
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		REVISION 00	DATE: MAY 2020
8 mm for roof plates for all tanks. However, Auxiliary absorbent tank shall be provided with minimum 8 mm thickness for shell . b) Negative tolerance on plate thickness shall not be considered in the plate thickness calculation and also shall not be provided in the tank. Only positive tolerance shall be considered. 3.4 Tank shall be suitably constructed for safe, proper and continuous operation under all conditions that can be expected in a plant life without undue strain, corrosion or other operating difficulties. 3.5 In calculating the minimum plate thickness, the specific gravity of the liquid shall be taken as per tank schedule (Section-III, Annexure-8). 3.6 For cylindrical tanks, the plates shall be cold rolled through plate bending machine by several number of passes to true curvature. 3.7 Vessels seams shall be so positioned that they do not pass though vessel connections. For cylindrical vessels consisting of more than two sections longitudinal seams shall be offset. 3.8 Wherever possible, the inside seam weld shall be ground smooth, suitable for application of corrosion resistant primer. 3.9 The joint efficiency factor to be adopted for design calculation of shell thickness shall be 0.7. 3.10 All roofs and supporting structures shall be designed to support dead load plus a uniform live load of not less than 150 kg/m² of projected area. Further, the static and dynamic loads of the agitator assembly along with the agitator platform shall be considered over and above the uniform live load. 3.11 Code conformance for flanges / counter flanges shall be ANSI B 16.5. Code conformance for bolts and nuts shall be SA 193 & 194 respectively. Further, all fasteners used in wetted condition must be of Alloy 926 or better material so that even if it comes in contact with liquid by swelling of rubber lining, thread remains unaffected. Raw material of fastener must undergo Inter-Granular Corrosion test as per ISO-3651, Part-1 for Nitric Acid test. 3.12 The number & size of nozzles (including flanges, counter flanges and inside piping) indicated in the tank schedule (Section-III, Annexure-8) are tentative and bidder guidance purpose only and the same may undergo change during detail engineering stage for which no commercial implication shall be entertained by BHEL. 3.13 Bidder shall furnish the STADD calculation along with the roof structure calculation during detail engineering for checking the stability of roof. 3.14 Bidder to note that surface cleaning shall be of Blast clean type. However, Grit blasting shall be decided during detail engineering for which no commercial implication shall be entertained by BHEL. Further, the surface cleaning of the tanks shall be in line with the requirements specified in the specification for rubber/glass flake lining (Section-I, Sub Section-C1B) 3.15 Bidder to note that foundation drawing along with loading data & anchor bolt details shall be provided by bidder within two weeks’ time from the LOI. However, Bidder to provide minimum anchor bolts for the Miscellaneous FGD tanks, as specified in tank schedule (Section-III, Annexure-8).			

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- 3.16 A corrosion allowance of 1.5 mm shall be considered for calculating the shell thickness of tanks.

4.0 WELDING

- 4.1 Welding shall be in accordance with the requirement of IS: 803, 816, 817 and 823 or equivalent and as specified in the specification for lining (Section-I, Sub-Section-C1B).
- 4.2 Welding sequence shall be adopted in such a way so as to minimize the distortion due to welding shrinkage. Contractor shall indicate in his drawing the sequence of welding proposed by him, which should meet prior approval of the Engineer.
- 4.3 All welders shall be BHEL / customer / consultant qualified as per the approved quality plan / field quality plan which will be submitted by the successful bidder during detail engineering stage. WPS and PQR shall be submitted by the successful bidder to BHEL / customer / consultant for review and approval.

5.0 TEST AND INSPECTION

- 5.1 The particulars of the proposed tests and the procedure for the tests shall be submitted to the Owner / Engineer for approval before conducting the tests. The successful bidder shall submit FQP (field quality plan) and demonstration test procedure for BHEL / customer / consultant's approval during detail engineering stage. In the event of any change in the field quality plan and demonstration test procedure, the same shall be incorporated by the bidder in the document and approved document shall be adhered by the bidder without any commercial implication.
- 5.2 DPT / MPI on all welds (100%).
- 5.3 All cross / Tee joints and butt welds to be Radio graphed in line with the joint efficiency as specified.
- 5.4 For the offered tanks, fill test shall be carried out for at least 24 hours. Atmospheric storage tanks on inside surface shall be leak tested before painting/ rubber or glass flake lining.
- 5.5 All quality plans / checklists for various items shall be furnished during detail engineering stage for BHEL / customer's approval and any changes required by BHEL / customer shall be incorporated in the documents and adhered without any price implication. However, minimum requirement of MQP as indicated in the technical specification shall be followed. All necessary items as required for inspection and testing of the tank including instruments shall be arranged by the bidder.

6.0 MANDATORY SPARES:

Not Applicable.

7.0 LIST OF COMMISSIONING SPARES:

SL. NO.	DESCRIPTION OF ITEMS	QUANTITY
1	Rubber Gasket of each size	2 nos.



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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

8.0 TERMINAL POINTS

- Matching counter flanges for all nozzles mounted on the tanks. However, counter flanges for all nozzles of tank shall be provided by the bidder.

9.0 EXCLUSIONS

- 1) Tank foundation & associated civil works, all instruments like level gauges, Level Transmitters, etc are excluded from bidder's scope of work. However, required no. of nozzles for the same shall be in bidder's scope of work.
- 2) All agitators including the agitator of drain sumps shall be provided as a free issue item to the bidder. The erection and commissioning of the agitators shall be in bidder's scope of work. However, BHEL shall arrange for the supervision of the erection & commissioning of the agitator assembly to the bidder as a free issue service.
- 3) The Sumps/drain pits indicated in the tank schedule (Section-III, Annexure-8) is excluded from bidder's scope of work. However, the erection and commissioning of the agitators and 9+ lining within the sump/drain pits shall be in bidder's scope of work.
- 4) All valves are excluded from bidder's scope of work.
- 5) All external piping from the counter flange of the nozzles of respective tanks is excluded from bidder's scope of work. However, matching counter flanges for all nozzle shall be in bidder's scope of work. Further the supply and erection of the piping material inside the tank shall be in bidder's scope. The rubber lining of the inlet pipes shall be in bidder's scope of work.

10.0 DRAWINGS AND DOCUMENTS TO BE SUBMITTED WITH THE BID

The bidder must submit the drawings / documents as mentioned under "CHECK LIST FOR DOCUMENT TO BE SUBMITTED" (In Section-III, Annexure-I) along with their bid. In absence of any of these documents, BHEL reserves right not to evaluate the offer of the concerned bidder.

11.0 DRAWINGS/ DOCUMENTS REQUIRED DURING DETAIL ENGINEERING

The successful bidder shall submit the drawing / documents as mentioned under SECTION-I, Sub-Section-D, Annexure-IV during detail engineering for approval / information / reference (as the case may be).

12.0 OTHER TECHNICAL REQUIREMENTS

- 1) 15 days' time is required by BHEL to offer their comments on the drawings and documents being submitted by the bidder (during detailed engineering stage in the event of L.O.I being placed) from the date of receipt.
- 2) Bidder to depute competent designer (s) at BHEL's office during detailed engineering stage to discuss drawings and other technical documents as and when required by BHEL.



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- 3) Bidder to assess the capability of their 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. No deviations shall be entertained.
- 4) Commercial implication includes price implication as well as delivery implication.
- 5) Size of hand rails on stairway and tank roof / top shall be minimum 32 NB and shall conform to IS 1239 (M). Handrails shall be galvanized as per painting specification.
- 6) Type of roof for vertical cylindrical storage tanks shall be either supported cone roof or self-supporting cone roof as per latest edition of relevant design code.
- 7) Commissioning of tanks will consist of installation of all accessories of tanks as per approved drawing/specification, charging of tank, water-fill test (for minimum 24 hours after complete filling of tank), satisfactory functioning of all accessories, emptying of tank, subsequent painting of complete tanks and changing of gaskets as per specification requirement.
- 8) Bidder to furnish prices and unit price of each item of proposed tanks as per BHEL's price format only along with the final price bid.
- 9) Bidder shall check that specifications of all the items are available in the NIT specification. However, in the event of absence of specification for any item, bidder will approach BHEL to furnish the specification of missing items and new specification will be adhered by the bidder for which no commercial implication shall be entertained by BHEL.
- 10) All tools and plants including welding machines, crane, hydra, etc. and instruments as required for construction, erection and commissioning, trial run and functional demonstration test at site shall be arranged by the bidder.
- 11) Bidder to furnish list of sub-vendors based on sub-vendor list enclosed with the specification during detail engineering stage for BHEL's / Customer review and approval and items shall be procured from these suppliers only.
- 12) Dealers are not acceptable for any item of the package. Bidder shall procure all items including plates, structural, flanges, counter flanges etc. from BHEL approved sub vendor only. No argument on this account shall be entertained.
- 13) All rubber lined pipes shall be provided with flanged type connections only. In other words, Rubber lined pipes shall be flange joined only.



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SUB SECTION-C1B

SPECIFIC TECHNICAL REQUIREMENTS – RUBBER LINING



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1.0 SCOPE OF WORKS

- 1.1 Design, manufacture, testing and supply of rubber lining material for the duty condition for FGD Tanks as specified in Annexure- 8 (Tank schedule), Section-III.
- 1.2 Erection and Commission of rubber lining, delivery of material at site, surface preparation for lining surfaces, lining the surface to the satisfaction of the customer shall be under bidder's scope, cost for Erection and Commission shall be included in the offer.
- 1.3 Ten(10) copies of Operation manuals containing all details of reference drawings and technical data shall be furnished by the Bidder.

2.0 SURFACE PREPARATION

- 2.1 The Tanks surface to be lined should be blasted to a bright grey metal finish (Sa 2½ requirement), free from rust, weld marks, oil and any other foreign matter. The blasting is carried out with the help of dry grit (copper sludge)/Sand under dry air pressure of 7 kg/cm² by Compressor. Surface roughness shall be 50-60 Microns.
- 2.2 After blast cleaning, blasted surface will be applied by surface protecting primer to prevent the corrosion. After 100% blasting of the particular Tank is completed, the surface is cleaned by appropriate solvent, so as to see that all the small dust particles are removed. Sharp corner shall be suitable rounded off. Surface should not have any sharp notch.
- 2.3 After this procedure suitable bonding agent and 3 to 4 coating of the specially formulated rubber adhesive should be applied for proper bonding of the Rubber Sheets to be lined.
- 2.4 Compressor and any other facilities required for grit/shot blasting shall be arranged by vendor. Any hoses provided in the compressed air line shall be tested with air before commencement of grit blasting job.
- 2.5 The grit/shot blasting machine shall be provided with safety valve (safe trip) as a protection against over pressure.
- 2.6 Scaffolding shall be done by the vendor. Any scaffolding provided by the vendor shall be of steel only.

3.0 GUIDELINES FOR DESIGNING AND FABRICATION OF STEEL CONSTRUCTIONS FOR RUBBER LINING:

Please refer Section-II, Sub-Section-A

4.0 RUBBER LINING

- 4.1 The lining shall completely cover the roof, sides and internals of Slurry Tanks, support angle, insert plates, openings, Man Hole / Inspection / Flange openings. etc.,
- 4.2 The rubber used for the lining of the tank is given below:

Sl. No	Tank	Rubber Lining details of interior surface / Painting details of interior surface
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1	Auxiliary absorbent tank, Limestone slurry storage Tank and Primary hydro cyclone Tank.	Bromobutyl rubber lining with Shore A hardness as 55±5 and min 4 mm thickness.
2	Process water Tank, Belt Filter Wash Tank and Clarified (Cake wash) Water Tank.	Epoxy lining of minimum 150 micron thickness (3 coats of 50 micron each)

4.3 After Rubber sheet applied on the surface, rubber sheets should be systematically pressed to the metal surface by the help of mechanical tools like Rubber Rollers and metal thin rollers to remove the air between metal and rubber sheet. All rubber joints are properly overlapped by 25 to 35 mm wide tapered cut rubber sheet. All the joints will be covered by 75 mm X 1.5 - 1.7 mm thick rubber strip.

4.4 Vendor shall specify the shelf life of the rubber material being supplied and shall furnish the storage methods to be followed at site to ensure that the rubber material shall not be spoilt during storage.

4.5 Vendor shall submit the surface preparation and lining procedure to the purchaser for approval. The lining work shall start only after obtaining approval from Purchaser.

5.0 INSPECTION AND TESTING OF RUBBER LINING

- 1 Ageing Test : 70°C for 24 hrs. (IS: 3400 Pt.4)
Change in Tensile Strength: ± 5%
Elongation at break: ± 10%
- 2 Abrasion Test : Wt. loss – Max. 25%
- 3 Tensile Strength : 35 kg/cm² (min) for Bromo Butyl and
40 kg/cm²(min) for Chloro Butyl Rubber
- 4 Elongation at break : ≥ 300% minimum for 4mm thk rubber specimen
- 5 Peeling strength : ≥ 3 N/mm
- 6 Hardness : 55 ± 5° Shore A
- 7 Spark Test : 1.5 KV/ mm
- 8 Lining shall be visually inspected to ensure free from poorly weed out fibers, entrapped air and exposed fires. Defects are to be repaired by sanding a generous area around the defected portion and applying a layer of rubber material.
- 9 Spark test shall be carried out at appropriate areas in the presence of Purchaser. Vendor should conduct test as per relevant standards.
- 10 After installation, the Rubber lining shall be subjected to testing at site as per relevant standards. If the performance is found not to meet the requirements as specified, the Rubber lining shall be rectified or replaced by the Vendor without any extra cost to the Purchaser.

6.0 FINISHING & INTERNAL TESTING

- 6.1 Rubber surface of all flanges and manhole of Equipment will be finished by the mechanical tools to get leakage free surface during commissioning.



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- 6.2 After above finishing, 100% testing will be carried out for continuity by high frequency high voltage spark tester. If there is any puncture, they are checked and rectified as per the standard procedure of repair (Clause 6.1) as mentioned in procedure.

7.0 REPAIRING PROCEDURE

- 7.1 Faulty spots on the rubber lining are cut off down to be substrate and the seams of the remaining rubber are beveled.
- 7.2 Rubber sheet with a broad bevel cut is glued on the substrate laid bare.
- 7.3 On spots to be repaired of a diameter < 300 mm, a second layer of Rubber sheet is glued covering the seams of the first layer.
- 7.4 Several spots to be repaired in a small area are jointly covered with a second layer of Rubber sheet.

8.0 PERFORMANCE GUARANTEE

The lining material shall be guaranteed for **an uninterrupted minimum life of 25000 hrs.** Performance parameters to be guaranteed by the vendor and tolerances permitted shall be as indicated in the data sheet. Rubber lining or any portion thereof is liable for rejection, if it fails to give any of the guaranteed performance parameters. The lining should be guaranteed for faultless material and workmanship. During Guarantee period any defects noticed due to faulty material and workmanship, shall be rectified by vendor free of cost.

9.0 PACKING

- 9.1 The part items of the Rubber lining should be identified by Tag numbers and should be packed as to minimize the possibility of damage during storage or transit. The packing should be suitable for tropical conditions.
- 9.2 Please refer Sub Section- C2 – A, SECTION – I for Packing Procedure.

10. DOCUMENTATION

DATA TO BE FURNISHED BY THE VENDOR AFTER RECEIPT OF PURCHASE ORDER:

- 10.1 List of Drawing and documents to be submitted for review, approval and information with submission dates.
- 10.2 Quality Assurance Plan to be submitted for approval.
- 10.3 Detailed dimensional General Arrangement drawing of the lining surfaces.
- 10.4 Document containing all the design data and information about the material, scope of work and weight of the material supply, Packing procedure etc.
- 10.5 Installation, operation and maintenance manual.
- 10.6 Surface preparation procedures.



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SUB SECTION-C1-C

SPECIFIC TECHNICAL REQUIREMENTS – GLASS FLAKE LINING



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1.0 INTENT OF SPECIFICATION

- a) This Specification defines the minimum requirements of glass flake lining of Slurry Tanks/drain sumps in the Flue Gas Desulphurization (FGD) plant.
- b) Tanks/Sumps to be lined contain Limestone Slurry/Gypsum Slurry. Slurry details are given in Annexure- 8 (Tank schedule), Section-III. The glass flake lining shall offer better resistance to corrosion/erosion and shall be based on Vinyl ester resin. Thickness of glass flake lining required is 3 mm thk.
- c) This specification covers the general design, selection of suitable glass flake material/resin, manufacture, shop inspection (As per latest applicable statutes, regulation and safety codes in the locality where the lining is to be carried out) and delivery at site, surface preparation of lining surface, lining the surface to the satisfaction of the customer, inspection of the lining at site, handling over to the ultimate customer.
- d) Compliance to this specification shall not relieve the vendor of the responsibility of furnishing glass flake lining materials of proper design, materials and workmanship to meet the specified requirements.

2.0 CODES AND STANDARDS:

The glass flake lining shall conform to the latest version of Indian/British/American/International Standards. Nothing in this specification shall construe to relieve the contractor of the required statutory responsibility. The Glass Flake Lining material shall be designed for the corrosion protection of the Slurry tank/drain sumps. The lining shall be glass flake filled vinyl ester-based coating system. Only Proven material has to be offered by the bidder. The reference standard are given below:

STANDARD	DESCRIPTION
ASTM D 4285	Standard Test Method for Indicating Oil or Water in Compressed Air
ASTM D 4541	Standard Test Method for Pull-Off Strength of Coating Using Portable Adhesion Testers
ASTM E 337	Standard test Method for Relative Humidity by Wet and Dry Bulb Psychrometer
ASTM D 4618	Standard Specification for Design and Fabrication of Flue Gas Desulfurization System Components for Protective Lining Application
ASTM D 5162	Practice for Discontinuity (Holiday) Testing of Non-Conductive Protective Coating on Metallic Substrates
NACE Standard RP0178-2003	Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels to be lined for Immersion Service
ISO 8501-1, 1988	Preparation of Steel Substrates Before Application of Paints and Related Products - Visual Assessment of Surface Cleanliness
SSPC"PA2	Measurement of Dry Paint Thickness with Magnetic Gauges



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3.0 SCOPE OF WORKS

- a) Supply of Vinyl ester based glass flake lining of minimum 3 mm thickness, storage, preparation of the surfaces for lining at site. All equipments required for lining shall be arranged by the lining vendor.
- b) Erection and Commissioning of the glass flake lining as per specification. Lining of the internal surfaces of slurry tanks and drain sumps to the satisfaction of the customer and testing the lined surface for proper adhesion, complete coverage and intactness with the base material/surface shall be under bidder's scope.
- c) To install the linings, full scaffolding access shall be provided to reach the internal walls and the entire area. Scaffold shall be properly erected with full planking in all work areas. Scaffolding shall not contact wall surfaces in work areas during lining application and surface preparation
- d) The execution of the surface preparation and lining shall be carefully planned in stages to obtain optimum lining quality with freedom from contamination and overspray or damage to lined surfaces from preparation in adjacent areas. Surface preparation will commence from the top and proceed progressively to the wall base and floor.
- e) Lining and preparation works shall be staggered or proceed progressively in order to meet cleanliness requirements or overcoating times indicated in this specification.
- f) Air-Compressor, Airless Spray pumps, hopper, blasting hose, lining hose, spray tip, blasting gun, spray gun and other equipment for blasting and spray application has to be arranged by lining vendor. Any scaffolding shall be made of Steel only.
- g) 10 copies of Operation and Maintenance Manuals containing all details of reference drawings and technical data shall be furnished by the Bidder.

4.0 VINYL ESTER BASED GLASS FLAKE LINING

4.1 For slurry tanks, the lining shall completely cover the roof, shell plates, support angle, Man Holes, Flanges, internal piping, baffle plates and any other component which is in contact with slurry. For drain sumps, lining shall cover all internal walls, bottom of sump and any other component which is in direct contact with slurry.

4.2 The glass flake lining used for the lining of the tanks/sumps is given as below:

Sl. No	Tanks/Sumps	Lining details of interior surface
1	Waste water Tank, Secondary Hydro cyclone feed Tank and Filtrate water Tank.	Vinyl ester-based Glass Flake lining of min 3 mm thickness.
2	Absorber Area drain sump (4 nos), Gypsum Area drain sump and Limestone Area drain sump.	Vinyl ester-based Glass Flake lining of min 3 mm thickness.



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5.0 ATMOSPHERIC CONDITION REQUIREMENTS

This section deals with the atmospheric condition requirement to be checked while undertaking the Glass Flake Lining at site.

1. Blasting or Coating shall not be applied if following conditions prevail.
 - When temperature of the surface to be coated is less than 3°C above the dew point, or the relative humidity is higher than 85%.
 - When the base metal temperature is greater than 60°C.
 - When the atmospheric temperature is below 4°C.
 - When there is, in the opinion of lining Contractor, the likely hood of an unfavourable change in the weather condition within 2 hours after coating.
 - When there is deposition of moisture in the form of rain or condensation.
2. Humidity shall be calculated by bidder using whirling hygrometer whose thermometers are calibrated.
3. Surface temperature shall be measured using suitable temperature gauge and calibration certificate of the same shall be provided by bidder.
4. Record will be maintained throughout the execution period. Readings shall be taken once in every 4 hours up to the time work is in progress. The frequency of reading should be increased during adverse weather conditions.
5. While working in unfavourable weather conditions (like monsoons or winters or if provided for in the contract or in large confined spaces where blasting and priming of the entire surface cannot be completed in one day operation, use of dehumidifier shall be resorted to. The dehumidification equipment will have to be maintained in such a way that the humidity is around 65% -75% inside the sump/tank at all times during the work. No flash rusting of the blast surface should take place till the time it receives a primer coat.
6. Where dehumidification equipment is to be used, the humidity readings are to be taken inside and outside the equipments to be coated.
7. Dehumidification equipment may not be necessary for contained space working if work is done at near ideal atmospheric conditions as described above.
8. In cases where dehumidification is not possible, alternate methods of warming up the work front like use of halogen lights, room heaters are to be adopted.
9. Humidity is to be taken at the location where the blasting coating operations taking place.

6.0 PRELIMINARY CHECK REQUIREMENTS

This section deals with the preliminary check requirements to be done while doing the lining work.



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6.1 CHLORIDE CONTAMINATION TEST:

The 2% ferricyanide paper method will generally be used to determine the chloride contamination as described below:

1. Apply de-mineralized water on approximate 12 cm² area of substrate and wait for 3 to 4 minutes.
2. Remove excess moisture by patting the substrate with clean lint free cloth.
3. Press a ferricyanide paper of approximate 12 cm² area against the substrate for approximately 5 seconds and remove the paper.
4. Total absence of blue spots on paper indicates the substrate is free from soluble salts
5. Light speckling paper indicates the substrate has still contamination but it is under the acceptance level. The component should be released for further process.
6. Large blue spots on the paper indicate the substrate is heavily contaminated.
7. In this case the following procedure to be done before coating.

- 7.1.1. Pressures wash the substrate with copious amount of town water.
- 7.1.2. Dry the substrate completely.
- 7.1.3. Re-blasts the surface.
- 7.1.4. Follow the salt contamination checking procedure again till you get the desired results.

8. The Ferricyanide papers should be stored by vendor in air tight container before and after use and the shelf life of Ferricyanide paper shall be one month.

6.2 ABRASIVE DRYNESS CHECK:

The abrasive to be used will be checked for dryness by taking a small quantity of abrasive on a filter /tissue paper and checking of traces of moisture absorbed in the filter/tissue paper. Frequency of test shall be once in day prior to blasting operation.

6.3 COMPRESSED AIR DRYNESS CHECK:

Compressed air to be used for blasting shall be free from oil & moisture and shall be tested adopting “Blotter Test” by vendor. A piece of blasting Paper will be held in front of blast hose nozzle to check for traces of oil/moisture captured by the blotting Paper. Frequency of test shall be once in day prior to blasting operation.

7.0 SURFACE PREPARATION

This section deals with the methods of surface preparation before coating application

7.1 MASKING:

- a. Bidder to ensure that areas not being coated are fully and adequately masked.
- b. Bidder to ensure that stud holes, dowel/oil ways etc. are suitably masked or plugged to prevent ingress of blasting abrasives.



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7.2 SURFACE PREPARATION METHODS:

The method of surface preparation dry abrasive manual blasting shall be done as follows:

- a. Surface to be coated shall be abrasive blasted. Before this operation, removal of existing coating to be carried out by chipping, grinding or by other suitable means. The walls of the tanks are painted with min 60μ DFT of Red Oxide Phosphate (rust proof primer), which is to be removed by vendor during blasting. Clean & dry Copper Slag Abrasive shall be used for ferrous base substrate.
- b. The minimum recommended compressed air required for Blasting shall be 7.0 m³/min at 6 kg/cm² pressure. NACE No.1/SSPC-SP-5 equivalent to SA 2½ of Swedish Standard blast profile (75 to 100 Microns) to be followed for cleaning the surface.
- c. The blasted surface shall be cleaned with dry compressed air/vacuum cleaner or with clean brush so that there is no presence of Dust & other foreign material. The surface will be then checked for chloride contamination (Refer Clause.6.1 for Chloride contamination check procedure). Vendor to ensure that the blasted surface is free from chloride contamination
- d. When cleanliness and blast profile are acceptable, the masking tape adjacent to the area to be coated shall be peeled back to prevent overlap and subsequent edge contamination.
- e. If the blasted surface has not been primed within specified time or if there is any previous visible sign of blast condition change then the surface shall be checked for metallic salt contamination and shall be reblasted. Where large areas are required to be blasted in a day, blasting shall be carried out from morning to evening ensuring weather condition. This shall be followed by a light sweep blast of the entire area, before priming. The blast cleaned surface shall be blown off with dry oil free compressed air or vacuum cleaned. A cell tape shall be thoroughly pasted to the cleaned surfaces. The tape shall be removed after a minute to check presence of dust if any. Comparator shall be used by vendor for checking the blast profile.

8.0 COATING APPLICATION

This section deals with the methods & requirements of coating application.

8.1 MIXING

- a. All coating material tins shall be individually stirred thoroughly to obtain a homogenous consistency.
- b. While doing spray application, the tins which come in pre-measured kits will be fully mixed individually using a pneumatic stirrer. While doing hand application only small batches of 1 Kg. capacity shall be taken. Here the mixing will be done by using a metal spatula.
- c. The mixing ratios as specified in the respective data sheet will be strictly adhered to. The base will be weighed out in kgs using mechanical weighing machines calibrated at site using any standard factory packed commercial product available freely in the market. The catalyst will be measured out in ML using marked syringes or measuring cylinders.



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8.2 APPLICATION PROCESS

- a. The preparation and application of coating is done as per relevant product data sheet. Reference will be made to product datasheet or where appropriate, contract specifications for carrying out coating.
- b. Coating in confined spaces should be done when the ambient temperature is low to avoid excess build up of styrene fumes.
- c. The entire thickness will be built in multiple coating.
- d. Each coat will consist of minimum two passes of wet on wet in perpendicular directions.
- e. The Dry film thickness will built of each coat will be checked and recorded.
- f. All the other people working with the paint will be provided with eye splash goggles and masks.
- g. Glass flake lining material shall be chosen considering the slurry conditions given in Annexure- 8 (Tank schedule), Section-III.
- h. Minimum and maximum intercoat intervals are as follows.
 - i. For primer coat -At 20°C - minimum 2 hours, maximum 14 hours.
 - ii. For build-up coats-minimum tack free of previous coat, maximum 3 days.
- i. Primer coat shall be of 75-100 µm thickness
- j. Built up Coat shall be of 3000-3100 µm in multiple coats.
- k. Total System DFT: 3000 microns approx.
- l. All weld joints phase transition joints will receive a stripe coat by brush in the same sequence of coating on the shell.

8.3 CURING & FINISH

a. Curing:

The completed linings shall be allowed to cure for a minimum of 48 hrs at 30°C prior to being placed in service. However, curing time shall be as per the datasheet provided by vendor for a proven material.

b. Finish:

It is to be noted that the coating will follow the profile of substrate. Any unevenness or other defects in the substrate may be reflected in the finish coating also. The finished coating shall have a matt/semi-glossy finish. A few local paint sag marks will not affect performance of coating and cannot be completely avoided. Hence this is permitted.

9.0 INSPECTION AND TESTING OF GLASS FLAKE LINING

After the completion of lining, the following tests shall be conducted by the vendor to assess the quality of glass flake lined surfaces.

- a. Lining shall be visually inspected to ensure that it shall be free from poor weed out fibers, entrapped air and exposed fires. The Glass flake lining shall also be subjected to testing at site as per relevant standards.
- b. Testing of coatings is normally carried out as soon as they are sufficiently cured to give true thickness & to withstand damage by the test equipment. If defects are found, repair will be carried out as per clause 10.0
- c. Spark test shall be carried out at appropriate areas in the presence of Purchaser. Vendor should conduct holiday test as per relevant standards. If the performance is found not to meet the requirements as specified, the Glass flake lining shall be rectified or replaced by the Vendor without any additional cost to the Purchaser.



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS FGD TANKS
4X250 MW NABINAGAR TPP**

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- d. Proper documentation with details of tests conducted by the vendor for evaluation of glass flake lining shall be submitted to the purchaser.
- e. Detailed QAP of glass flake lining shall be submitted by vendor to BHEL during detailed engineering for approval. Any comments given by BHEL/Customer shall be incorporated/complied by vendor without any commercial implication to BHEL.

10.0 REPAIRING PROCEDURE FOR GLASS FLAKE COATING

- a. If the exposed or damaged surface is less than 10cm², then such repair can be carried out without grit blasting. Any area in excess of this amount should be grit blasted using a vacuum blaster where possible.
- b. In case of damage area less than 10cm², then it can be repaired as following.
 - i. De-contaminate surrounding area by using a suitable solvent such as methylated spirit, acetone, xylene etc. After washing clean and allow solvent to evaporate.
 - ii. Roughen up exposed metal & clean using rotary wire brush or a coarse emery paper with at least 60 grade grit. Brush away residues then further roughen surface of the existing coating up to 100 mm away from the damaged area. Brush away residues & ensure the whole area is clean.
 - iii. Apply a thin coat of material to the surface of the exposed metal only taking care not to cover more than a few millimetres of the existing coating. Allow this freshly applied material to become tack-free.
 - iv. Brush styrene monomer over the whole surface to be repaired (i.e. the whole area roughened by emery) & allow to evaporate from the surface.
 - v. Apply at least 2 main coats material over the treated area taking care not to brush on to any roughened or contaminated areas. The Glass flake should be allowed to harden sufficiently to bear the weight of next coat before application of further coats. However, it does not need to be tack-free between coats.

11.0 PERFORMANCE GUARANTEE

The lining shall be guaranteed for uninterrupted minimum life of 25,000 hrs. Performance parameters to be guaranteed by the vendor and tolerances permitted shall be as indicated in the data sheet. Glass Flake lining or any portion thereof is liable for rejection, if it fails to give any of the guaranteed performance parameters. During Guarantee period any defects noticed due to faulty material and workmanship, shall be rectified by vendor free of cost.

12.0 PACKING

The packing should be suitable for tropical conditions. Vendor shall make arrangements for storing the Glass flake lining materials in AC containers at site.

13.0 DOCUMENTATION

DATA TO BE FURNISHED BY THE VENDOR AFTER RECEIPT OF PURCHASE ORDER:

- 13.1 List of Drawing and documents to be submitted for review, approval and information with submission dates.
- 13.2 Catalogue/Datasheets for the Vinyl ester-based Glass Flake Lining material

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- 13.3 Detailed dimensional drawing of the lining surfaces indicating the design data and information about the material, scope of work and weight of the material supply etc.
- 13.4 Surface preparation and Lining procedures
- 13.5 Manufacturing Quality Assurance Plan for Glass flake material and adhesive to be submitted for approval.
- 13.6 Repair and rectification procedure for Glass Flake lining
- 13.7 Installation, Operation and maintenance manual.



TITLE:

**4X250 MW NABINAGAR TPP
TECHNICAL SPECIFICATION FOR
MISC. FGD TANKS**

SPECIFICATION No: PE-TS-463-167-A101

SECTION-I, SUB-SECTION-C2

REV. 00

DATE: MAY 2020

SHEET :

CUSTOMER SPECIFICATION



TITLE:

**4X250 MW NABINAGAR TPP
TECHNICAL SPECIFICATION FOR
MISC. FGD TANKS**

SPECIFICATION No: PE-TS-463-167-A101

SECTION-I, SUB-SECTION-C2

REV. 00

DATE: MAY 2020

SHEET :

SUB SECTION-C2 - A

CUSTOMER SPECIFICATION: GENERAL REQUIREMENT

GENERAL TECHNICAL REQUIREMENTS

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

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

GENERAL TECHNICAL REQUIREMENTS

PART - C

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1.00.00	INTRODUCTION This part covers technical requirements which will form an integral part of the Contract. The following provisions shall supplement all the detailed technical specifications and requirements brought out in Section VI, the Technical Specification and the Technical Data Sheets.			
2.00.00	BRAND NAME Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific item mentioned shall be understood to be indicative of the function and quality desired, and not restrictive; other manufacturer's products may be considered provided sufficient information is furnished to enable the Employer to determine that the products proposed are equivalent to those named.			
3.00.00	BASE OFFER & ALTERNATE PROPOSALS The Bidder's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognised that the Contractor may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered, provided the base offer is in line with technical specifications and such proposals meet the specified design standards and performance requirement and are acceptable to the Employer. Sufficient amount of information for justifying such proposals shall be furnished to Employer alongwith the bid to enable the Employer to determine the acceptability of these proposals.			
4.00.00	COMPLETENESS OF FACILITIES			
4.01.00	Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure a completely engineered plant shall be provided.			
4.02.00	All equipments furnished by the Contractor shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions. All same standard components/ parts of same equipment provided, shall be interchangeable with one another.			
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4.03.00	For the C&I systems, the Contractor shall be required to provide regular information about future upgrades and migration paths to the Employer.			
5.00.00	RULES, REGULATIONS, CODES & STANDARDS			
5.01.00	In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India, NTPC rules/codes of practices as well as of the locality where they will be installed, including the following: a) Indian Electricity Act b) Indian Electricity Rules c) Indian Explosives Act d) Indian Factories Act and State Factories Act e) Indian Boiler Regulations (IBR) f) Regulations of the Central Pollution Control Board, India g) Regulations of the Ministry of Environment & Forest (MoEF), Government of India h) Pollution Control Regulations of Department of Environment, Government of India i) State Pollution Control Board. (j.) Rules for Electrical installation by Tariff Advisory Committee (TAC). (k.) Building and other construction workers (Regulation of Employment and Conditions of services) Act, 1996 (l.) Building and other construction workers (Regulation of Employment and Conditions of services) Central Rules, 1998 (m.) Explosive Rules, 1983 (n.) Petroleum Act, 1984 (o.) Petroleum Rules, 1976,			
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5.02.00	(p.) Gas Cylinder Rules, 1981 (q.) Static and Mobile Pressure Vessels (Unified) Rules, 1981 (r.) Workmen's Compensation Act, 1923 (s.) Workmen's Compensation Rules, 1924 (t.) NTPC Safety Rules for Construction and Erection (u.) NTPC Safety Policy (v.) Any other statutory codes / standards / regulations, as may be applicable. Unless covered otherwise in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply: a) Bureau of Indian standards (BIS) b) Japanese Industrial Standards (JIS) c) American National Standards Institute (ANSI) d) American Society of Testing and Materials (ASTM) e) American Society of Mechanical Engineers (ASME) f) American Petroleum Institute (API) g) Standards of the Hydraulic Institute, U.S.A. h) International Organisation for Standardisation (ISO) i) Tubular Exchanger Manufacturer's Association (TEMA) j) American Welding Society (AWS) k) National Electrical Manufacturers Association (NEMA) l) National Fire Protection Association (NFPA) m) International Electro-Technical Commission (IEC)/European Norm (EN) n) Expansion Joint Manufacturers Association (EJMA) o) Heat Exchange Institute (HEI)			
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	p) IEEE standard			
	q) JEC standard			
5.03.00	Other International/ National standards such as DIN, JIS, VDI, EN, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English.			
5.04.00	Not used.			
5.05.00	In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.			
5.06.00	Two (2) English language copies of all national and international codes and/or standards used in the design of the plant, equipment, civil, structural and architectural works shall be provided by the Contractor to the Employer within two calendar months from the date of the Notification of Award.			
5.07.00	In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect.			
5.08.00	A detailed list of standards apart from those mentioned in the respective detailed specifications in other parts of Section-VI to which all equipment/systems/civil works should conform as indicated in this Part C and elsewhere in the specification.			
6.00.00	EQUIPMENT FUNCTIONAL GUARANTEE			
6.01.00	The functional guarantees of the equipment under the scope of the Contract is given in Section-VI Part - A of Technical Specifications. These guarantees shall supplement the general functional guarantee provisions covered under Defect liabilities Section-IV, General Conditions of Contract.			
6.02.00	Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Contractor as specified elsewhere in this specification.			
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7.00.00	DESIGN OF FACILITIES/ MAINTENANCE & AVAILABILITY CONSIDERATIONS			
7.01.00	DESIGN OF FACILITIES All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere. The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, assemblies and subassemblies shall be done so that it facilitates easy field assembly and dismantling. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical or close to the operating range of the unit.			
7.02.00	MAINTENANCE AND AVILABILITY CONSIDERATIONS Equipment/works offered shall be designed for high availability, low maintenance and ease of maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability/ availability and ease of maintenance. The Bidder shall also furnish details of availability records in the reference plants stated in his experience list. Bidder shall state in his offer the various maintenance intervals, spare parts and man-hour requirement during such operation. The intervals for each type of maintenance namely inspection of the furnace, inspection of the entire hot gas path and the minor and major overhauls shall be specified in terms of fired hours , clearly defining the spare parts and man-hour requirement for each stage. Lifting devices i.e. hoists and chain pulley jacks ,etc. shall be provided by the contractor for handling of any equipment or any of its part having weight in excess of 500 Kgs during erection and maintenance activities. Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist / crane shall be provided by the contractor for lifting the equipment and accessories covered under the specification.			
8.00.00	DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY CONTRACTOR			
8.01.00	Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required to ensure a completely			
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	engineered plant shall be provided in respect of mechanical, electrical, control & instrumentation, civil & structural works as per the scope. Each main and auxiliary equipment/item of the plant including instruments shall be assigned a unique tag number. The assignment of tag numbers shall be in accordance with KKS system. In all drawings/documents/data sheet etc. KKS tag number of the equipment/item/instrument etc. shall be indicated. The Contractor shall furnish engineering data /drawings in accordance with the schedule of information as specified in Technical Data Sheets and Technical Specification. A comprehensive engg and quality coordination procedure shall be finalized with the successful bidder covering salient features as described in this section of specifications. 8.02.00 The number of copies/prints/CD-ROMs/manuals to be furnished for various types of document is given in Annexure-VI to this Part-C, Section-VI of the Technical Specification. 8.03.00 The documentation that shall be provided by the Contractor is indicated in the various sections of specification. This documentation shall include but not be limited to the following: 8.03.01 A) BASIC ENGINEERING DOCUMENTATION Prior to commencement of the detailed engineering work, the Contractor shall furnish a Plant Definition Manual within 12 weeks from the date of the Notification of Award. This manual shall contain the following as a minimum: i) System description of all the mechanical, electrical, control & instrumentation & civil systems. ii) Technology scan for each system / sub-system & equipment. iii) Selection of appropriate technology / schemes for various systems/ subsystems including techno-economic studies between various options. iv) Optimisation studies including thermal cycle optimisation. v) Sizing criteria of all the systems, sub-systems/ equipments/ structures/ equipment foundations alongwith all calculations justifying and identifying the sizing and the design margins. vi) Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups.		
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	vii) Operation Philosophy and the control philosophy of the equipments/system covered under the scope. ix) General Layout plan of the FGD System incorporating all facilities in Bidder's as well as those in the Employer's scope. This drawing shall also be furnished in the form of CD-ROMs to the Employer for engineering of areas not included in bidder's scope. x) Basic layouts and cross sections of the main plant building (various floor elevations), boiler, fuel oil area and other areas included in the scope of the bidder. xi) Documentation in respect of Quality Assurance System as listed out elsewhere in this specification. The successful bidder shall furnish within three (3) weeks from the date of Notification of Award, a list of contents of the Plant Definition Manual (PDMs) including techno-economic studies, which shall then be mutually discussed & finalised with the Employer. B) DETAILED ENGINEERING DOCUMENTS i) General layout plan of the FGD System. ii) Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant. iii) Flow diagram, process and instrumentation diagrams along with write up and system description. iv) Performance curves for Absorber v) Piping isometric, composite layout and fabrication drawings vi) Piping engineering diagrams, pipe and fittings schedules, valve schedules, hanger and support schedules, insulation schedules. vii) Technical data sheets for all bought out and manufactured items. Contractor shall use the Employer's specifications as a base for placement of orders on their sub vendors. viii) Detailed design calculations for components, system, piping etc., wherever applicable including sizing calculations for all auxiliaries like mills, fans etc. as per criteria specified elsewhere in specification. ix) Absorber sizing calculations. Absorber performance data.			
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	x) Mass Balance Diagram xi) Characteristic Curves/ Performance Correction Curves. xii) Comprehensive list of all terminal points which interface with Employer's facilities, giving details of location, terminal pressure, temperature, fluid handled & end connection details, forces, moments etc. xiii) Power supply single line diagram, block logics, control schematics, electrical schematics, etc. xiv) Protection system diagrams and relay settings. xv) Cables schedules and interconnection diagrams. xvii) Cable routing plan. xviii) Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, and installation drawings for field mounted instruments, logic diagrams, control schematics, wiring and tubing diagrams of panels and enclosures etc. Drawings for open loop and close loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc. xix) Alarm and annunciation/ Sequence of Event (SOE) list and alarms & trip set points. xx) Sequence and protection interlock schemes. xxi) Type test reports, insulation co-ordination study report xxii) Control system configuration diagrams and card circuit diagrams and maintenance details. xxiii) Detailed Control system manuals. xxiv) Detailed flow chart for digital control system. xv) Mimic diagram layout, Assignment for other application engg. drawings and documents. xxvi) Civil and Structural works drawings and documents for all structures, facilities, architectural works, foundations underground and overground works and super-structural works as included in the			
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8.03.02	scope of the bidder civil calculation sheets including structural analysis and design alongwith output results. xxvii) Underground facilities, levelling, sanitary, land scaping drawings. xxviii) Geotechnical investigation and site survey reports (if and as applicable). xxix) Model study reports wherever applicable. xxx) Functional & guarantee test procedures and test reports. xxxi) Documentation in respect of Quality Assurance System, and Documentation in respect of Commissioning, as listed out elsewhere in this specification. xxxii) Maintenance schedule for Absorber & auxiliaries clearly indicating interval, duration if shutdown required, manhours required and tools & tackles required for maintenance. The Contractor's while submitting the above documents/ drawings for approval/ reference as the case may be, shall mark on each copy of submission the reference letter alongwith the date vide which the submissions are made.			
	INSTRUCTION MANUALS The Contractor shall make first submission of instruction manual for all the equipments covered under the Contract as per agreed engineering information schedule. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalisation and approval of the Employer the Instruction Manuals shall be submitted as indicated in Annexure-IV. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals have been supplied to the Employer. The Instruction Manuals shall comprise of the following. A) ERECTION MANUALS The erection manuals shall be submitted atleast three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum. a) Erection strategy. b) Sequence of erection.			
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	c) Erection instructions. d) Critical checks and permissible deviation/tolerances. e) List of tool, tackles, heavy equipments like cranes, dozers, etc. f) Bill of Materials g) Procedure for erection and General Safety procedures to followed during erection/installation. h) Procedure for initial checking after erection. i) Procedure for testing and acceptance norms. j) Procedure / Check list for pre-commissioning activities. k) Procedure / Check list for commissioning of the system. l) Safety precautions to be followed in electrical supply distribution during erection. B) OPERATION & MAINTENANCE MANUALS a) The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the manufacturers shall be typewritten with a margin on the left hand side. b) The arrangement and contents of O & M manuals shall be as follows: 1) <u>Chapter 1 - Plant Description</u>: To contain the following sections specific to the equipment/system supplied (a) Description of operating principle of equipment / system with schematic drawing / layouts.			
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	(b) Functional description of associated accessories / controls. Control interlock protection write up. (c) Integrated operation of the equipment alongwith the intended system. (This is to be given by the supplier of the Main equipment by taking into account the operating instruction given by the associated suppliers). (d) Exploded view of the main equipment, associated accessories and auxiliaries with description. Schematic drawing of the equipment alongwith its accessories and auxiliaries. (e) Design data against which the plant performance will be compared. (f) Master list of equipments, Technical specification of the equipment/ system and approved data sheets. (g) Identification system adopted for the various components, (it will be of a simple process linked tagging system). (h) Master list of drawings (as built drawing - Drawings to be enclosed in a separate volume). 2) <u>Chapter 2.0 - Plant Operation:</u> To contain the following sections specific to the equipment supplied (a) Protection logics provided for the equipment alongwith brief philosophy behind the logic, Drawings etc. (b) Limiting values of all protection settings. (c) Various settings of annunciation/interlocks provided. (d) Startup and shut down procedure for equipment alongwith the associated systems in step mode. (e) Do's and Don'ts related to operation of the equipment. (f) Safety precautions to be take during normal operation. Emergency instruction on total power failure condition/lubrication failure/any other conditions. (g) Parameters to be monitored with normal value and limiting values. (h) Equipment isolating procedures.		
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	(i) Trouble shooting with causes and remedial measures. (j) Routine testing procedure to ascertain healthiness of the safety devices alongwith schedule of testing. (k) Routine Operational Checks, Recommended Logs and Records (l) Change over schedule if more than one auxiliary for the same purpose is given. (m) Preservation procedure on long shut down. (n) System/plant commissioning procedure. 3) <u>Chapter 3.0 - Plant Maintenance</u>- To contain the following sections specific to the equipment supplied. (a) Exploded view of each of the equipments. Drawings alongwith bill of materials including name, code no. & population. (b) Exploded view of the spare parts and critical components with dimensional drawings (In case of Electronic cards, the circuit diagram to be given) and spare parts catalogue for each equipment. (c) List of Special T/ P required for Overhauling /Trouble shooting including special testing equipment required for calibration etc. (d) Stepwise dismantling and assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained etc. Clearance to be maintained etc. (e) Preventive Maintenance schedules linked with running hours/calendar period alongwith checks to be carried out. (f) Overhauling schedules linked with running hours/calendar period alongwith checks to be done. (g) Long term maintenance schedules (h) Consumables list alongwith the estimated quantity required during normal running and during maintenance like Preventive Maintenance and Overhauling. (i) List of lubricants with their Indian equivalent, Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at			
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	facilities), and any other facility in an integrated & intelligent 3D software solution using rule-based, data centric 3D Design software with equipment drawings, data sheets, intelligent P&ID correlated with intelligent 3D Model, BOQ, schematics and logic diagrams etc. attached to the respective equipment / systems in the aforesaid 3D model. Contractor shall make a presentation on 3D model every 3 months from LOA to enable NTPC to review the progress of engineering. After the completion of engineering the corresponding complete 3D review model shall be handed over to the employer for its reference. Contractor shall provide 3D model (which shall include visual interference check, walk-through animation, video simulation for major equipment placement and removal, visual effect, photo realism etc), which is extracted from intelligent 3D model, for employer's review as & when desired by employer. However, all piping layouts, equipment layouts, floor plans, ducting layout (Air/flue gas, A/C, Ventilation etc.), General Arrangement drawings of major buildings, structural arrangement drawings and RCC layout drawings shall necessarily be extracted from the aforesaid 3D model and submitted for employer's review along with the 3D review model to enable NTPC to review and approve these drawings. b) All documents/text information shall be in latest version of MS Office / MS Excel / PDF FORMAT as applicable. c) All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules. d) Each drawing submitted by the Contractor (including those of subvendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units. e) The drawings submitted by the Contractor (or their subvendors) shall bear Employer's drawing number in addition to contractor's (their sub-vendor's) own drawing number. Employer's drawing numbering system shall be made available to the successful bidder so as to enable him to assign Employer's drawing numbers to the drawings to be submitted by him during the course of execution of the Contract.			
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	The Contractor shall also furnish a "Master Drawing List" which shall be a comprehensive list of all drawings/ documents/ calculations envisaged to be furnished by him during the detailed engineering to the Employer. Such list should clearly indicate the purpose of submission of these drawings i.e. "FOR APPROVAL" or "FOR INFORMATION ONLY". Similarly, all the drawings/ documents submitted by the Contractor during detailed engineering stage shall be marked "FOR APPROVAL" or "FOR INFORMATION" prior to submission. Further, space shall be identified on each drawing for Approval stamp and electronic signature. f) The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the project. The review of these documents/ data/ drawings by the Employer will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipments provided by others and external connections & dimensions which might affect plant layout. The review by the Employer should not be construed to be a thorough review of all dimensions, quantities and details of the equipments, materials, any devices or items indicated or the accuracy of the information submitted. The review and/ or approval by the Employer/ Project Manager shall not relieve the Contractor of any of his responsibilities and liabilities under this contract. g) After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Employer. h) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Contractor's risk. The Contractor is expected not to make any changes in the design of the equipment /system, once they are approved by the Employer. However, if some changes are necessitated in the design of the equipment/system at a later date, the Contractor may do so, but such changes shall promptly be brought to the notice of the Employer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification. i) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of Employer prior to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority/ representative of Employer based on requirements of such piping indicated in approved/ finalised Flow Scheme/ Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this package.		
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8.04.00	Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the contractor well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability.			
	j)	As Built Drawings After final acceptance of individual equipment / system by the Employer, the Contractor will update all original drawings and documents for the equipment / system to “as built” conditions and submit no. of copies as per Annexure VI.		
	k)	Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data/ drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.		
	l)	The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The Employer shall review the drawings and return soft copy to the Contractor authorizing either to proceed with manufacture or fabrication, or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Contractor to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule.		
	m)	All engineering data submitted by the Contractor after final process including review and approval by the Project Manager/ Employer shall form part of the contract documents and the entire works covered under these specification shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the Project Manager in writing.		
	n)	The Contractor shall submit drawings in line with the suggestive MDL covered in Part-B, Section-VI of Technical Specification and which shall be duly integrated with approved PERT network.		
ENGINEERING INFORMATION SUBMISSION SCHEDULE				
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	Prior to the award of Contract, a Detailed Engineering Information Submission Scheduler/Master Drawing List duly integrated with approved PERT network shall be tied up with the Employer. For this, the bidder shall furnish a detailed list of engineering information alongwith the proposed submission schedule. This list would be a comprehensive one including all engineering data / drawings / information for all bought out items and manufactured items. The information shall be categorized into the following parts. i) Information that shall be submitted for the approval to the Employer before proceeding further, and ii) Information that would be submitted for Employer's information only. The Master Drawing List (MDL) shall be updated periodically and submitted to the employer, highlighting the changes made in MDL. The schedule should allow adequate time for proper review and incorporation of changes/ modifications, if any, to meet the contract without affecting the equipment delivery schedule and overall project schedule. The early submission of drawings and data is as important as the manufacture and delivery of equipment and hardware and this shall be duly considered while determining the overall performance and progress.			
8.05.00	ENGINEERING PROGRESS AND EXCEPTION REPORT			
8.05.01	The Contractor shall submit every month an Engineering progress and Exception Report giving the status of each engineering information including a) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission b) Drawings which were not submitted as per agreed schedule.			
8.05.02	The draft format for this report shall be furnished to the Employer within four (4) weeks of the award of the contract, which shall then be discussed and finalised with the Employer.			
8.06.00	Engineering Co-ordination Procedure			
8.06.01	The following principal coordinators will be identified by respective organizations at time of award of contract: NTPC Engineering Coordinator (NTPC EC): Name :			
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	Designation : Address : a) Postal : b) Telegraphic / e-Mail : c) FAX : TELEPHONE : Contractor's/ Vendor's Engineering Coordinator (VENDOR EC): Name : Designation : Address : a) Postal : b) Telegraphic / e-Mail : c) FAX : TELEPHONE : 8.06.02 All engineering correspondence shall be in the name of above coordinators on behalf of the respective organizations. 8.06.03 Contractor's/Vendor's Drawing Submission and Approval Procedure: a) All data/information furnished by Vendor in the form of drawings/ documents/catalogues or in any other form for NTPC's information/ interface and or review and approval are referred by the general term "drawings". b) The 'Master drawings list' indicating titles, Drawing Number, Date of submission and approval etc. shall be finalised mutually between Contractor and Employer before the award of contract. This list shall be updated if required at suitable interval during detailed engineering. c) All drawings (including those of subvendor's) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The Contractor shall furnish this format to his subvendor along with his purchase order for subvendor's compliance. d) Employer and contractor shall follow their own numbering systems for the drawings. However, Employer shall intimate the contractor, NTPC drawing number on receipt of the first submission of each drawing. Vendor,			
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	thereafter, shall indicate NTPC's drawing number in subsequent Submission, in the space provided for this purpose in title plate, in addition to his own drawing number. e) The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data / drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same. f) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper endorsement for checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. g) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The drawings submitted by the Contractor/vendor shall be reviewed by NTPC and their comments shall be forwarded within four (4) weeks of receipt of drawings. Upon review of each drawing, depending on the correctness and completeness of the drawing, the same will be categorized and approval accorded in one of the following categories : CATEGORY- I: Approved CATEGORY- II Approved, subject to incorporation of comments/ modification as noted. Resubmit revised drawing incorporating the comments. CATEGORY –III Not approved. Resubmit revised drawings for approval after incorporating comments/ modification as noted. CATEGORY -IV For information and records. h) Contractor shall resubmit the drawings approved under Category II, III & IV within three (3) weeks of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision Number enclosed in a triangle (eg. 1, 2, 3 etc). Contractor shall not make any changes in the portions of the drawing other than those commented. If changes are required to be made in the portions already approved, the			
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	Contractor shall resubmit the drawing identifying the changes for Employer's review and approval. Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and Employer shall review only such revised portion of documents. i) In case, the Contractor/ Vendor does not agree with any specific comment, he shall furnish the explanation for the same to NTPC for consideration. In all such cases the Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work. j) It is responsibility of the Contractor/ Vendor to get all the drawings approved in the Category I & IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule. k) If Contractor/ Vendor fails to resubmit the drawings as per the schedule, construction work at site will not be held up and work will be carried out on the basis of comments furnished on previous issues of the drawing. l) These comments will be taken care by the contractor while submitting the revised drawing. The contractor shall use a single transmittal for drawings. Submission. This shall include transmittal numbers and date, number of copies being sent, names of the agencies to whom copies being sent, drawing number and titles, remarks or special notes if any etc.			
9.00.00	TECHNICAL CO-ORDINATION MEETING			
9.01.00	The Contractor shall be called upon to organise and attend monthly Design/ Technical Co-ordination Meetings (TCMs) with the Employer/Employer's representatives and other Contractors of the Employer during the period of contract. The Contractor shall attend such meetings at his own cost at NEW DELHI / NOIDA or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.			
9.02.00	The Contractor should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the Contractor shall submit all drawings as per the agreed Engineering Information Submission Schedule. The drawings submitted by the Contractor will be reviewed by the Employer as far as practicable within three (3) weeks from the date of receipt of the drawing .The comments of the Employer shall then be discussed across the table during the above Technical Co-ordination Meeting (s) wherein best efforts shall be made by both sides to ensure the approval of the drawing.			
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9.02.01	The Contractor shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Contractor shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.			
9.02.02	Should any drawing remain unapproved for more than six (6) weeks after it's first submission ,this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.			
9.03.0	Any delays arising out of failure by the Contractor to incorporate Employer's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Contractor to alter the Contract completion date.			
10.00.00	DESIGN IMPROVEMENTS The Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly. If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.			
11.00.00	EQUIPMENT BASES A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base, unless otherwise specifically agreed to by the Employer. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.			
12.00.00	PROTECTIVE GUARDS Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards shall be designed for easy installation and removal for maintenance purpose.			
13.00.00	LUBRICANTS, SERVO FLUIDS AND CHEMICALS			
13.01.00	I. All the first fills of consumables and one years topping requirement of consumables such as greases, oil, lubricants, servo fluids / control fluids, gases and essential chemicals etc. which will be required to put the equipment covered under the scope of specifications, into successful commissioning / initial operation and to establish completion of facilities shall			
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	be supplied by the Contractor. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum. Bidder shall supply a quantity not less than 10 % of the full charge or one (1) year topping requirement mentioned above (whichever is higher) of each variety of lubricants, servo fluids, gases, chemicals etc (as detailed above) which is expected to be utilized during the first year of operation. The additional quantity shall be supplied in separate container. 13.02.00 As far as possible lubricants marketed by the Indian Oil Corporation shall be used. The variety of lubricants shall be kept to a minimum possible. Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals etc. required for the complete plant covered herein shall be furnished. On completion of erection, a complete list of bearings/ equipment giving their location and identification marks shall be furnished to the Employer alongwith lubrication requirements.		
14.00.00	LUBRICATION		
14.01.00	Equipment shall be lubricated by systems designed for continuous operation. Lubricant level indicators shall be furnished and marked to indicate proper levels under both standstill and operating conditions.		
15.00.00	MATERIAL OF CONSTRUCTION		
15.01.00	All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilised for various components shall be those which have established themselves for use in such applications.		
16.00.00	RATING PLATES, NAME PLATES & LABELS		
16.01.00	Each main and auxiliary item of plant including instruments shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.		
16.02.00	Each item of plant shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the Employer or as detailed in appropriate section of the technical specifications.		
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16.03.00	Such nameplates or labels shall be of white nonhygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back. The name plates shall be suitably fixed on both front and rear side.			
16.04.00	Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with enamel. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.			
16.05.00	Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support. Suitable scale shall also be provided to indicate load on support or hanger.			
16.06.00	Valves, steam traps and strainers shall be identified by Employer's tag number of a metal tap permanently attached to non pressure parts such as the yoke by a stainless steel wire. The direction of flow shall also be marked on the body.			
16.07.00	Safety and relief valves shall be provided with the following: a) Manufacturer's identification. b) Nominal inlet and outlet sizes in mm. c) Set pressure in Kg/cm² (abs). d) Blowdown and accumulation as percentage of set pressure. e) Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.			
16.08.00	All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.			
16.09.00	All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.			
17.00.00	TOOLS AND TACKLES The Contractor shall supply with the equipment one complete set of all special tools and tackles and other instruments required and other instruments for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment,			
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	checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder alongwith the offer. The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Contractor shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Contractor should bring his own tools and tackles. In case these tools and tackles are used by the Contractor during erection, commissioning or initial operation the same shall be refurbished repaired/replaced as required to the satisfaction of the Employer before handing over to the Employer. All the tools and tackles shall be of reputed make acceptable to the Employer.			
18.00.00	WELDING			
18.01.00	If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be per formed by others the requirements shall be submitted to the Employer in advance of commencement of erection work.			
19.00.00	COLOUR CODE FOR ALL EQUIPMENTS/ PIPINGS/ PIPE SERVICES			
19.01.00	All equipment/ piping/ pipe services are to be painted by the Contractor in accordance with Employer's standard colour coding scheme, which will be furnished to the Contractor during detailed engineering stage.			
20.00.00	PROTECTION AND PRESERVATIVE SHOP COATING			
20.01.00	PROTECTION All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or over ground environment as the case may be. The requirements for painting specification shall be complied with as detailed out in Part-A & B of the Technical Specification.			
20.02.00	PRESERVATIVE SHOP COATING All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the			
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	equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted as per the requirements covered in the relevant part of the Technical Specification. Transformers and other electrical equipments, if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colors shall be as per manufacturer's standards, to be selected and specified by the Employer at a later date. 20.03.00 Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer. 20.04.00 All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the Employer. 20.05.00 All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Employer. Lube oil piping or carbon steel shall be pickled. 20.06.00 Painting for Civil structures and equipment/system covered under this package shall be done as specified under technical requirements on civil works in relevant part of this specifications.		
21.00.00	QUALITY ASSURANCE PROGRAMME		
21.01.00	To ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with ISO-9001/IS-14001. A quality assurance programme of the contractor shall generally cover the following: a) His organisation structure for the management and implementation of the proposed quality assurance programme b) Quality System Manual c) Design Control System		
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	d) Documentation Control System e) Qualification data for Bidder's key Personnel. f) The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc. g) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls. h) Control of non-conforming items and system for corrective actions. i) Inspection and test procedure both for manufacture and field activities. j) Control of calibration and testing of measuring testing equipments. k) System for Quality Audits. l) System for indication and appraisal of inspection status. m) System for authorising release of manufactured product to the Employer. n) System for handling storage and delivery. o) System for maintenance of records, and p) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per formats enclosed as Annexure-I and Annexure-II respectively.			
22.00.00	GENERAL REQUIREMENTS - QUALITY ASSURANCE			
22.01.00	All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award on enclosed format No. QS-01-QAI-P-1/F3-R0. Monthly progress reports shall be furnished.			
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22.02.00	Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media through C-folders, a web based system of NTPC ERP in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM (As per format at Annexure-I)			
22.03.00	Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site (As per format at Annexure – II).			
22.04.00	The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.			
22.05.00	The contractor shall submit to the Employer Field Welding Schedule for field welding activities in the format enclosed at Annexure-V . The field welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site.			
22.06.00	The contractor shall have suitable Field Quality Organization with adequate manpower at Employer's site, to effectively implement the Field Quality Plan (FQP) and Field Quality Management System for site activities. The contractor shall submit the details of proposed FQA setup (organizational structure and manpower) for employer's approval. The FQA setup shall be in place at least one month before the start of site activities.			
22.07.00	No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to predespatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Despatch			
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	Clearance Certificate (MDCC).			
22.08.00	All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties; chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details			
22.09.00	All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer.			
	All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.			
22.10.00	All brazers, welders and welding operators employed on any part of the contract either in Contractor's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.			
22.11.00	Welding procedure qualification & Welder qualification test results shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorized representative.			
22.12.00	For all IBR pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. However, other piping system ASME B31.1 or other relevant code as applicable shall be followed. Similarly, any other statutory requirements for the equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding			
22.13.00	All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.			
22.14.00	No welding shall be carried out on cast iron components for repair.			
22.15.00	Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.			
22.16.00	All non-destructive examination shall be performed in accordance with written procedures as per International Standards. The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination) or equivalent. NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.			
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	In general all plates of thickness greater than 40mm & for pressure parts plates of thickness equal to or greater than 25mm shall be ultrasonically tested otherwise as specified in respective equipment specification. All bar stock/Forging of diameter equal to or greater than 40 mm shall be ultrasonically tested.			
22.17.00	The Contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the sub-contractor proposed by the Contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Contractor and finalised with the Employer, shall be subject to Employer's approval on enclosed format No. QS-01-QAI-P-01/F3. The contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion and identified in "DR" category prior to any procurement. Monthly progress reports on sub-contractor detail submission / approval shall be furnished preferably on enclosed format at Annexure-IV. Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.			
22.18.00	For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. Within three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the monthly basis by the Contractor along with a report of the Purchase Order placed so far for the contract.			
22.19.00	Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-contractor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.			
22.20.00	The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the			
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22.21.00	mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan. Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc. For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable. Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative. 22.24.00 Environmental Stress Screening All solid state electronic system / equipment / sub assembly shall be free from infant mortile components. For establishing the compliance to this requirement, the contractor / sub – contractor should meet the following. 1) The Contractor / Sub – contractor shall furnish the established procedure being followed for eliminating infant mortile components. The procedure followed by the Contractor / Sub – contractor should be substantiated along with the statistical figures to validate the procedure being followed. The necessary details as required under this clause shall be furnished at the stage of QP finalization. Or In case the Contractor / Sub – contractor do not have any established procedure to eliminate infant mortile components then two or 10% whichever is less, most densely populated Panels shall be tested for Elevated Temperature Cycle Test as per the following procedure. <u>Elevated Temperature Test Cycle</u> During the elevated temperature test which shall be for 48 hours, the ambient temperature shall be maintained at 50° C. The equipment shall be interconnected with devices and kept under energized conditions so as to repeatedly perform all operations it is expected to perform in actual service		
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	with load on various components being equal to those which will be experienced in actual service. During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature at 50° C. In case of any failure during the test cycle, the further course of action should be mutually discussed for demonstrating the intent of the above requirement. 2) <u>Burn in Test Cycle</u> The test shall be conducted on all the panels fully assembled and wired including the panels having undergone the above mentioned elevated temperature test. The period of Burn in Test Cycle shall be 120 hrs and process shall be similar to the elevated temperature test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time. During the above tests, the process I/O and other load on the system shall be simulated by simulated inputs and in the case of control systems; the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable. During the Burn in Test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature. 22.25.00 The Contractor / Sub-contractor shall carry out routine test on 100% item at contractor / sub-contractor's works. The quantum of check / test for routine & acceptance test by employer shall be generally as per criteria / sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check / test for routine / acceptance test shall be as agreed during detailed engineering stage. 23.00.00 QUALITY ASSURANCE DOCUMENTS 23.01.00 The Contractor shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (✓)mark.		
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23.01.01	Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document. The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing. The final quality document will be compiled and issued at the final assembly place of equipment before despatch. However CD-Rom may be issued not later than three weeks.			
23.02.00	Typical contents of QA Documentation is as below:- (a.) Quality Plan (b.) Material mill test reports on components as specified by the specification and approved Quality Plans. (c.) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans. (d.) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment. (e.) Heat Treatment Certificate/Record (Time- temperature Chart) (f.) All the accepted Non-conformance Reports (Major/Minor)/deviation, including complete technical details / repair procedure). (g.) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points. (h.) Certificate of Conformance (COC) wherever applicable. (i.) MDCC			
23.03.00	Similarly, the contractor shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.			
23.04.00	Before despatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The			
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	supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review. (a.) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release. (b.) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector. (c.) If a decision is made for despatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the despatch of equipment.			
23.05.00	TRANSMISSION OF QA DOCUMENTATION On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Employer. For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 3 weeks after the date of the last delivery of equipment.			
24.00.00	PROJECT MANAGER'S SUPERVISION			
24.01.00	To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Project Manager and without prejudice to the provisions of 'Arbitration' clause in Section GCC, the Contractor shall proceed to comply with the Project Manager's decision.			
24.02.00	The work shall be performed under the supervision of the Project Manager. The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following:			
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	(a.) Interpretation of all the terms and conditions of these documents and specifications (b.) Review and interpretation of all the Contractor's drawing, engineering data, etc (c.) Witness or his authorised representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract (d.) Inspect, accept or reject any equipment, material and work under the contract (e.) Issue certificate of acceptance and/or progressive payment and final payment certificates (f.) Review and suggest modifications and improvement in completion schedules from time to time, and (g.) Supervise Quality Assurance Programme implementation at all stages of the works.			
25.00.00	INSPECTION, TESTING AND INSPECTION CERTIFICATES			
25.01.00	The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.			
25.02.00	The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.			
25.03.00	The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two			
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	(2) copies. 25.04.00 The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract. 25.05.00 When the factory tests have been completed at the Contractor's or sub-contractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract. 25.06.00 In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing. 25.07.00 The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract. 25.08.00 To facilitate advance planning of inspection in addition to giving inspection notice as specified at clause no 25.03.00 of this chapter, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month. 25.09.00 All inspection, measuring and test equipment used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.			
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25.10.00	Associated document for Quality Assurance programme			
25.10.01	Manufacturing Quality Plan Format No. : QS-01-QAI-P-09/F1-R1 enclosed at Annexure-I.			
25.10.02	Field Quality Plan Format No.: QS-01-QAI-P-09/F2-R1 enclosed at Annexure-II.			
25.10.03	List of items requiring quality plan and sub supplier approval. Format No.: QS-01-QAI-P-01/F3-R0 (Annexure-III).			
25.10.04	Status of items requiring Quality Plan and sub supplier approval. Format enclosed at Annexure-IV.			
25.10.05	Field Welding Schedule Format enclosed at Annexure-V.			
25.11.00	Not Used			
25.12.00	DEMONSTRATION OF APPLICATION ENGINEERING			
25.12.01	Based on NTPC inputs, the Contractor shall prepare and submit typical implemented scheme in their system (Control system & HMI) on sample basis. The typical cases to be covered shall include but not be limited to the following. (i) Logics/Loops: a) Drive logics implementation for each type of binary drive along with its display in HMI. b) Sequence implementation along with its display in HMI. c) Single non-cascade controller implementation. d) Cascade loop implementation. e) Master slave implementation with different slave combination. f) Temperature & pressure compensation for flow signals & pressure compensation for level signals as applicable. (ii) HMI Functions: a) LVS Annunciation. b) Graphics. c) HSR d) Logs/Reports.			
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25.12.02	e) Calculations (Basic & Performance Calculations).			
	The above typical cases shall be finalized with the Employer through Technical Co-ordination meetings.			
	After review and finalization of the typical cases, the implementation of each logic & control loop shall be carried out by the Contractor based on NTPC inputs. After implementation of these logics & loops, the Contractor shall test each logic /loop and record the observations in a format to be provided by the Employer and demonstrate to Employer at Employer premises during engineering finalization. Any modifications as a result of the demonstration shall be done and documented as part of the test report along with the final scheme. Similarly, HMI functions shall also be demonstrated by the Contractor at Employer premises & the results shall be documented as part of test report.			
25.12.03	During the integrated testing at the Contractor's works, only sample checks shall be done by the Employer for the items covered in above application engineering demonstration.			
26.00.00	PRE-COMMISSIONING AND COMMISSIONING FACILITIES			
26.01.00	(a) As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Employer and the Contractor for correctness of and completeness of facility or part thereof and acceptability for initial pre-commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Contractor's quality assurance programme as well as those included in Part-D, Section-VI and elsewhere in the Technical Specifications.			
	(b) The Contractor's pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall be commenced during which period the complete facilities, equipments shall be operated integral with sub-systems and supporting equipment as a complete plant.			
	(c) All piping system shall be flushed, steam blown, air blown as required and cleanliness demonstrated using acceptable industry standards. Procedures to accomplish this work shall be submitted for approval to the Employer six months prior to the respective implementations. The Employer will approve final verification of cleanliness.			
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26.03.00	The Contractor shall intimate the Employer about the commencement of initial operation and shall furnish adequate notice to the Employer in this respect. (c) Any loss of generation due to constraints attributable to the Employer shall be construed as Deemed Generation. (d) An Initial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Initial Operation shall be prepared by the Contractor. This report, besides recording the details of the various observations during initial operation shall also include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Initial Operation. Based on the observations, necessary modifications/repairs to the plant shall be carried out by the Contractor to the full satisfaction of the Employer to enable the latter to accord permission to carry out the Guarantee tests on the facilities. However, minor defects which do not endanger the safe operation of the equipment, shall not be considered as reasons for with- holding the aforesaid permission.			
	Guarantee Tests a) The final test as to prove the Functional Guarantees shall be conducted at Site by the Contractor in presence of the Employer. The contractor's Commissioning, start-up and initial operation shall make the unit ready to conduct such test. Such test will be commenced, within a period of <u>three (3) months</u> after the successful completion of Initial Operations. Any extension of time beyond the above <u>three (3) months</u> shall be mutually agreed upon. b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the functional guarantee. c) For performance/ demonstration tests instrumentations, of accuracy class shall be as per specified test codes. The numbers and location of the instruments shall be as per the specified test codes. In addition the values of parameters shall be logged from the information system provided under Employer's Distributed Digital Control Monitoring and Information system. Test will be conducted at specified load points. d) Any special equipment, tools and tackles required for the successful completion of the Guarantee Tests shall be provided by the Contractor, free of cost.			
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	e) The Guarantee tests and specific tests to be conducted on equipments have been brought out in detail elsewhere in the specifications.			
27.00.00	TAKING OVER Upon successful completion of Initial Operations and all the tests conducted to the Employer's satisfaction, the Employer shall issue to the Contractor a Taking over Certificate as a proof of the final acceptance of the equipment. Such certificate shall not unreasonably be withheld nor will the Employer delay the issuance thereof, on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the Contractor of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.			
28.00.00	TRAINING OF EMPLOYER'S PERSONNEL			
28.01.00	Training for Employers O&M Personnel The scope of service under training of Employer's engineers shall include a training module covering upto six (6) man months in the areas of Operation & Maintenance. Such training should enable the personnel to individually take the responsibility of operating and maintaining the FGD system in a manner acceptable to the Employer.			
28.02.00	Training for Employers Engineering Personnel The scope of services under training for Employer's engineering personnel shall also necessarily include two (2) manmonth. This shall cover all disciplines viz, Mechanical, Electrical, C&I, & QA etc. and shall include all the related areas like Design familiarization, training on product design features and product design softwares of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing, erection, welding etc. An indicative module of the training requirement of Employer's Engineering personnel is attached as Annexure-VII.			
28.03.00	Bidder shall furnish in his offer, details of training module(s) covering above requirements which shall be subject to Employer's approval. Consolidated training period included above {i.e. 6 man months (7 man months in case of projects where ZLD system is included in scope) and 3 man months (4 man months in case of projects where ZLD system is included in scope) respectively for O&M and			
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	Engineering) is indicative only. Employer reserves the right to re appropriate the training period between O&M and engineering depending upon the details of training module proposed by the Bidder.	
28.04.00	Exact details, extent of training and the training schedule shall be finalised based on the Bidder's proposal within two (2) months from placement of award.	
28.05.00	In all the above cases, wherever the training of Employer's personnel is arranged at the works of the manufacturer's it shall be noted that the lodging and boarding of the Employer's personnel shall be at the cost of Contractor. The Contractor shall make all necessary arrangements towards the same.	
28.06.00	Take off prices (product wise) should be indicated by the Bidder in the Bid Proposal Sheets. Employer reserves the right to include or exclude these item(s) during placement of Award. Note: For training purposes, one (1) man month implies 30 working days (excluding all intervening holidays) per person.	
29.00.00	SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also cover: i) Working platforms should be fenced and shall have means of access. ii) Ladders in accordance with Employer's safety rules for construction and erection shall be used. Rungs shall not be welded on columns. All the stairs shall be provided with handrails immediately after its erection.	
30.00.00	NOISE LEVEL The equivalent 'A' weighted sound pressure level measured at a height of 1.5 m above floor level in elevation and at a distance of one (1) metre horizontally from the nearest surface of any equipment/machine, furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA . However for Ball Mills the noise levels as per following shall also be acceptable: a) Ball Mill < 90 dBA	
31.00.00	PACKAGING AND TRANSPORTATION All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the	
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	time of erection. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Contractor shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting despatch of equipment. Before despatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & preassembly to bare minimum. The Employer's Inspector shall have right to insist for completion of works in shops before despatch of materials for transportation.													
32.00.00	ELECTRICAL EQUIPMENTS/ENCLOSURES													
32.01.00	All electrical equipments and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specifications.													
33.00.00	INSTRUMENTATION AND CONTROL													
	All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications.													
33.01.00	All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale. All scales and charts shall be calibrated and printed in Metric Units as follows: <table><tr><td>1. Temperature</td><td>- Degree centigrade (deg C)</td></tr><tr><td>2. Pressure</td><td>- Kilograms per square centimetre (Kg/cm²). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.</td></tr><tr><td>3. Draught</td><td>- Millimetres of water column (mm wc).</td></tr><tr><td>4. Vacuum</td><td>- Millimeters of mercury gauge (mm Hg) or water column (mm Wcl).</td></tr><tr><td>5. Flow (Gas)</td><td>- Tonnes/ hour</td></tr></table>				1. Temperature	- Degree centigrade (deg C)	2. Pressure	- Kilograms per square centimetre (Kg/cm ²). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.	3. Draught	- Millimetres of water column (mm wc).	4. Vacuum	- Millimeters of mercury gauge (mm Hg) or water column (mm Wcl).	5. Flow (Gas)	- Tonnes/ hour
1. Temperature	- Degree centigrade (deg C)													
2. Pressure	- Kilograms per square centimetre (Kg/cm ²). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.													
3. Draught	- Millimetres of water column (mm wc).													
4. Vacuum	- Millimeters of mercury gauge (mm Hg) or water column (mm Wcl).													
5. Flow (Gas)	- Tonnes/ hour													
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	6. Flow (Steam) - Tonnes/ hour 7. Flow (Liquid) - Tonnes / hour 8. Flow base - 760 mm Hg. 0 deg.C 9. Density - Grams per cubic centimeter.			
33.02.00	All instruments and control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plan-in connection at rear.			
33.03.00	All electronic modules shall have gold plated connector fingers and further all input and output modules shall be short circuit proof. These shall also be tropicalised & components shall be of industrial grade or better.			
34.00.00	ELECTRICAL NOISE CONTROL The equipment furnished by the Contractor shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Contractor's equipment which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD as per IEC-61000-2. Radio Frequency interference (RFI) and Electro Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems as per EN-50082-2 (1995).			
35.00.00	SURGE PROTECTION FOR SOLID STATE EQUIPMENT All solid state systems /equipment shall be able to withstand the electrical noise and surge as encountered in actual service conditions and inherent in a power plant and shall meet the requirements of surge protection as defined in ANSI C37.90.1-1989 on its suitable equivalent class of IEC 254-4. Details of the features incorporated and relevant tests carried out. The test certificates. etc. shall be submitted by the Bidder.			
36.00.00	INSTRUMENT AIR SYSTEM The instrument air supply system as supplied by the Bidder for various pneumatic control & instrumentation devices like pneumatic actuators, power cylinders, E/P converters, piping / tubing etc. Each pneumatic instrument shall have an individual air shut - off valve. The pressure regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built-in filter housing blow down valve.			
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37.00.00	TAPPING POINTS FOR MEASUREMENTS Tapping points shall include probes, wherever applicable, for analytical measurements and sampling. For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. The Contractor will be intimated about thread standard to be adopted. The following shall be provided on equipment by the Bidder. The standard which is to be adopted, will be intimated to the Contractor. i) Temperature test pockets with stub and thermowell ii) Pressure test pockets			
38.00.00	SYSTEM DOCUMENTATION The Bidder shall provide drawings, system overview & description, hardware/ software details, technical literature, functional & hardware schemes, bill of material, parts list, interconnection diagrams, data sheets, erection/ installation/ commissioning procedures, instruction/ operating manuals, etc. for each of the C& I system / sub-systems/ equipment supplied under this package. The documentation shall include complete details of the C&I systems/ sub-systems/ equipment to enable review by Employer during detailed engineering stage and to provide information to plant personnel for operation & Maintenance (including quick diagnostics & trouble shooting) of these C&I systems/ sub-systems/ equipment at site. The minimum documentation requirements for C&I systems shall be as stipulated under C&I "Technical Data Sheets" Part of specifications. In addition to this, system documentation for control system shall include as a minimum to that specified elsewhere in the Technical Specification. The exact format, submission schedule and contents of various documents shall be as finalised during detailed engineering stage.			
38.01.00	Bill of material (instrument list) for all C&I equipment/ devices shall be furnished by the bidder in standard formats as approved by the Employer.			
39.00.00	MAINTENANCE MANUALS OF ELECTRONIC MODULES The Contractor shall have to furnish two (2) sets of all maintenance manual of each and every electronic card/module as employed on the various systems and equipment including peripherals etc., offered by him. The Contractor will also have to furnish the data regarding the expected failure rate of various modules and other system components. Further , the contractor shall furnish a set of operating manuals which should include block diagrams ,make, model/type ,details wiring and external			
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	connection drawings etc as required to do the testing and maintenance of the electronic modules.			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	LIST OF CODES AND STANDARDS			
	Indian Standards	Title	International and Internationally recognised standards	
	IS:277	Galvanised steel sheets (plain or corrugated)		
	IS:655	Specification for metal air duct		
	IS:800	Code of practice for use of structural steel in general building construction	BS 449:1969 BS 5950 ASA A57, 1-1952	
	IS:807	Code of practice for design, manufacture, erection and testing (Structural portion) of cranes and hoists 6588 (Issued by Standards Association of Australia). DIN 120:1936 (Sheet 1) DIN 120:1936 (Sheet 2) 327 part-I, 1951 BS 466 part-II, 1960 BS 644:1960 BS 1757:1951 BS 2573:part-I:1960	Draft Revision of A.S. NO. CS.2 SAA Crane and Hoist code Doc:No. BU/4 Rev	
	IS:875	Code of practice for design loads (other than earthquake) for buildings and structures Leading standards (issued by Canadian Standard) DIN-1055-1955 (Issued by ASA)	National Building code of Canada (1953)-Part-IV Design section 4.1	
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS:1239 Part-I	Mild steel tubes	(ISO/R 65-1957) (ISO/R-64-1958) (ISO/R-65-1958) (BS 1387 : 1957)	
	IS:1239 Part-II	Mild steel tubulars and other wrought steel pipe fittings	BS 1387 : 1967 BS 1387 :1967 BS 1740 :1965	
	IS:2825	Code for unfired vessels		
	IS:1520	Horizontal centrifugal pumps for clear cold and fresh water		
	IS:1600	Code for practice for performance of constant speed IC Engines for general purpose		
	IS:1601	Specification for performance of constant speed IC Engines for general Purpose		
	IS:1893	Criteria for earthquake resistant design of structures		
	IS1978-1971	Line Pipe April 1969.	API Standards 5L	
	IS:2254-1970	Dimensions of vertical shaft motor for pumps	IEC Pub 72-1 part I NEMA Pub MG 1 1954	
	IS:2266	Steel wire ropes for general engineering purposes	BS :302 : 1968	
	IS:2312	Propellant type Ventilation fans		
	IS:2365	Steel wire suspension ropes for lifts and hoists	BS : 1957	
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS:3346	Method for the determination of thermal conductivity of thermal insulation materials (two slab guarded hot plate method)	DIN 52612 (Deutscher Normenausschuss) ASTM C 163-1964 (American Society of Testing and materials) ASTM C 167-1974 ASTM C 177-1963	
	IS:3354	Outline dimensions for electric lifts.		
	IS:3401	Silica gel		
	IS:3588	Specification for electrical axial flow fans		
	IS:3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000 mm Nominal Diametre)		
	IS:3677	Unbonded rock and slag wool for thermal insulation		
	IS:3815	Point hook with shank for general engineering purposes	BS 482 - 1968 Doc.:67/3 1284 (Revision of BS 2903) (Issued BS)	
	IS:3895	Specification for monocry-stallines semiconductor rectifier cells and stacks		
	IS:3963	Roof extractor unit		
	IS:3975	Mild steel wires, strips and tapes for armouring cables		
	IS:4503	Shell and tube type heat Exchanger		
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS:4540	Specification for monory-stallines rectifire assembly equipment		
	IS:4671	Expanded polystyrene for thermal insulation purpose		
	IS:4736	Hot dip zinc coating on steel tubes		
	IS:4894	Centrifugal fans		
	IS:5456	Code of practice for testing of positive displacement type air compressors and exhauster (For Test Tolerance Only)		
	IS:5749	Forged ramshorn hooks	Entwurf DIN 15402 Blett 1 Entwurf DIN 15402 BS 3017-1958	
	IS:6392	Steel pipe flanges	BS 4504 : 1969	
	IS:6524 Part-I	Code of practice for design of tower cranes Static and rail mounted	BS 2799 : 1956	
	IS:7098	Cross linked Polyethylene insulated PVC sheathed cables	Standard No. 1 to IPCEA (USA) Pub. No. 5-66-524	
	IS:7373	Specification for wrought aluminium and aluminium sheet and strips		
	IS:7938	Air receivers for compressed air installation		
	ISO:1217	Displacement compressor-Acceptance test		
	ASHRAE-33 and air heating coils.	Methods of testing for rating of forced circulation air cooling		
	ASHRAE-52-76	Air cleaning device used in general ventilation for removing particle matter.		
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	ASHRAE-22-72 Method of testing for rating of water cooled refrigerant condensers. ASHRAE 23-67 Methods of testing for rating of positive displacement refrigerant compressors. ARI-450-6 Standard for water cooled refrigerant condensers. ARI-550 Standard for centrifugal water chilling packages. ARI-410 Standard for forced circulation air cooling and air heating coils ARI-430/435 Central station AHU/Application of Central Station AHU BS:848 (Part-1,2) Fans BS:400 Low carbon steel cylinders for the storage & transport of permanent gases. BS:401 Low carbon steel cylinders for the storage & transport of liquified gases. CTI Code Acceptance test code for Water Cooling Tower. ACT-105 ANSI-31.5 Refrigerant piping ASME-PTC- Atmospheric Water Cooling Equipment 23-1958 AMCA A-21C Test Code for air moving devices API:618 Reciprocating Compressor for general refinery services. HYDRAULIC INSTITUTE STANDARDS. HYDRANT SYSTEM MANUALS OF TAC. TAC MANUALS OF SPRAY SYSTEM NFPA USA/ NSC UK/ UL USA/ FM USA STANDARDS. INDIAN EXPLOSIVES ACT. INDIAN FACTORIES ACT. STANDARD OF TUBULAR EXCHANGER MANUFACTURER'S ASSOCIATION.			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	CODE AND STANDARD FOR CIVIL WORKS Some of the applicable Standards, Codes and references are as follows: Excavation & Filling IS: 2720 (Part-II, IV TO VIII, XIV, XXI, XXIII, XXIV, XXVII TO XXIX, XL) Methods of test for soils-determination for water content etc. IS: 4701 Code of practice for earth work on canals. IS: 9758 Guide lines for Dewatering during construction. IS: 10379 Code of practice for field control of moisture and compaction of soils for embankment and sub-grade. Properties, Storage and Handling of Common Building Materials IS: 269 Specification for ordinary Portland cement, 33 grade. IS: 383 Specification for coarse and fine aggregates from natural sources for concrete. IS: 432 Specification for mild steel and (Parts 1&2) medium tensile steel bars and hard-drawn steel wires for concrete reinforcement. IS: 455 Specification for Portland slag cement. IS: 702 Specification for Industrial bitumen. IS: 712 Specification for building limes. IS: 808 Rolled steel Beam channel and angle sections. IS: 1077 Specification for common burnt clay building bricks. IS: 1161 Specification of steel tubes for structural purposes. IS: 1363 Hexagon head Bolts, Screws and nuts of production grade C. IS: 1364 Hexagon head Bolts, Screws and Nuts of Production grade A & B. IS: 1367 Technical supply conditions for Threaded fasteners. IS: 1489 Specification for Portland-pozzolana cement: (Part-I) Fly ash based.			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	(Part-II)	Calcined clay based.	
	IS: 1542	Specification for sand for plaster.	
	IS: 1566	Specification for hard-drawn steel wire fabric for concrete reinforcement.	
	IS: 1786	Specification for high strength deformed bars for concrete reinforcement.	
	IS: 2062	Specification for steel for general structural purposes.	
	IS: 2116	Specification for sand for masonry mortars.	
	IS: 2386 (Parts-I to VIII)	Testing of aggregates for concrete.	
	IS: 3150	Hexagonal wire netting for general purpose.	
	IS: 3495 (Parts-I to IV)	Methods of tests of burnt clay building bricks.	
	IS: 3812	Specification for fly ash, for use as pozzolana and admixture.	
	IS: 4031	Methods of physical tests for hydraulic cement.	
	IS: 4032	Methods of chemical analysis of hydraulic cement.	
	IS: 4082	Recommendations on stacking and storage of construction materials at site.	
	IS: 8112	Specification for 43 grade ordinary portland cement.	
	IS: 8500	Medium and high strength structural steel.	
	IS: 12269	53 grade ordinary portland cement.	
	IS: 12894	Specification for Fly ash lime bricks.	
	Cast-In-Situ Concrete and Allied Works		
	IS: 280	Specification for mild steel wire for general engineering purposes.	
	IS: 456	Code of practice for plain and reinforced concrete.	
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 			
	IS: 457 Code of practice for general construction of plain & reinforced concrete for dams & other massive structures. IS: 516 Method of test for strength of concrete. IS: 650 Specification for standard sand for testing of cement. IS: 1199 Methods of sampling and analysis of concrete. IS: 1791 General requirements for batch type concrete mixers. IS: 1838 (Part-I) Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type). IS: 2204 Code of practice for construction of reinforced concrete shell roof. IS: 2210 Criteria for the design of reinforced concrete shell structures and folded plates. IS: 2438 Specification for roller pan mixer. IS: 2502 Code of practice for bending and fixing of bars for concrete reinforcement. IS: 2505 General requirements for concrete vibrators, immersion type. IS: 2506 General requirements for concrete vibrators, screed board type. IS: 2514 Specification for concrete vibrating tables. IS: 2645 Specification for Integral cement water proofing compounds. IS: 2722 Specification for portable swing weigh batches for concrete. (single and double bucket type) IS: 2750 Specification for Steel scaffolding. IS: 2751 Code of practice for welding of mild steel plain and deformed bars for reinforced concrete construction. IS: 3025 Methods of sampling and test waste water. IS: 3366 Specification for Pan vibrators. IS: 3370 Code of practice for concrete structures for the storage of			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	(Part I to IV) IS: 3414 IS: 3550 IS: 3558 concrete. IS: 4014 (Parts I & II) IS: 4326 of buildings. IS: 4461 IS: 4656 IS: 4925 IS: 4990 IS: 4995 (Parts I & II) IS: 5256 IS: 5525 concrete work. IS: 5624 IS: 6461 IS: 6494 IS: 6509 IS: 7861 IS: 9012 IS: 9103	liquids. Code of practice for design and installation of joints in buildings. Methods of test for routine control for water used in industry. Code of practice for use of immersion vibrators for consolidating concrete. Code of practice for steel tubular scaffolding. Code of practice for earthquake resistant design and construction of buildings. Code of practice for joints in surface hydro-electric power stations. Specification for form vibrators for concrete. Specification for batching and mixing plant. Specification for plywood for concrete shuttering work. Criteria for design of reinforced concrete bins for the storage of granular and powdery materials. Code or practice for sealing joints in concrete lining on canals. Recommendations for detailing of reinforcement in reinforced concrete work. Specification for foundation bolts. Glossary of terms relating to cement concrete. Code of practice for water proofing of underground water reservoirs and swimming pools. Code of practice for installation of joints in concrete pavements. Code of practice for extreme weather concreting. (Parts I & II) Recommended practice for shot concreting. Specification for admixtures for concrete.		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 55 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
		IS: 9417 Recommendations for welding cold worked steel bars for reinforced concrete construction. IS: 10262 Recommended guidelines for concrete mix design. IS: 11384 Code of practice for composite construction in structural steel and concrete. IS: 11504 Criteria for structural design of reinforced concrete natural draught cooling towers. IS: 12118 Specification for two-parts poly sulphide. IS: 12200 Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams. IS: 13311 Method of non-destructive testing of concrete. Part-1 Ultrasonic pulse velocity. Part-2 Rebound hammer. SP:23 Handbook of concrete mixes SP: 24 Explanatory Handbook on IS: 456-1978 SP: 34 Handbook on concrete reinforcement and detailing. Precast Concrete Works SP: 7(PartVII/ National Building Code- Structural design of prefabrication and Sec.7) systems building. IS: 10297 Code of practice for design and construction of floors and roofs using precast reinforced/prestressed concrete ribbed or cored slab units. IS: 10505 Code of practice for construction of floors and roofs using pre-cast reinforced concrete units. Masonry and Allied Works IS: 1905 Code of Practice for Structural Safety of Buildings-Masonry walls. IS: 2212 Code of Practice for Brickwork.		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 56 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS: 2250 Code of Practice for Preparation and use of Masonry Mortar. SP: 20 Explanatory hand book on masonry code. Sheeting Works IS:277 Galvanised steel sheets (plain or corrugated). IS: 459 Unreinforced corrugated and semi-corrugated asbestos cement sheets. IS: 513 Cold-rolled carbon steel sheets. IS: 730 Specification for fixing accessories for corrugated sheet roofing. IS: 1626 Specification for Asbestos cement building pipes and pipe fittings, gutters and gutter fittings and roofing fittings. IS: 2527 Code of practice for fixing rain water gutters and down pipe for roof drainage. IS: 3007 Code of practice for laying of asbestos cement sheets. IS: 5913 Methods of test for asbestos cement products. IS: 7178 Technical supply conditions for tapping screw. IS: 8183 Bonded mineral wool. IS: 8869 Washers for corrugated sheet roofing. IS: 12093 Code of practice for laying and fixing of sloped roof covering using plain and corrugated galvanised steel sheets. IS: 12866 Plastic translucent sheets made from thermosetting polyster resin (glass fibre reinforced). IS: 14246 Specification for continuously pre-painted galvanised steel sheets and coils. Fabrication and Erection of Structural Steel Work IS: 2016 Specification for plain washers.			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS: 814 IS: 1852 IS: 3502 IS: 6911 IS: 3757 IS: 6623 IS: 6649 IS: 800 IS: 816 IS: 4000 IS: 9595 IS: 817 IS: 1811 IS: 9178 IS: 9006 IS: 7215 IS: 12843 IS: 4353 SP: 6 (Part 1 to 7)	Specification for covered Electrodes for Metal Arc Welding for weld steel. Specification for Rolling and Cutting Tolerances for Hot rolled steel products. Specifications for chequered plate. Specification for stainless steel plate, sheet and strip. Specification for high strength structural bolts Specification for high strength structural nuts. High Tensile friction grip washers. Code of practice for use of structural steel in general building construction. Code of practice for use of Metal Arc Welding for General Construction. Code of practice for assembly of structural joints using high tensile friction grip fasteners. Code of procedure of Manual Metal Arc Welding of Mild Steel. Code of practice for Training and Testing of Metal Arc Welders. Qualifying tests for Metal Arc Welders (engaged in welding structures other than pipes). Criteria for Design of steel bins for storage of Bulk Materials. Recommended Practice for Welding of Clad Steel. Tolerances for fabrication steel structures. Tolerance for erection of structural steel. Recommendations for submerged arc welding of mild steel and low alloy steels. ISI Hand book for structural Engineers.		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 58 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
		IS: 1608 Method of Tensile Testing of Steel products other than sheets, strip, wire and tube. IS: 1599 Method of Bend Tests for Steel products other than sheet, strip, wire and tube IS : 228 Methods of chemical Analysis of pig iron, cast iron and plain carbon and low alloy steel. IS : 2595 Code of Practice for Radio graphic testing. IS : 1182 Recommended practice for Radiographic Examination of fusion welded butt joints in steel plates. IS : 3664 Code of practice for Ultra sonic Testing by pulse echo method. IS : 3613 Acceptance tests for wire flux combination for submerged Arc Welding. IS : 3658 Code of practice for Liquid penetrant Flaw Detection. IS : 5334 Code of practice for Magnetic Particle Flaw Detection of Welds. Plastering and Allied Works IS : 1635 Code of practice for field slaking of Building lime and preparation of putty. IS : 1661 Application of cement and cement lime plaster finishes. IS : 2333 Plaster-of-paris. IS : 2402 Code of practice for external rendered finishes. IS : 2547 Gypsum building plaster. IS : 3150 Hexagonal wire netting for general purpose. Acid and Alkali Resistant Lining IS : 158 Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali & heat resisting. IS : 412 Specification for expanded metal steel sheets for general purpose.		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 59 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS : 4441	Code of practice for use of silicate type chemical resistant mortars.		
	IS : 4443	Code of practice for use of resin type chemical resistant mortars.		
	IS : 4456	Method of test for chemical resistant tiles. (Part I & II)		
	IS : 4457	Specification for ceramic unglazed vitreous acid resistant tiles.		
	IS : 4832	Specification for chemical resistant mortars.		
		Part I	Silicate type	
		Part II	Resin type	
		Part III	Sulphur type	
	IS : 4860	Specification for acid resistant bricks.		
	IS : 9510	Specification for bitumasitc, Acid resisting grade.		
	Water Supply, Drainage and Sanitation			
	IS : 458	Specification for concrete pipes.		
	IS : 554	Dimensions for pipe threads, where pressure tight joints are made on thread.		
	IS : 651	Specification for salt glazed stoneware pipes.		
	IS : 774	Flushing cisterns for water closets and urinals.		
	IS : 775	Cast iron brackets and supports for wash basins and sinks.		
	IS : 778	Copper alloy gate, globe and check valves for water works purposes.		
	IS : 781	Cast copper alloy screw down bib taps and stop valves for water services.		
	IS : 782	Caulking lead.		
	IS : 783	Code of practice for laying of concrete pipes.		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2		GENERAL TECHNICAL REQUIREMENTS
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	IS : 1172 Basic requirements for water supply, drainage and sanitation. IS : 1230 Cast iron rain water pipes and fittings. IS : 1239 Mild steel tubes, tubulars and other wrought steel fittings. IS : 1536 Centrifugally cast (Spun) iron pressure pipes for water, gas and sewage. IS : 1537 Vertically cast iron pressure pipes for water, gas and sewage. IS : 1538 Cast iron fittings for pressure pipe for water, gas and sewage. IS : 1703 Ball valves (horizontal plunger type) including float for water supply purposes. IS : 1726 Cast iron manhole covers and frames. IS : 1729 Sand cast iron spigot and socket, soil, water and ventilating pipes, fittings and accessories. IS : 1742 Code of practice for building drainage. IS : 1795 Pillar taps for water supply purposes. IS : 1879 Malleable cast iron pipe fittings. IS : 2064 Code of practice for selection, installation and maintenance of sanitary appliances. IS : 2065 Code of practice for water supply in building. IS : 2326 Automatic flushing cisterns for urinals. IS : 2470 Code of practice for installation of septic tanks. (Part-I & II) IS : 2501 Copper tubes for general engineering purposes. IS : 2548 Plastic seat and cover for water-closets. IS : 2556 Vitreous sanitary appliances (vitreous china). (Part 1 to 15) IS : 2963 Non-ferrous waste fittings for wash basins and sinks.			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 61 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS : 3114 IS : 3311 IS : 3438 IS : 3486 IS : 3589 IS : 3989 IS : 4111 (Part I to IV) IS : 4127 IS : 4764 IS : 4827 IS : 5329 IS : 5382 IS : 5822 IS : 5961 IS : 7740 IS : 8931 IS : 8934 IS : 9762 IS : 10446	Code of practice for laying of cast iron pipes. Waste plug and its accessories for sinks and wash basins. Silvered glass mirrors for general purposes. Cast iron spigot and socket drain pipes. Electrically welded steel pipes for water, gas and sewage (200mm to 2000mm nominal diameter). Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories. Code of practice for ancillary structure in sewerage system. Code of practice for laying of glazed stone-ware pipes. Tolerance limits for sewage effluents discharged into inland-surface waters. Electro plated coating of nickel and chromium on copper and copper alloys. Code of practice for sanitary pipe work above ground for buildings. Rubber sealing rings for gas mains, water mains and sewers. Code of practice for laying of welded steel pipes for water supply. Cast iron grating for drainage purpose. Code of practice for road gullies. Cast copper alloy fancy bib taps and stop valves for water services. Cast copper alloy fancy pillar taps for water services. Polyethylene floats for ball valves. Glossary of terms for water supply and sanitation.		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 62 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
		IS : 10592 Industrial emergency showers, eye and face fountains and combination units. IS : 12592 Specification for precast concrete manhole covers and frames. IS : 12701 Rotational moulded polyethylene water storage tanks. SP: 35 Hand book on water supply and drainage. - Manual on Sewerage and sewage treatment (Published by CPH & EEO) As updated. Doors, Windows and Allied Works IS : 204 Tower Bolts Part-I Ferrous metals. Part-II Nonferrous metals. IS : 208 Door Handles. IS : 281 Mild steel sliding door bolts for use with padlocks. IS : 362 Parliament Hinges. IS : 420 Specification for putty, for use on metal frames. IS : 1003 Specification for timber panelled and glazed shutters- Part-I door (Part-I) shutters. IS : 1038 Steel doors, windows and ventilators. IS : 1081 Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators. IS : 1341 Steel butt hinges. IS : 1361 Steel windows for industrial buildings. IS : 1823 Floor door stoppers. IS : 1868 Anodic coatings on Aluminium and its alloys. IS : 2202 Specification for wooden flush door shutters (solid core type); (Part-II) particle board face panels and hard board face panels		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 63 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
		IS:2209 Mortice locks (vertical type). IS:2553 Safety glass IS:2835 Flat transparent sheet glass. IS:3548 Code of practice for glazing in buildings. IS:3564 Door closers (Hydraulically regulated). IS : 3614 Fire check doors; plate, metal covered and rolling type. IS:4351 Steel door frames. IS:5187 Flush bolts. IS:5437 Wired and figured glass IS:6248 Metal rolling shutters and rolling grills. IS:6315 Floor springs (hydraulically regulated) for heavy doors. IS:7196 Hold fasts. IS:7452 Hot rolled steel sections for doors, windows and ventilators. IS:10019 Mild steel stays and fasteners. IS:10451 Steel sliding shutters (top hung type). IS:10521 Collapsible gates. R oof Water Proofing and AlliedWorks IS:1203 Methods of testing tar and bitumen. IS:1322 Specification for bitumen felts for water proofing and damp proofing. IS:1346 Code of practice for water proofing of roofs with bitumen felts. IS:1580 Specification for bituminous compound for water proofing and caulking purposes.		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 64 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS:3067 Code of practice for general design details and preparatory work for damp proofing and water proofing of buildings. IS:3384 Specification for bitumen primer for use in water proofing and damp proofing. Floor Finishes and Allied Works IS:1237 Specification for cement concrete flooring tiles. IS:1443 Code of practice for laying and finishing of cement concrete flooring tiles. IS:2114 Code of practice for laying in-situ terrazzo floor finish. IS:2571 Code of practice for laying in-situ cement concrete flooring. IS:3462 Specification for unbacked flexible PVC flooring. IS:4971 Recommendations for selection of industrial floor finishes. IS:5318 Code of practice for laying of flexible PVC sheet and tile flooring. IS:8042 Specification for white portland cement. IS:13801 Specification for chequered cement concrete flooring tiles. Painting and Allied Works IS:162 Specification for fire resisting silicate type, brushing, for use on wood, colour as required. IS:1477 Code of practice for painting of ferrous metals in buildings. Part-I Pretreatment. Part-II Painting. IS:1650 Specification for colours for building and decorative finishes. IS:2074 Specification for red oxide-zinc chrome, priming, ready mixed paint air drying. IS:2338 Code of practice for finishing of wood and wood based materials. Part-I Operations and workmanship			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 65 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS एनटीपीसी NTPC		
	Part-II IS:2395 Part-I Part-II IS:2524 Part-I Part-II IS:2932 IS:2933 IS:4759 IS:5410 IS:5411 (Part-I) IS:6278 IS:10403 Piling and Foundation IS:1080 IS:1904 IS:2911 IS:2950 IS:2974 (Part-I TO V) IS:6403	Schedules Code of practice for painting concrete, masonry and plaster surfaces. Operations and workmanship. Schedule. Code of practice for painting of nonferrous metals in buildings. Pretreatment. Painting. Specification of synthetic enamel paint, exterior, under-coating and finishing. Specification enamel paint, under coating and finishing. Code of practice for hot dip zinc coating on structural steel and other allied products. Specification for cement paint Specification for plastic emulsion paint-for exterior use Code of practices for white washing and colour washing. Glossary of terms relating to building finishes. Code of practice for design and construction of simple spread foundations. Code of practice for design and construction of foundations in Soils; General Requirements. Code of practice for designs and construction of Pile foundations (Relevant Parts). Code of practice for designs and construction of Raft (Part-I) foundation. Code of practice for design and construction of machine foundations. Code of practice for determination of Allowable Bearing pressure on Shallow foundation.	
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS:8009 Part-I Part-II IS:12070 DIN:4024 VDI:2056 VDI:2060 Stop Log and Trash Rack IS:4622 IS:5620 IS:11388 IS:11855 Roads IRC:5 IRC:14 IRC:16 IRC:19 IRC:21 IRC:34 IRC:36 IRC:37 IRC:56 IRC:73 IRC:86	Code of practice for calculation of settlement of foundation subjected to symmetrical vertical loads. Shallow foundations. Deep foundations. Code of practice for design and construction of shallow foundations on rocks. Flexible supporting structures for machines with rotating machines. Criteria for assessing mechanical vibrations of machines. Criteria for assessing rotating imbalances in machines. Recommendations for fixed - wheel gates structural design. Recommendations for structural design criteria for low head slide gates. Recommendations for design of trash rack for intakes. General requirements for rubber seals for hydraulic gates. Standard specifications and Code of practice for road bridges, section-I general Features of Design. Recommended practice of 2cm thick bitumen and tar carpets. Specification for priming of base course with bituminous primers. Standard specifications and code of practice for water bound macadam. Standard specifications and Code of practice for road bridges, section-III - Cement concrete (plain and reinforced). Recommendations for road construction in waterlogged areas. Recommended practice for the construction of earth embankments for road works. Guidelines for the Design of flexible pavements. Recommended practice for treatment of embankment slopes for erosion control. Geometric design standards for rural (non-urban) highways. Geometric Design standards for urban roads in plains.		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 67 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	IRC:SP:13	Guidelines for the design of small bridges & culverts.	
	IRC - Publication	Ministry of Surface Transport (Roads Wing), Specifications for road and bridge works.	
	IS:73	Specification for paving bitumen	
	Loadings		
	IS:875 (Pt. I to V)	Code of practice for design loads other than earthquake) for buildings and structures.	
	IS:1893	Criteria for earthquake resistant design of structures.	
	IS:4091	Code of Practice for design and construction of foundation for transmission line towers & poles.	
	IRC:6	Standard specifications & code of practice for road bridges, Section-II Loads and stresses.	
	M.O.T.	Deptt. of railways Bridge Rules.	
	Safety		
	IS:3696 (Part I & II)	Safety code for scaffolds and ladders.	
	IS:3764	Safety code for excavation work.	
	IS:4081	Safety code for blasting and related drilling operations.	
	IS:4130	Safety code for demolition of buildings.	
	IS:5121	Safety code for piling and other deep foundations.	
	IS:5916	Safety code for construction involving use of hot bituminous materials.	
	IS:7205	Safety code for erection on structural steelwork.	
	IS:7293	Safety code for working with construction machinery.	
	IS:7969	Safety code for handling and storage of building materials	
	IS:11769	Guidelines for safe use of products containing asbestos.	
	- Indian Explosives Act. 1940 as updated.		
	Architectural design of buildings		
	SP:7	National Building Code of India	
	SP:41	Hand book on functional requirements of buildings (other than industrial buildings)	
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS एनटीपीसी NTPC		
	Miscellaneous IS:802 Code of practice for use of structural steel in (Relevant parts) overhead transmission line towers. IS:803 Code of practice for design, fabrication and erection of vertical mild steel cylindrically welded in storage tanks. IS:10430 Criteria for design of lined canals and liner for selection of type of lining. IS:11592 Code of practice for selection and design of belt conveyors. IS:12867 PVC handrails covers. CIRIA Design and construction of buried thin-wall pipes. Publication REFERENCE CODES AND STANDARDS FOR CONTROL AND INSTRUMENTATION The design, manufacture, inspection, testing & installation of all equipment and system covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable VDE, IEEE, ANSI, ASME, NEC, NEMA, ISA AND Indian Standards and their equivalents. Temperature Measurements - Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974). - Temperature measurement - Thermocouples ANSI MC 96.1 - 1982. - Temperature measurement by electrical Resistance thermometers - IS:2806. - Thermometer - element - Platinum resistance - IS:2848. Pressure Measurements - Instruments and apparatus for pressure measurement - ASME PTC 19.2 (1964). - Electronic transmitters BS:6447. - Bourdon tube pressure and vacuum gauges - IS:3624 - 1966. - Process operated switch devices (Pr. Switch) BS-6134.		
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	Flow Measurements Instruments and apparatus for flow measurements - ASME PTC 19.5 (1972) Interim supplement, Part-II. Measurement of fluid flow in closed conduits - BS-1042. Electronic Measuring Instrument & Control Hardware/ Software - Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973): IS:9319. - Safety requirements for electrical and electronic measuring and controlling instrument - ANSI C 39.5 - 1974. - Compatibility of analog signals for electronic industrial process instruments - ISA - S 50.1 (1982) ANSI MC 12.1 - 1975. - Dynamic response testing of process control instrumentation ISA - S 26 (1968). - Surge Withstand Capability (SWC) tests - ANSI C 37.90 a/IEEE-472 or suitable class of IEC-255-4 equivalent to ANSI C37.90a/IEEE-472. - Printed circuit boards - IPC TM - 650, IEC 326 C. - General requirement and tests for printed wiring boards - IS 7405 (Part-I) 1973. - Edge socket connectors - IEC 130-11. - Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2. - Dimensions of attachment plugs & receptacles - ANSI C 73 - 1973 (Supplement ANSI C 73 a - 1980). - Direct acting electrical indicating instrument - IS:1248 - 1968 (R). - Standard Digital Interface for Programmable Instrumentation - IEEE-488.2 - 1990. - Information Processing Systems - Local Area Networks - Part 2 : Logical Link Control - IEEE-802.2 - 1989. - Standard for Local Area Networks : Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1985. - Supplements A, B, C and E to Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1988.			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	16. Standard for Local Area Networks : Token - Passing Bus Access Method - IEEE-802.4 - 1985. 17. Standard for Local Area Networks : Token - Ring Access Method and Physical Layer Specification - IEEE-802.5 - 1985. 18. IEEE Guide to Software Requirements Specifications - IEEE-830 - 1984. 19. Hardware Testing of Digital Process Computers - ISA RP55.1 - 1983. 20. Electromagnetic Susceptibility of Process Control Instrumentation - SAMA PMC 33.1 - 1978. 21. Interface Between the Data Terminal Equipment and Data Circuit - Terminating Equipment Employing Serial Binary Data Interchange - EIA-232-D-1987. 22. Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment, Part 3 : Radiated Electromagnetic Field Requirements - IEC 801-3-1984. Instrument Switches and Contact 1. Contact rating - AC services NEMA ICS 2 - 1978 (with revision through May 1983), Part - 2-125, A6000. 2. Contact rating - DC services NEMA ICS 2-1978 Part-2 125, N600. Enclosures 1. Type of Enclosures - NEMA ICS Part - 6 - 1978 (with Rev. 1 4/80) through 110.22 (Type 4 to 13). 2. Racks, panels and associated equipment - EIA : RS - 310 C- 1983 (ANSI C 83.9 - 1972). 3. Protection class for Enclosures, cabinets, control panels & desks - IS:2147 - 1962. Apparatus, enclosures and installation practices in hazardous area 1. Classification of hazardous area - NFPA 70 - 1984, Article 500. 2. Electrical Instruments in hazardous dust location - ISA - 512.11, 1973. 3. Intrinsically safe apparatus - NFPA 493 1978. 4. Purged and pressurised enclosure for electrical equipment in hazardous location - NFPA 496-1982. 5. Enclosures for Industrial Controls and Systems - NEMA IS 1.1 - 1977.		
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	Sampling System 1. Stainless steel material of tubing and valves for sampling system - ASTM A 296-82, Grade 7 P 316. 2. Submerged helical coil heat exchangers for sample coolers ASTM D11 92-1977. 3. Water and steam in power cycle - ASME PTC 19.11. 4. Standard methods of sampling system - ASTM D 1066-99. Annunciators 1. Specifications and guides for the use of general purpose annunciators - ISA S 19.1, 1979. 2. Surge withstand capability tests - ANSI C 37.90a - 1989/IEEE-472 or suitable class of IEC 255-4 equivalent to ANSI C37.90a 1989/IEEE-472 3. Damp heat cycling test - IS:2106 4. Specification for Electromagnetic Susceptibility - SAMA DMC 33, 1/78 Protections 1. Relays and relay system associated with electric power apparatus. ANSI C 37.90, 1 - 1989. 2. General requirements & tests for switching devices for control and auxiliary circuits including contactor relays - IS:6875 (Part-I) - 1973. 3. Turbine water damage prevention - ASME TDP-1-1980. 4. Boiler safety interlocks - NFPA 85 - 2011 or latest version. UPS System 1. Practices and requirements for semi-conductor power rectifiers - ANSI C 34.2, 1973. 2. Relays and relays system associated with electrical power apparatus - ANSI C 3.90 - 1983. 3. Surge withstand capability test - ANSI C 37.90 1 -1989. 4. Performance testing of UPS - IEC 146. 5. Stationary cells & Batteries Lead Acid type (with tubular positive plates) specification IS-1651-1991.			
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	6. Recommended practice for sizing large lead storage batteries for generating stations & sub-stations - IEEE-485-1985. 7. Printed Circuit Board - IPC TM 650, IEC 326C. 8. General Requirements & tests for printed wiring boards, IS:7405 (Part-I) 1973. Control Valves 1. Control valve sizing - Compressible & Incompressible fluids - ISA S 75.01-1985. 2. Face to face dimensions of control valves - ANSI B 16.00 - 1973. 3. ISA Hand Book of Control Valves - (ISBN : B: 1047-087664-234-2). 4. Codes for pressure piping - ANSI B 31.1 5. Control Valve leak class - ISA RP 39.6 Process Connection & Piping 1. Codes for pressure piping "power piping" - ANSI B 31.1. 2. Seamless carbon steel pipe ASTM - A - 106. 3. Forged & Rolled Alloy steel pipe flanges, forged fittings and valves and parts - ASTM - A - 182. 4. Material for socket welded fittings - ASTM - A - 105. 5. Seamless ferritic alloy steep pipe - ASTM - A - 335. 6. Pipe fittings of wrought carbon steel and alloy steel - ASTM - A - 234. 7. Composition bronze of ounce metal castings - ASTM - B - 62. 8. Seamless Copper tube, bright annealed - ASTM - B - 168. 9. Seamless copper tube - ASTM - B - 75. 10. Dimension of fittings - ANSI - B - 16.11. 11. Valves flanged and butt welding ends - ANSI - B - 16.34. Instrument Tubing 1. Seamless carbon steel pipe - ASTM - A 106. 2. Material of socketweld fittings - ASTM - A105. 3. Dimensions of fittings - ANSI - B - 16.11.			
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	4. Code for pressure piping, welding, hydrostatic testing - ANSI B 31.1. Cables 1. Thermocouples extension wires/cables - ANSI MC 96.1 - 1992. 2. Requirements for copper conductor-Wiring cables for telecommunications & information processing system - VDE:0815. 3. Colour coding of single or multi-pair cables - ICEA - S - 61-402 (third edition) NEMA WCS - 1979 with revisions thorough 2/83. 4. Insulation & Sheathing compounds for cables : VDE 0207 (Part-4, 5 & 6). 5. Guide design and installation of cable systems in power generating stations (insulation, jacket materials) - IEEE Std. 422-1977. 6. Rules for Testing insulated cables and flexible cables : VVDE - 0472 7. Requirements of vertical flame propagation test - IEEE 383 - 1974 (R 1980) 8. Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B-33-81. 9. Oxygen index and temperature index test - ASTM D - 2863. 10. Smoke density measurement test - ASTMD - 2843. 11. Acid gas generation test - IEC - 754 - 1. 12. Swedish Chimney test - SEN - 4241475 (F3). 13. Teflon (FEP) insulation & sheath test - ASTMD - 2116. 14. Thermocouple compensating cables - Testing requirements & sampling plan IS:8784. 15. PVC insulated electric cables for working voltage upto and including 1100 V - IS:1554 (Part-I). Cable Trays, Conduits 1. Guide for design and installation of cable systems in power generating station (Cable trays, support systems, conduits) - IEEE Std. 422, 1977, NEMA VE-1 1979, NFPA 70-1984. 2. -do- Test Standards. NEMA VE-1-1979. 3. Zinc coating "hot dip" on assembled products for galvanising of carbon steel cable trays - ASTM A - 386-78.		
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	Public Address System 1. Specifications for lod speakers - IS:7741 (Part-I, II and III) 2. Code of safety requirement for electric mains operated audio amplifiers - IS:1301 3. Specification for Public Address Amplifiers - IS:10426. 4. Code of practice for outdoor installation of PA system - IS:1982. 5. Code of practice for installation for indoor amplifying and sound distribution system - IS:1881. 6. Basic environmental testing procedures for electronic and electrical items - IS:9000. 7. Characteristics and methods of measurements for sound system equipment - IS:9302 8. Code of practice of electrical wiring installations (System voltage not exceeding 650 volts) - IS:732 9. Rigid steel conduits for electric wiring - IS:9537 (Part-I and II) 10. Fittings for rigid steel conduits for electrical wiring - IS:2667 11. Degree of protection provided by enclosure for low voltage switchgear and control gear - IS:2147. Vibration Monitoring System 1. API 670 - 1994 2. BS : 4675 Part-2			
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO. CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS	PAGE 75 OF 83

ANNEXURE-I

MFGR.'s LOGO	MANUFACTURER'S NAME AND ADDRESS	MANUFACTURING QUALITY PLAN		PROJECT :
		ITEM :	QP NO.: REV.NO.: DATE: PAGE: OF....	PACKAGE : CONTRACT NO. : MAIN-SUPPLIER:
		SUB-SYSTEM:		

SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C / N				D*	M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	**	10.		11.

		LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: MANUFACTURER/SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS 'W'	 FOR NTPC USE	DOC. NO.:		REV..... CAT.....	
MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER						
SIGNATURE				REVIEWED BY	APPROVED BY	APPROVAL SEAL	

FORMAT NO.: QS-01-QAI-P-09/F1-R1

1/1

ENGG. DIV./QA&I

LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC. NO.:CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENT	PAGE 76 OF 83
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ANNEXURE-II

SUPPLIER'S LOGO	SUPPLIER'S NAME AND ADDRESS	FIELD QUALITY PLAN		PROJECT :
		ITEM :	QP NO.:	PACKAGE :
		SUB-SYSTEM:	REV. NO.:	CONTRACT NO. :
			DATE:	MAIN-SUPPLIER:
			PAGE: OF....	

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.

		LEGEND: * RECORDS, IDENTIFIED 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)		DOC. NO.:			REV.....		
MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER								
SIGNATURE				FOR NTPC USE	REVIEWED BY	APPROVED BY	APPROVAL SEAL		

FORMAT NO.: QS-01-QAI-P-09/F2-R1

1/1

ENGG. DIV./QA&I

LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC.NO.:CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENT	PAGE 77 OF 83
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ANNEXURE-III

	Project :	Stage :	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL					DOC. NO.:	
	Package :							REV. NO.:	
	Supplier :							DATE :	
	Contractor No. :		SUB-SYSTEM :					PAGE : OF	

S. N.	Item	QP/ Insp. Cat.	QP No.	QP Sub. Schedule	QP approval schedule	Proposed sub-supplier	Place	Sub-suppliers approval status / category	Sub-supplier Details submission on schedule	Remarks

LEGENDS

SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY NTPC)

A – For these items proposed vendor is acceptable to NTPC. To be indicated with letter “A” in the list alongwith the condition of approval, if any.

DR – For these items “Detailed required” for NTPC review. To be identified with letter “DR” in the list.

NOTED – For these items vendors are approved by Main Supplier and accepted by NTPC without specific vendor approval from NTPC. To be identified with “NOTED.”

QP/INSPN CATEGORY:

CAT-I : For these items the Quality Plans are approved by NTPC and the final acceptance will be on physical inspection witness by NTPC.

CAT-II : For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on the basis review of documents as per approved QP.

CAT-III : For these items Main Supplier approves the Quality Plans. The final acceptance by NTPC shall be on the basis certificate of conformance by the main supplier.

UNITS/WORKS : Place of manufacturing Place of Main Supplier of multi units/works.

FORMAT NO.: QS-01-QAI-P-1/F3-R0

1/1

Engg. Div. / QA&I

LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC.NO.:CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENT	PAGE 78 OF 83
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ANNEXURE-IV

	Project :	Stage :	STATUS OF ITEM REQUIRING QP& SUB-SUPPLIER APPROVAL						DOC. NO.:		
	Package :								REV. NO.:		
	Contractor :								DATE :		
	Contractor No. :								PAGE : OF		
S. N.	Item / Service	QP/ Insp. Cat.	QP Sub. Schedule Approval schedule	Date of submission	Date of comm t Appl.	Status Code C/II/I	Proposed Sub-suppliers	Place of manufacturing works	Approval Status	Sub-supplier detail submission schedule	Remarks
FORMAT						1/1	Engg. Div. / QA&I				

LOT-IA PROJECTS STEAM GENERATOR ISLAND PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC.NO.:CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENT	PAGE 79 OF 83
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ANNEXURE-V

		Project :		Stage :		FIELD WELDING SCHEDULE (To be raised by the contractor)							DOC. NO.:			
		Contractor :				Welding Code:							REV. NO.:			
		Contractor No. :											DATE :			
		System :											PAGE :		OF	
Sl. No.	DRG No. for Weld Location and Identification mark	Description of parts to welded	Matl. Spec.	Dimensions		Process of welding	Type of Weld	Electrode filler spec.	WPS. No.	Min. pre-heat	Heat treatment		NDT method/ Quantum	REF		Remarks
											Temp.	Holding time		Spec. No.	ACC Norm Ref.	
NOTES:																
SIGNATURE																
FORMAT						1/1						Engg. Div. / QA&I				

LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC.NO.:CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENT	PAGE 80 OF 83
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CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS (Annexure-VI)																																																											
	<table><tr><th>S.No</th><th>Description of Drgs/Docs</th><th>No of Prints</th><th>No of CD ROMs/DVDs/Portable Hard Disk</th></tr><tr><td rowspan="8">1</td><td>Drawings, Data sheets, Design calculations, Purchase specifications and other documents</td><td></td><td></td></tr><tr><td>First submission and submission with major changes</td><td></td><td></td></tr><tr><td>▪ Layout (A0&A1 sizes)</td><td>4</td><td>-</td></tr><tr><td>▪ Other Drawings/Documents (A0&A1 sizes)</td><td>2</td><td>-</td></tr><tr><td>▪ P&ID (All sizes)</td><td>4</td><td>-</td></tr><tr><td>a) Final drawings/documents (Directly to site)</td><td>6</td><td>2</td></tr><tr><td>b) "As Built" Drawing/Documents (Directly to site)</td><td>6</td><td>2</td></tr><tr><td>c) Analysis reports of Equipments / piping /structures components/system employing software packages as detailed in the specifications.</td><td>2</td><td>2</td></tr><tr><td>2</td><td>Erection Manual (Directly to site)</td><td>4 sets</td><td>2</td></tr><tr><td rowspan="2">3</td><td>Operation & Maintenance manual</td><td rowspan="2">1 set</td><td rowspan="2">--</td></tr><tr><td>i) First Submission</td></tr><tr><td></td><td>ii) Final Submission (Directly to site)</td><td>4 sets</td><td>2</td></tr><tr><td rowspan="2">4</td><td>Plant Hand Book</td><td rowspan="2">1</td><td rowspan="2">1</td></tr><tr><td>i) First Submission</td></tr><tr><td rowspan="2">5</td><td>Commissioning and Performance Test Procedure manual</td><td rowspan="2">1 set</td><td rowspan="2">--</td></tr><tr><td>i) First Submission</td></tr><tr><td></td><td>ii) Final Submission (Directly to site)</td><td>4 sets</td><td>2</td></tr></table>				S.No	Description of Drgs/Docs	No of Prints	No of CD ROMs/DVDs/Portable Hard Disk	1	Drawings, Data sheets, Design calculations, Purchase specifications and other documents			First submission and submission with major changes			▪ Layout (A0&A1 sizes)	4	-	▪ Other Drawings/Documents (A0&A1 sizes)	2	-	▪ P&ID (All sizes)	4	-	a) Final drawings/documents (Directly to site)	6	2	b) "As Built" Drawing/Documents (Directly to site)	6	2	c) Analysis reports of Equipments / piping /structures components/system employing software packages as detailed in the specifications.	2	2	2	Erection Manual (Directly to site)	4 sets	2	3	Operation & Maintenance manual	1 set	--	i) First Submission		ii) Final Submission (Directly to site)	4 sets	2	4	Plant Hand Book	1	1	i) First Submission	5	Commissioning and Performance Test Procedure manual	1 set	--	i) First Submission		ii) Final Submission (Directly to site)	4 sets	2
S.No	Description of Drgs/Docs	No of Prints	No of CD ROMs/DVDs/Portable Hard Disk																																																									
1	Drawings, Data sheets, Design calculations, Purchase specifications and other documents																																																											
	First submission and submission with major changes																																																											
	▪ Layout (A0&A1 sizes)	4	-																																																									
	▪ Other Drawings/Documents (A0&A1 sizes)	2	-																																																									
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LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC.NO.:CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS Annexure-VI	PAGE 81 OF 83																																																								

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS (Annexure-VI)			
	S.No	Description of Drgs/Docs	No of Prints	No of CD ROMs/DVDs/Portable Hard Disk
	6	Performance and Functional Guarantee Test Report i) First Submission	2 sets	--
		ii) Approved Copies (Direct to Site)	4 sets	2
	7	Project Completion Report (Directly to site)	6 sets	2
	8	QA programme including Organisation for implementation and QA system manual(with revisions)	1	--
	9	Vendor details in respect of proposed vendors including contractor's evaluation report.	2	--
	10	Manufacturing QPs, Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc		
		i) For review/comment	1	--
		ii) Approved final copies of Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc (Direct to Site)	4	2
	11	Welding Manual, Heat Treatment Manuals, Storage & preservation manuals		
		i) For review/comment	1 set	--
		ii) Approved copies (Direct to Site)	4 sets	2
	12	QA Documentation Package for items / equipment manufactured and despatched to site	2 sets	2
13	QA Documentation Package for field activities on equipment/systems at site	2 sets	2	
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-C BID DOC.NO.:CS-0011-109(1A)-2	GENERAL TECHNICAL REQUIREMENTS Annexure-VI	PAGE 82 OF 83



TITLE:

**4x250 MW NABINAGAR TPP
TECHNICAL SPECIFICATION FOR
MISC. FGD TANKS**

SPECIFICATION No: PE-TS-463-167-A101

SECTION-I, SUB-SECTION-C2B

REV. 00

DATE: MAY 2020

SHEET : 1 OF 1

SUB SECTION-C2 - B

CUSTOMER SPECIFICATION: QUALITY ASSURANCE

CLAUSE NO.	QUALITY ASSURANCE	एनटीपीसी NTPC
1.04.05	Functional checks of the valves for smooth opening and closing shall also be done.	
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.	
1.06.0	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	
1.07.0	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.	
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.:CS-0011-109(1A)-2	SUB-SECTION – V-QM1 FGD System Page 2 of 4

CLAUSE NO.	QUALITY ASSURANCE	
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.	
1.08.0	STRUCTURES , DUCTS, HOPPERS:	
1.08.01	All materials shall be tested for chemical and mechanical properties as per relevant standard. All plates above 40mm shall be 100% Ultrasonically tested.	
1.08.02	Visual inspection of all welds shall be performed in accordance with AWS D1.1.	
1.08.03	NDT requirements of structural steel welds shall be as under:	
	i) 100% RT/UT on butt-welds of plate thickness ≥ 32 mm.	
	ii) For plates of $25\text{mm} \leq \text{thickness} < 32\text{mm}$ -10% RT and 100% MPI.	
	iii) For plates of thickness $< 25\text{mm}$ -10% MPI/LPI.	
1.08.04	Edge for shop and field weld shall be examined by MPI for plate thickness ≥ 32 mm.	
1.09.0	VACUUM BELT FILTER SYSTEM:	
1.09.01	Impeller, casing and shaft of vacuum pumps shall be tested for chemical and mechanical properties as per relevant standard. All plates above 40mm shall be 100% Ultrasonically tested.	
1.09.02	UT on shaft (if greater or equal to 40mm) and impeller shall be carried out.	
1.09.03	All vacuum pumps shall be tested at shop for capacity, power, pressure, efficiency, noise and vibration etc.	
1.09.04	Filter cloths and belts shall be tested for physical properties as per relevant standard	
1.09.05	Hydro cyclones shall be checked by visual, dimensional etc.	
1.10.0	SPRAY NOZZLES:	
1.10.01	Spray nozzles shall be tested for physical properties	
1.10.02	Spray nozzles also shall be subjected to performance test.	
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.:CS-0011-109(1A)-2	SUB-SECTION – V-QM1 FGD System Page 3 of 4

CLAUSE NO.	QUALITY ASSURANCE		
1.11.0 1.11.01 1.11.02 1.11.03 1.12.0 1.12.01 1.12.02 1.12.03 1.12.04 1.12.05 1.13.0 1.14.0 1.14.01	AGITATORS: Rubber lining shall be tested for hardness and spark test Impellers shall be tested for dimensional and balancing check Gear Boxes shall be tested for run test as per standard practice FANS: Rotor components shall be subjected to ultrasonic test at mill and magnetic particle inspection / liquid penetrant examination after rough machining. Butt welds in rotor components shall be subjected to 100% RT and all welds shall be magnetic particle/dye penetrant tested after stress relieving. All rotating components and assemblies of fan shall be balanced dynamically Performance test shall be carried out on fans as per Technical specification/ Relevant standard Test for Natural Frequency and hardness of Fans blades shall be carried out as per Technical specification/ Relevant standard Thermal Insulation, Lagging & Cladding: (a) Lightly resin bonded mineral wool: LRB mattresses/sections of Rockwool/ Glasswool shall conform to & tested as per relevant clauses of Indian Standards and shall meet the requirements of NTPC data sheet. Type tests except Thermal Conductivity shall be regularly carried out once in three months, Thermal Conductivity Type Test shall be carried out minimum once in twelve months by the manufacturer. Requirements of various components like Binding wires, Lacing wires, Wire mesh, etc. shall be as per NTPC approved data sheet / as given in respective Sub-Section of Technical Requirements of Steam Generator & Auxiliaries. (b) Lagging & Cladding: All insulation shall be protected by means of an outer covering of Aluminium sheeting conforming to ASTM B-209-1060 temper H14 from reputed manufacturer meeting the requirements of NTPC data sheet. OTHER CRITICAL EQUIPMENTS: Checks/ NDTs shall be done as per relevant Indian Standards or equivalent International Standards.		
LOT-IA PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.:CS-0011-109(1A)-2	SUB-SECTION – V-QM1 FGD System	Page 4 of 4



TITLE:

**4 X 250 MW NABINAGAR TPP
TECHNICAL SPECIFICATION FOR
MISC. FGD TANKS**

SPECIFICATION No: PE-TS-463-167-A101

SECTION-I, SUB-SECTION-C2-C

REV. 00

DATE: MAY 2020

SHEET : 1 OF 1

SUB SECTION-C2 - C

CUSTOMER SPECIFICATION: PAINTING SPECIFICATION

 RANIPET	Bharat Heavy Electricals Limited Boiler Auxiliaries Plant Ranipet – 632 406	BHEL DOC NO.	PS: NN FGD: : G201
		REVISION NO.	01
		DATE	18.11.2019

NABINAGAR FGD PACKAGE

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

NTPC CONTRACT NO: CS-0270-109(1A) -2/FC/19-20/18-19 dtd 10.07.2019

NTPC DRG NO: 0270-109-PVM-H-001

BHEL RANIPET Customer No(s).: G201-G204

Prepared By	Reviewed & Approved By
	
Rajamanickam M Dy.Manager/QA	K.C. Gandhi Parimalam DGM/QA

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

RECORD OF REVISION

REV NO	DATE	DETAILS OF REVISION
00	01.11.2019	Original Issue - First Submission
01	18.11.2019	NTPC comments: SI no: 32, 33& 38 of FGD, DFT- 300 microns BHEL reply: The SI nos: 32, 33& 38 of FGD are of Limestone silo structures, Limestone silo- Outside surfaces and Platform structures are given painting as per the civil specification as they are the steel structures. As per the clause 31.03.00 of Sec.VI, Part-B, Sub section IV-D civil works, total DFT is 240 microns only. We have given as per the NTPC specification only. We request you to kindly consider and approve our painting schedule. NTPC comments: We understand that the painting details of DCS and control panels shall be provided in the respective GA/ IA details kindly clarify. BHEL reply: We wish to submit that the painting details of DCS and control panels is provided in the respective GA/IA details. We request you to kindly approve the painting schedule.

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

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	100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ	75	300

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
				Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100	Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	25	
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)	55 286	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)	55 586	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

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
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

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

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	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	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	70	240

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
			conforming to ISO 8501-1	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	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)		
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)	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	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 With gloss retention (SSPC paint spec no.36, ASTM	70	240

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
	Inside surfaces are of C276 clad sheets, hence no paint is envisaged.			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	D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)		
7	Absorber system casing top- Outside surfaces (Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D) Inside surfaces are of C276 clad 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	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

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
				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)		
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) (Clause 20.03.00 of Part- C Section VI)	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
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

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
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 (Clause 20.03.00 of Part- C Section VI)	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
		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

SI No	SURFACE LOCATION		PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
					PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
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 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
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	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	70	240

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

				with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ		exposure, gloss less than 30 and colour change less than 2.0Δ E)		
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 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

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
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

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

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 237 FW 610 FW 612 FW 613 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	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

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

				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)		
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) 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 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
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) Idle 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	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume	70	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane	70	240

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
			profile 40-60µm conforming to ISO 8501-1	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	100	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)		
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 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
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	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

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
				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)		
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)				

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
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) 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
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

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
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,	FW 742 FW 743 FW 744 FW 745 FW 747 FW 748 FW 749	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	NIL	--	60

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
	Process Water tank, Belt filter washing tank, Primary Hydrocyclone feed tank, Clarified water tank, Tank internal structure Inside surfaces	FW 800 FW 802				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.		
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	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	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	60	120

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
						Identification Tag: Sky Blue Shade no: 101 as per IS 5		
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

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

3. GATES & DAMPERS

01	Gates & Dampers > 95° 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 (Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)	57 466 57 566	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	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	70	240

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
				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	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)		

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

4. PAINTING OF DAMAGED AREAS

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 scheme If primer is intact- Intermediate & finish as per respective scheme
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

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

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. PGMA's 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 SI 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 PGMA's are to be painted. Incase 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.

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

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 aluminium 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	--

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

PGMA DETAILS

SNO	PGMA	PGMA DESCRIPTION	PGMA 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 Suction & Discharge Silencers Acoustic Enclosure Water Injection cooling system

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

			Pipe, Valves & Instruments Special Tools
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SNO	PGMA	PGMA DESCRIPTION	PGMA DETAILS
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)
19	FW 293	Elevator and accessories	Base Frame Buffer Spring Mast Section Cage Control Panel & AC Mandatory Spares

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

SNO	PGMA	PGMA DESCRIPTION	PGMA DETAILS
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

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

SNO	PGMA	PGMA DESCRIPTION	PGMA DETAILS
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

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

SNO	PGMA	PGMA DESCRIPTION	PGMA 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 CheckValves 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

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

			Cantilever Arm Fasteners & clamps Brackets
46	FW 996	Tools	Erection, commissioning, special tools
SNO	PGMA	PGMA DESCRIPTION	PGMA DETAILS
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



TITLE:
4 X 250 MW NABINAGAR TPP
TECHNICAL SPECIFICATION FOR
MISC. FGD TANKS

SPECIFICATION No: PE-TS-463-167-A101

SECTION-I, SUB-SECTION-D

REV. 00

DATE: MAY 2020

SHEET : 1 OF 1

SECTION-I

SUB-SECTION-D



**MISCELLANEOUS TANKS
SUB-VENDOR LIST**

SPECIFICATION NO. PE-TS-463-167-A001

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ANNEXURE - I

**LIST OF MAKES OF SUB-VENDOR ITEMS
MISCELLANEOUS TANKS**



MISCELLANEOUS TANKS SUB-VENDOR LIST

SPECIFICATION NO. PE-TS-463-167-A001

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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
3	STRUCTURAL STEEL / MS-PLATE	ISMT	BARAMATI	UP TO 200 NB
		SAIL		
		ESSAR STEEL		
		TISCO		
		RINL		
		JINDAL		
		M/S UTTAM VALUE STEEL (LLOYDS)		
		ISPAT		
		JSW		
4	GATE, GLOBE AND CHECK (CS STEEL VALVES)	INDIAN IRON & STEEL CO. LTD		
		A.V. VALVES LTD	AGRA	
		MICON VALVES(INDIA) PVT LTD	MUMBAI	GATE VALVES: Up to 50NB – Class-800 with MOC as FCS. Class 150 with MOC as CSS. Size 65 NB to 600 NB- Class up to 600 with MOC as CCS/CSS.
				NR VALVES: Up to 50NB – Class-800 with MOC as FCS. Class 150 with MOC as CSS. Size 65 NB to 700 NB- Class up to 600 with MOC as CCS/CSS.
				GLOBE VALVES: Up to 50NB – Class-800 with MOC as FCS. Class 150 with MOC as CSS. Size 65 NB to 80 NB- Class 150 with MOC as CCS.
		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	



MISCELLANEOUS TANKS SUB-VENDOR LIST

SPECIFICATION NO. PE-TS-463-167-A001

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		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	
5	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		
6	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	



**MISCELLANEOUS TANKS
SUB-VENDOR LIST**

SPECIFICATION NO. PE-TS-463-167-A001

PAGE 4 of 4

		TRUE FORGE	FARIDABAD	
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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 / GLASS FLAKE LINING FOR SLURRY TANKS/SUMPS

Rubber / Glass flake Lining for the Wet Limestone based Flue Gas Desulphurisation (FGD) System offered by the bidder shall be only from such manufacturer(s) who has supplied rubber/glass flake lining application for coal based thermal power station for Wet Limestone based FGD application or similar application in other process industry. The lining shall be guaranteed for uninterrupted minimum life of 25,000 hrs. Proof of such guarantee may be established from performance certificate/Test Certificates.



Bharat Heavy Electricals Limited

Boiler Auxiliaries Plant
Ranipet – 632 406
Vellore Dist., (TN)

PGMA Categorization for QP and Vendor Category

Customer: N T P C Limited

Project: NABINAGAR FGD PROJECT (4X250MW)

Package: FGD Package [BAP WO: G201-G204]

NTPC Contract No.: CS-0270-109(1A) -2-FC/19-20/1819 dtd 10.07.2019

NTPC DRG NO: 0270-109-QVM-Q-018

DOC.NO.:BAP:QA:MECH:PGMA CAT:G201

REV.01

Dtd. 07-11-2019

SL NO	PGMA	ITEM DESCRIPTION	REF DOCUMENT	QP CATEGORY	VENDOR CATEGORY
PRODUCT : Fans (Mechanical)-Manufacturing Items					
1	55 000	AXIAL FAN TOOL & FIXTURES	DRG	III	III
2	55 081	BOOSTER FAN FOUNDATION MATERIAL	DRG	III	III
3	55 082	BOOSTER FAN HAND RAILS & INSERT PLATE	DRG	III	III
4	55 089	BOOSTER FAN CANOPY FOR MOTOR	DRG	III	III
5	55 286	AXIAL BOOSTER FAN ROTOR	DRG	I	I
6	55 586	AXIAL BOOSTER FAN STATOR	DRG	I	I
PRODUCT : Fans (Mechanical)-BOI Items					
1	55 084	AXIAL BOOSTER COOLING/ SEAL FAN	P.S	III	III
2	55 091	FIRST FILL LUBRICANTS	P.S	III	III
3	55 880	AXIAL BOOSTER FAN COUPLING	P.S	III	III
4	55 286	O- RING, SIMMER RINGS	P.S	III	III
		OTHER SEALS	P.S	III	III
		FASTENERS	IS	III	III
		NAME PLATES	--	III	III
		ANTI-FRICTION BEARINGS	CATALOGUE	III	III
		MALE STUD UNION	CATALOGUE	III	III
		CUP SPRINGS	P.S	III	III
		ELA PIPE CONNECTION	P.S	III	III
		PILLOW BLOCK BEARINGS	CATALOGUE	III	III
		RECTANGULAR RING	CATALOGUE	III	III
		RUBBER HOSE& RUBBER BELT/FABRIC FOR EXPANSION JOINT	P.S	III	III
5	55 980	BOOSTER FAN LOS	MQP	I	III
		LUB OIL COOLERS	CATALOGUE	III	III
		LUB OIL REGULATORS	CATALOGUE	III	III
		PRESSURE CONTROL VALVE	P.S	III	III
		LUB OIL FILTERS	P.S	III	III
		LUB OIL PUMPS	P.S	III	III
		VALVE FOR LUB OIL SYSTEM		III	III
		NAME PLATES		III	III
PRODUCT : FGD (Mechanical)-Manufacturing Items					
1	FW 216	ABSORBER BAFFLE GRATING SUPPORT	DRG	III	III
2	FW 217	ABSORBER MIST ELIMINATOR SUPPORT	DRG	III	III
3	FW 218	ABSORBER SPRAY PIPE SUPPORT	DRG	III	III
4	FW 219	ABSORBER SYSTEM BASE	SQP	III	III
5	FW 220	ABSORBER SYSTEM STRUCTURES	SQP	III	III
6	FW 221	ABSORBER SYSTEM CASING BOTTOM	MQP	II	III
7	FW 222	ABSORBER SYSTEM CASING TOP	MQP	II	III

NTPC DRG NO: 0270-109-QVM-Q-018					
DOC.NO.:BAP:QA:MECH:PGMA CAT:G201		REV.01	Dtd. 07-11-2019		
SL NO	PGMA	ITEM DESCRIPTION	REF DOCUMENT	QP CATEGORY	VENDOR CATEGORY
8	FW 226	EMERGENCY QUENCH WATER TANK	SQP	III	III
9	FW 228	ABSORBER- W/D INTERFACE	P.S	III	III
10	FW 231	ABSORBER SHEAR PLATE	DRG	III	III
11	FW 232	DUCT SUPPORT BYPASS DUCT& BOOSTER FAN	DRG/SQP	III	III
12	FW 233	DUCT SUPPORT BOOSTER FAN & BYPASS DUCT	DRG/SQP	III	III
13	FW 234	DUCT SUPPORT ABSORBER & STACK	DRG/SQP	III	III
14	FW 236	STRUCTURES FOR RC PUMPHOUSE	DRG/SQP	III	III
15	FW 237	GALLERIES AND RAILINGS FOR STAIRS	DRG	III	III
16	FW 238	HOOK UP DUCT WITH STRUCTURE	DRG/SQP	III	III
17	FW 251	EXPANSION JOINT BETWEEN BYPASS	SQP	III	III
18	FW 255	DUCT BETWEEN BYPASS DUCT & BOOSTER FAN	SQP	III	III
19	FW 256	DUCT BETWEEN BOOSTER FAN AND ABSORBER	SQP	III	III
20	FW 257	DUCT BETWEEN ABSORBER AND STACK	SQP	III	III
21	FW 260	DUCT STRUCTURE BETWEEN BYPASS& BOOSTER FAN	SQP	III	III
22	FW 261	DUCT STRUCTURE BETWEEN BOOSTER FAN& ABSORBER	SQP	III	III
23	FW 262	DUCT STRUCTURE BETWEEN ABSORBER & STACK	SQP	III	III
24	FW 280	FOUNDATION MATERIAL FOR DUCT STRUCTURES	DRG	III	III
25	FW 281	FOUNDATION MATERIAL FOR ABSORBER	DRG	III	III
26	FW 282	FOUNDATION MATERIAL FOR ELEVATOR	DRG	III	III
27	FW 283	FOUNDATION MATERIAL FOR RC PUMP SHED	DRG	III	III
28	FW 285	SUPPORTING STRUCTURES FOR EMERGENCY QUENCH WATER TANK	DRG/SQP	III	III
29	FW 292	STRUCTURES FOR ELEVATOR	SQP	III	III
30	FW 310	STRUCTURES FOR BOOSTER FAN HANDLING	SQP	III	III
31	FW 610	GALLERIES & RAILINGS FOR ABSORBER	SQP	III	III
32	FW 710	MONORAIL FOR HOIST& CRANES	SQP	III	III
33	FW 717	MAN HOLE DOOR	DRG	III	III
34	FW 721	AGITATOR SUPPORT	DRG	III	III
35	FW 722	GALLERIES & RAILINGS FOR TANK	DRG	III	III
36	FW 730	LIMESTONE SILO STRUCTURE	SQP	III	III
37	FW 731	LIME STONE SILO	SQP	III	III
38	FW 733	LIMESTONE SILO APPROACH PLATFORM	DRG	III	III
39	FW 740	FOUNDATION MATERIAL FOR TANKS	DRG	III	III
40	FW 742	LIMESTONE SLURRY STORAGE TANK	SQP	III	III
41	FW 743	AUXILIARY ABSORBER TANK	SQP	III	III
42	FW 744	FILTRATE TANK	SQP	III	III
43	FW 745	WASTAGE WATER TANK	SQP	III	III
44	FW 747	HYDROCYCLONE WASTE WATER TANK	SQP	III	III
45	FW 748	PROCESS WATER TANK	SQP	III	III
46	FW 749	ALL TANKS INTERNAL STRUCTURE	DRG	III	III

NTPC DRG NO: 0270-109-QVM-Q-018					
DOC.NO.:BAP:QA:MECH:PGMA CAT:G201		REV.01	Dtd. 07-11-2019		
SL NO	PGMA	ITEM DESCRIPTION	REF DOCUMENT	QP CATEGORY	VENDOR CATEGORY
47	FW 760	FOUNDATION MATERIAL FOR PIPE RACKS	DRG	III	III
48	FW 761	STRUCTURE FOR PIPE RACKS	SQP	III	III
49	FW 762	FOUNDATION MATERIAL FOR SILO STRUCTURE	DRG	III	III
50	FW 763	FOUNDATION MATERIAL FOR PIPE RACKS	DRG	III	III
51	FW 766	PLATFORMS FOR PIPE RACKS	DRG	III	III
52	FW 767	PLATFORM SUB PIPE RACK	DRG	III	III
53	FW 768 FW 769	TRESTLE FOR PIPE RACKS	DRG	III	III
54	FW 785	BELT FILTER WASHING TANK	SQP	III	III
55	FW 786	PRIMARY HYDROCYCLONE FEED TANK	SQP	III	III
56	FW 787	STRUCTURES INSIDE GYPSUM DEWATERING BUILDING& BALL MILL BUILDING	SQP	III	III
57	FW 800	CLARIFIED WATER TANK	SQP	III	III
58	FW 802	NEUTRALIZATION TANK & ACCESSORIES	SQP	III	III
PRODUCT : FGD (Mechanical)- BOI Items					
1	FW 212	SLURRY RECIRCULATION PUMP SYSTEM	MQP	I	I
2	FW 212	OTHER ITEMS OF SLURRY RECIRCULATION PUMP SYSTEM LIKE ACCESSORIES ETC	P.S	III	III
3	FW 213	ABSORBER SYSTEM INTERNALS	SQP	III	III
4	FW 214	ABSORBER BAFFLE GRATING	P.S	III	III
5	FW 215	MIST ELIMINATOR& ACCESSORIES	SQP	III	III
6	FW 223	ABSORBER SYSTEM ACCESSORIES	P.S	III	III
7	FW 227	EMERGENCY QUENCH SYSTEM	P.S	III	III
8	FW 229	W/D WASH SYSTEM	P.S	III	III
9	FW 230	AIR OXIDATION SYSTEM- OXIDATION BLOWER	MQP	I	I
10	FW 230	OTHER ITEMS OF AIR OXIDATION SYSTEM	P.S	III	III
11	FW 235	SPECIAL FASTENERS	P.S	III	III
12	FW 239	VIEWING PORTS	DRG	III	III
13	FW 243	SLURRY DIST RC PUMP& ABSORBER	DRG	III	III
14	FW 244	OXIDATION AR DISTRIBUTION SYSTEM	P.S	III	III
15	FW 249	HANDLING EQUIPMENT- RC PUMP	DRG/P.S	III	III
16	FW 250	FLOOR GRILLS	P.S	III	III
17	FW 252	EXPANSION JOINT	MQP	III	III
18	FW 267	INSULATION MATERIALS FOR DUCTS	SQP	III	III
19	FW 268	FIXING COMPONENTS AND CLADDING	SQP	III	III
20	FW 269	CLADDING SHEET FOR DUCT	P.S	III	III
21	FW 293 FW 716	ELEVATOR AND ACCESSORIES	P.S	III	III
22	FW 612	GALLERIES AND RAILINGS FOR DAMPER	DRG	III	III
23	FW 613	GALLERIES AND RAILINGS FOR DUCTS	DRG	III	III
24	FW 701	SLURRY PUMPS	MQP	I	I
25	FW 701	OTHER ACCESSORIES OF SLURRY PUMPS	P.S	III	III
26	FW 702	CLEAR WATER PUMPS AND ACCESSORIES	MQP	III	III
27	FW 712	FLOOR GRILLS	SQP	III	III
28	FW 713	CHAIN PULLEYS	DRG	III	III

NTPC DRG NO: 0270-109-QVM-Q-018					
DOC.NO.:BAP:QA:MECH:PGMA CAT:G201		REV.01	Dtd. 07-11-2019		
SL NO	PGMA	ITEM DESCRIPTION	REF DOCUMENT	QP CATEGORY	VENDOR CATEGORY
29	FW 714	HOISTS	DRG	III	III
30	FW 720	AGITATORS	MQP	I	I
31	FW 723	AIR CANNON SILO	DRG	III	III
32	FW 724	BAG FLITER AND FAN ASSY SILO	DRG	III	III
33	FW 725	NOZZLES AND FLANGES	DRG	III	III
34	FW 729	LIME STONE SILO LINING	P.S	III	III
35	FW 735	LIMESTONE GRINDING WET BALL MILL	MQP	I	I
36	FW 735	OTHER ACCESSORIES OF LIME STONE GRINDING WET BALL MILL	P.S	III	III
37	FW 738	GYPSUM VACUUM BELT FILTER	MQP	I	I
38	FW 738	OTHER ACCESSORIES OF GYPSUM BELT FILTER	P.S	III	III
39	FW 741	LINING FOR TANKS & SUMPS (FROM DOMESTIC SOURCE)	MQP	I	III
40	FW 741	LINING FOR TANKS & SUMPS (FROM FOREIGN SOURCE)	MQP	II	III
41	FW 751	PROCESS WATER PIPE ACCESSORIES	SQP	III	III
42	FW 752	COOLING WATER PIPE ACCESSORIES	SQP	III	III
43	FW 753	SLURRY PIPE ACCESSORIES	SQP	III	III
44	FW 753	RUBBER LINED PIPING OF SLURRY PIPES	MQP	I	III
45	FW 754	SERVICE AIR PIPE ACCESSORIES	SQP	III	III
46	FW 755	INSTRUMENT AIR PIPE ACCESSORIES	SQP	III	III
47	FW 784	HSFG BOLTS	P.S	III	III
48	FW 798	AIR RECEIVERS	SQP	III	III
49	FW 814	ROOFING SHEET	P.S	III	III
50	FW 815	RC PUMP INLET AND OUTLET VALVE	P.S	I	III
51	FW 816	MANUAL BUTTERFLY VALVE -UTILITY	P.S	III	III
52	FW 817	MOTOR BUTTERFLY VALVE- UTILITY	P.S	III	III
53	FW 818	PNEUMATIC BUTTERFLY VALVE- UTILITY	P.S	III	III
54	FW 819	MANUAL BUTTERFLY VALVE- LS SLURRY	P.S	III	III
55	FW 820	MOTOR BUTTERFLY VALVE- LS SLURRY	P.S	III	III
56	FW 821	PNEUMATIC BUTTERFLY VALVE- LS SLURRY	P.S	III	III
57	FW 822	MANUAL BUTTERFLY VALVE- GYPSUM SLURRY	P.S	III	III
58	FW 823	MOTOR BUTTERFLY VALVE- GYPSUM SLURRY	P.S	III	III
59	FW 824	PNEUMATIC BUTTERFLY VALVE- GYPSUM SLURRY	P.S	III	III
60	FW 825	MANUAL BUTTERFLY VALVE- AIR	P.S	III	III
61	FW 826	MOTOR BUTTERFLY VALVE- AIR	P.S	III	III
62	FW 827	PNEUMATIC BUTTERFLY VALVE- AIR	P.S	III	III
63	FW 828	MANUAL GATE VALVE- UTILITY	P.S	III	III

NTPC DRG NO: 0270-109-QVM-Q-018					
DOC.NO.:BAP:QA:MECH:PGMA CAT:G201			REV.01	Dtd. 07-11-2019	
SL NO	PGMA	ITEM DESCRIPTION	REF DOCUMENT	QP CATEGORY	VENDOR CATEGORY
64	FW 829	MOTOR GATE VALVE- UTILITY	P.S	III	III
65	FW 830	PNEUMATIC GATE VALVE- UTILITY	P.S	III	III
66	FW 834	MAIN GLOBE VALVE- UTILITY	P.S	III	III
67	FW 840	CERAMIC VALVES	P.S	III	III
68	FW 841	CONTROL VALVES	P.S	III	III
69	FW 842	MANUAL PINCH VALVES- GYPSUM SLURRY	P.S	III	III
70	FW 845	BALL VALVES- WATER	P.S	III	III
71	FW 848	CHECK VALVES- WATER	P.S	III	III
72	FW 851	DIAPHRAGM VALVES- SLURRY	P.S	III	III
73	FW 854	ROOT VALVE	P.S	III	III
74	FW 988	COMMISSIONING SPARES	DRG/T.S/D.S/ CATALOGUE	III	III
75	FW 996	TOOLS& TACKLES	DRG	III	III
PRODUCT : Gates & Dampers (Mechanical) - Manufacturing Items					
1	57-XXX	Guillotine Gate	Endorsement Sheet & RQP	I	III
2	57-XXX	Damper	Endorsement Sheet & RQP	I	III
3	57-XXX	Other Misc. Item of Guillotine Gates like Transition duct Assy, Mating flange & Air tank.	DRG/PS	III	III
4	57-XXX	Other Misc. Item of Biplane Damper	DRG/PS	III	III
5	57-XXX	Commissioning spares For Gates & Dampers	CQP/DRG/PS	III	III
PRODUCT : Gates & Dampers (Mechanical) - Bought Out Items					
1	57-XXX	Chain	DRG	III	III
2	57-XXX	Bearings	DRG / CATALOGUE	III	III
3	57-XXX	Sprocket	DRG	III	III
4	57-XXX	Adjusting Bolt	DRG	III	III
5	57-XXX	Manual Operators	DRG/PS	III	III
6	57-XXX	Nylon Bush	DRG	III	III
7	57-XXX	Shaft Collar	DRG	III	III
8	57-XXX	Graphite Filament Packing	DRG	III	III
9	57-XXX	Graph oil Bearing	DRG	III	III
10	57-XXX	Fasteners And Raw Matls. Etc.,	IS	III	III
11	57-XXX	Air Cylinder	PS/DRG	III	III
12	57-XXX	Filter Cum Lubricator	DRG/PS	III	III
13	57-XXX	Check Valve	DRG	III	III
14	57-XXX	Isolation Valve	DRG	III	III
15	57-XXX	Other Items Like Fasteners, Hose, Adaptors, Flexible Conduit, Crimping Lug, Electric Cable, Tube Clips, Raw Matls., Etc.,	IS/DRG/PS	III	III
16	57-XXX	Tee Union	DRG	III	III
17	57-XXX	Male Connector	DRG	III	III
18	57-XXX	Expansion Piece	DRG	III	III
19	57-XXX	Blower With Motor	DRG/PS	III	III
20	57-XXX	Solenoid Valve	DRG/PS	III	III

NTPC DRG NO: 0270-109-QVM-Q-018					
DOC.NO.:BAP:QA:MECH:PGMA CAT:G201			REV.01	Dtd. 07-11-2019	
SL NO	PGMA	ITEM DESCRIPTION	REF DOCUMENT	QP CATEGORY	VENDOR CATEGORY
21	57-XXX	Limit Switch & Lever	DRG/PS	III	III

NTPC DRG NO: 0270-109-QVM-Q-018					
DOC.NO.:BAP:QA:MECH:PGMA CAT:G201			REV.01	Dtd. 07-11-2019	
SL NO	PGMA	ITEM DESCRIPTION	REF DOCUMENT	QP CATEGORY	VENDOR CATEGORY

NOTES :-

- 1) All other minor items which are not indicated in the above list can be considered as Cat-III items
- 2) All items shall meet project Tech specification requirement.
- 3) This Catg. List to be read along with approved QP and the quantum of inspection shall be as per the approved QP.

QP Category :

Category - I Quality Plan Approval by NTPC, where physical inspection by **NTPC** is envisaged.

Category - II Quality Plan / Inspection Check List Approval by **NTPC**, but no physical inspection by **NTPC** is envisaged. Certification by Main supplier will be submitted as per NTPC format. (For items under Inspection category-II) If required surveillance may be carried out by NTPC.

Category - III Only Manufacturer's **Certificate of Compliance (COC)** shall be submitted for the issue of dispatch clearance by NTPC wherever applicable.

Vendor Category:

Category - I Acceptable to / Approved by NTPC

Category - III No Specific Vendor Approval by NTPC is required

RECORD OF REVISIONS		
00	Original Issue	Dtd 23/10/2019
01	Revised Issue NTPC comments: SI no: 24 under FGD BOI, All types of Slurry pumps BHEL reply: Noted & we wish to submit that since PGMA description is Slurry pumps, we have mentioned it as that. It covers all types of slurry pumps only. Slurry pumps will be released only in this PGMA. We reiterate that M/s NTPC need not have any doubts on that. NTPC comments: SI no: 25 under FGD BOI, Clear Water pumps BHEL reply: Incorporated in the document since water pumps medium is clear water only. NTPC comments: C-276 (Raw material & cladding) Cat-II inspection. BHEL reply: Noted and incorporated under SI nos: 06& 07 under FGD manufacturing items as those PGMA's only cover this requirement.	Dtd 07/11/2019

Prepared by	Rajamanickam M DM/QA	
Approved By	K C Gandhi Parimalam DGM/QA	



TITLE:

**4X250 MW NABINAGAR TPP
TECHNICAL SPECIFICATION FOR
FGD TANKS**

SPECIFICATION No: PE-TS-463-167-A101

SECTION-I, SUB-SECTION- D

REV. 00

DATE: MAY 2020

SHEET : 1 OF 1

ANNEXURE-II

QUALITY PLANS

QAP OF MS PLATES

Manufacturer's Name: Approved sub vendor			MANUFACTURING QUALITY PLAN				PROJECT: PACKAGE: Misc.Tanks (Site Fabricated) LOI No. : Customer : BHEL		BHEL Doc. No.: Rev. No. : 0 Date: SHEET 1 OF 1				
			ITEM: MS PLATES Sub-system- Misc.tanks										
Sl. No.	Components and Operation	Characteristic/ Item	Class	Type of Check	Extent of Check	Reference Document	Acceptance Norm	Format of Record (D*)		Agency			Remarks
1	2	3	4	5	6	7	8	9	D	M	B	C	12
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 dimensionl check	MA	Visual and measurement	100%	Mfg.TC	Mfg.TC IS1852	Mfgr. TC	√	P	**W	**W	
3		Identification/markings	MA	Corelation establish	100%	As per manufacturing practice	As per manufacturing practice IS 2062	Mfgr. TC	√	P	V	**W	
		LEGEND : * RECORDS IDENTIFIED WITH "TICK" SHALL BE INCLUDED C: BHEL B : VENDOR M.Manufacturer								DOC. NO. : Rev No.0			
Manufacturer / Contractor / Sub contractor Signature		CR-Critical Characteristics MA - Major Characteristics MI- Minor Characteristics				FOR BHEL		FOR CUSTOMER		APRD. BY			

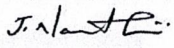
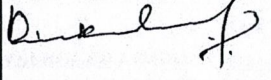
Notes ** In case material is despatched directly from Approved sub-vendor plant/stockyard or procured from dealer against co related TC's witnessing by BHEL is waived off and material will be accepted based on MTC of approved sub vendor. In case material is procured from dealer and co related TC's are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

- Above quality plan is tentative. Final QAP shall be decided during detailed engineering.

QAP OF PIPE FITTINGS ,FLANGES & ACCESSORIES

Manufacturer's Name:		QUALITY ASSURANCE PLAN		PROJECT: PACKAGE: Misc.Tanks (Site Fabricated) LOI No. : Customer : BHEL		BHEL Doc. No.: Rev. No. : 0 Date: SHEET 1 OF 1			
		INSPECTION CHECK LIST FOR PIPE FITTINGS ,FLANGES & ACCESSORIES							
Sl. No.	Components and Operation	Class	Type of Check	Reference Document/Acceptance Norm	Agency			Remarks	
					M	B	C		
1	2	3	4	5	6			7	
1	Pipes Fittings,Flanges & Accessories	MI	Visual	As per Approved Data Sheet/Tech spec.	P	V	V		
2		MI	Dimensional	As per Approved Data Sheet/Tech spec.	P	V	V		
3		MI	Review of TC	As per MTC	P	V	V		
		MA	Hydro Test	As per MTC	P	V	V		
		LEGEND : * RECORDS IDENTIFIED WITH "TICK" SHALL BE INCLUDED C : CUSTOMER /BHEL B. : VENDOR M. : Manufacturer					DOC. NO. :		
Manufacturer / Contractor / Sub contractor Signature		CR-Critical Characteristics MA - Major Characteristics MI- Minor Characteristics IR-Inspection Report ,MTC- Material/Manufacturer's Test. Certificate				FOR BHEL FOR CUSTOMER		APRD. BY	APPROVAL SEAL

- Above quality plan is tentative. Final QAP shall be decided during detailed engineering.

		CONTRACTOR'S NAME & ADDRESS /		MANUFACTURING QUALITY PLAN				PROJECT							
				ITEM : RUBBER LINING OF PIPING CONFORMING TO Tech Spec. 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	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK M	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	D*	AGENCY M C 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	Verification	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:						6130-109-Rvm-R-012 Rev 01							
		* RECORDS, IDENTIFIED 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'						DOC.NO. CAT...							
PREPARED BY		APPROVED BY		FOR NTPC USE:						REVIEWED BY		APPROVED BY		APPROVAL SEAL	
SIGNATURE		PAGE 01 OF 02													

		CONTRACTOR'S NAME & ADDRESS 1/		MANUFACTURING QUALITY PLAN				PROJECT :					
				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	CHARACTERISTICS	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

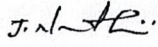
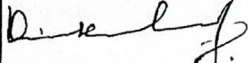
b. M/s Jasmino Polymertech Pvt Ltd ; Works Address : L-61, MIDC Industrial Area, Taloja, Dist-Raigad, Maharashtra -410208

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, IDENTIFIED 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. 6130-09-BVM-8-012 CAT...			
			Rev 01.			
PREPARED BY	APPROVED BY		FOR NTPC USE:	REVIEWED BY	APPROVED BY	APPROVAL SEAL
MAIN-SUPPLIER						
SIGNATURE	PAGE 02 OF 02					

-Above quality plan is tentative. Final QAP shall be decided during detailed engineering.

SYSTEM EQUIPMENT		STANDARD FIELD QUALITY PLAN					QP NO.: 0000-999-QOM - I-001		REVIEWED BY:		APPROVED BY:	
Misc. Tanks		CONFORMING TO CODE: IS:803-1976					Rev. No	0	Date	15-02-2005		
							Page 1 Of 1					
							VALID UPTO: 14-02-2008					
SL. NO	ACTIVITY AND OPERATION	CHARACTERISTICS / INSTRUMENTS	CLASS # OF CHECK	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		10.		
1.	2.	3.	4.	5.	6.	7.	8.	9.	D			
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/ BHFL/ 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, IDENTIFIED 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)

FORMAT NO.: QS-01-QAI-P-10/F4-R1

1/1

ENGG. DIV./QA&I

Page 201 of 335



**4 X 250 MW NABINAGAR TPP
TECHNICAL SPECIFICATION FOR
FGD TANKS**

SPECIFICATION No: PE-TS-463-167-A101

SECTION-I Sub Section-D

REV. 00

DATE: MAY 2020

SHEET : 1 OF 1

ANNEXURE-III

**SIZING CALCULATION, SELECTION PARAMETER FOR ALL
TANKS (SLURRY & WATER) AND TYPICAL DRAIN SUMPS
SKECTH**

01	31.03.2020	Rev_01	KMK	MKT	NPR
00	14.12.2019	Fresh Issue	KMK	MKT	NPR
Rev	Date	Description/Note	PRD	CHD	APD
REVISIONS					
FLUE GAS DESULPHURIZATION (FGD) SYSTEM					
TITLE: SIZING CALCULATION & SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)					
	OWNER : BHARTIYA RAIL BIJLEE COMPANY LTD CONSULTANT: NTPC PROJECT : NABINAGAR (4X250MW) FGD SYSTEM PACKAGE				
	EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD. BOILER AUXILIARIES PLANT, RANIPET				
	COLLABORATOR: MITSUBISHI HITACHI POWER SYSTEMS LTD AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION				
	NAME	MHPS	Rev	01	
PREPARED BY	Kabilash	Y.Tanaka	STATUS : FOR APPROVAL		
CHECKED BY	Manoj K T		CUSTOMER NO. G201, G202, G203, G204		
APPROVED BY	Naveen R		BHEL DOCUMENT NO. 4-FW-000-00877		
NTPC DRG./DOC NO. 0270-109-PVM-U-009					



SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.

4-FW-000-00877

Customer Document No.

0270-109-PVM-U-009

1. Gas condition for Tank Sizing:

S.No.	Gas Condition	Feature
1	VWO	Maximum Absorbed SO ₂ Condition Maximum Inlet Gas flow condition

2. Tank Sizing Basis

Tank size is decided as per the following

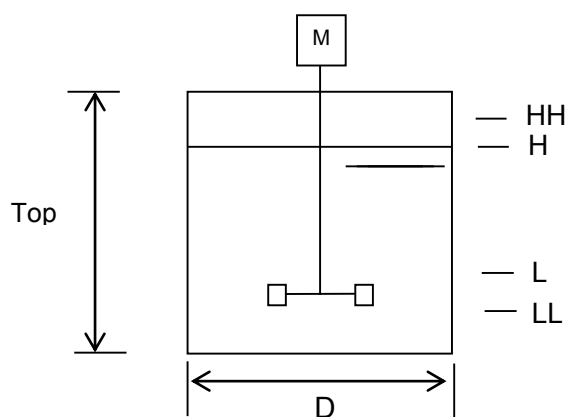
LL – Pump LL level m

L – LL + 0.2 m

H – Effective height m

HH – H + 0.2 m

Top – HH + 0.5 m



$$\text{Effective volume} = 3.14 / 4 \times \Phi^2 \times (H-L)$$

$$\text{Hold volume} = 3.14 / 4 \times \Phi^2 \times (HH)$$

$$\text{H/D ratio} = 1-1.2$$



SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.

4-FW-000-00877

Customer Document No.

0270-109-PVM-U-009

S.No	Item No	Service	Design Spec	Process Parameter	Design Basis
1	00- HTM- 03-BB- 001	Filtrate water Tank	4500 mm D X 5000 mm H Quantity = 1 no (Common for four units)	Process Capacity	94.64 m³/h (Refer Mass Flow Balance (Design Point) data stream no. <402> x 4 units).
				Retention Time	0.5 hr. (As per MHPS Practice and in line with all current ongoing NTPC Projects) ①
				Required volume	94.64 m³/h x 0.5 hr = 47.32 m³



SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.

4-FW-000-00877

Customer Document No.

0270-109-PVM-U-009

S.No	Item No	Service	Design Spec	Process Parameter	Design Basis
2.	00- HTM- 04-BB- 001	Secondary waste water Hydro Cyclone feed Tank	5000 mm D X 5200mm H Quantity = 1 no. (Common for four units)	Process Capacity for each tank	61.48 m ³ /h (Refer Mass Flow Balance Design Point data stream no. <202> x 4 units.)
				Retention Time	1hr (As per NTPC Contract specification Part B Clause: 7.07.02) ①
				Required volume	61.48 m ³ /h x 1hr = 61.48 m ³
				<	



SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.

4-FW-000-00877

Customer Document No.

0270-109-PVM-U-009

S.No	Item No	Service	Design Spec	Process Parameter	Design Basis
3	00-HTM-00-BB-001	Primary Hydro Cyclone feed Tank	5500 mm D X 6400 mm H Quantity = 1 no. (Common for four units)	Process Capacity for each tank	106.4m³/h (Refer Mass Flow Balance Design Point data stream no. <201> x 4 units.)
				Retention Time	1hr (As per NTPC Contract specification Part A Clause: 5.05.00) ①
				Required volume	106.4 m³/h x 1hr = 106.4 m³
				<	



SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.

4-FW-000-00877

Customer Document No.

0270-109-PVM-U-009

S.No	Item No	Service	Design Spec	Process Parameter	Design Basis
4	00- HTM- 05-BB- 001	Waste water tank	6500 mmD X 7000 mmH Quantity = 1 no (Common for four units)	Process Capacity	19.64 m ³ /h (Refer Mass Flow Balance (Design Point) data stream no. <205> x 4 units).
				Retention Time	8 hr (As per NTPC Contract specification Part B Clause: 7.07.06) ①
				Required volume	19.64 m ³ /h x 8 hr = 157.12 m ³
	<				



SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.

4-FW-000-00877

Customer Document No.

0270-109-PVM-U-009

S.No	Item No	Service	Design Spec	Process Parameter	Design Basis
5	00-HTK-03-BB-001/002	Lime stone slurry storage Tank A/B	11500 mmDX 11700 mm H Quantit y = 2 no.	Process Capacity for each tank	a) Limestone required = 4.63 TPH per unit from (Refer Mass Flow Balance (Design Point) data stream no <501>) b) 20% (w/w) Limestone slurry = 4.63 TPH / 20% mass flow rate = 23.15 TPH per unit c) 20%(w/w) Limestone slurry density = 1.130 t/m ³ d)20% (w/w) Limestone slurry = 23.15 TPH / 1.130volume flow rate = 20.48 m ³ /hr per unit For four (4) units=20.48 m ³ /hrX4 =81.92 m ³ /h
				Retention Time	12.0 hr (As per NTPC Contract specification Part B Clause: 6.06.00) ①

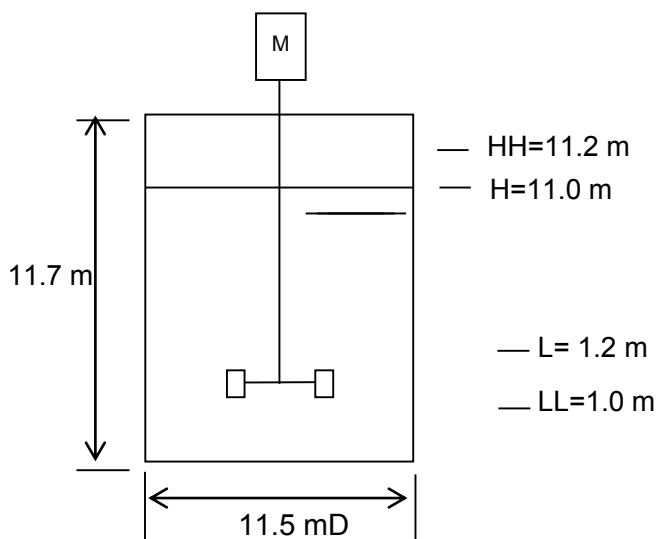


SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.	4-FW-000-00877
Customer Document No.	0270-109-PVM-U-009

Required
volume

$81.92 \text{ m}^3/\text{h} \times 12 \text{ hr} = 983.04 \text{ m}^3$



Tank Level is designated as follows

Top	11.7
HH	11.2
H	11.0
L	1.2
LL	1.0

Effective volume

$$= 3.14 / 4 \times 11.5^2 \times (11.0 - 1.2) \text{ m}$$

$$= 1017.40 \text{ m}^3 > 983.04 \text{ m}^3$$

Hold Volume

$$= 3.14 / 4 \times 11.5^2 \times (11.2) \text{ m}$$

$$= 1162 \text{ m}^3$$



SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.	4-FW-000-00877
Customer Document No.	0270-109-PVM-U-009

S.No	Item No	Service	Design Spec	Process Parameter	Design Basis						
6	00- HTT- 00-BB- 001	Auxiliary Absorbent Tank	9500 mmD X10300 mmH Quantity = 1 no (Common for four units)	Process Capacity	Absorber Tank Volume including the spray pipe drain = 659 m³. 13.9m(W) X 7.9m (L) X 6.0m(H) = 659 m3(1m extra height taken for spray pipe drain) ①						
				Retention Time	Batch Operation						
				Required volume	659 m³						
				10.3 m HH=9.8 m H=9.6 m 9.5 mD <table><tr><td>Top</td><td>10.3</td></tr><tr><td>HH</td><td>9.8</td></tr><tr><td>H</td><td>9.6</td></tr><tr><td>L</td><td>1.2</td></tr><tr><td>LL</td><td>1.0</td></tr></table> Effective volume = 3.14 / 4 x 9.5 ^ 2 x (9.6-0.0) = 680.12m³>659 m³ Hold Volume = 3.14 / 4 x 9.5 ^ 2 x (9.8) = 694.3 m³		Top	10.3	HH	9.8	H	9.6
Top	10.3										
HH	9.8										
H	9.6										
L	1.2										
LL	1.0										



SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.

4-FW-000-00877

Customer Document No.

0270-109-PVM-U-009

S. No	Item No	Service	Design Spec	Process Parameter	Design Basis
7	10/20/30/40-HTT-00-BB-001	Absorber Area Drain Sump	4000 mmW X4000 mm LX 4000 mm D Quantity = 4 nos. for four Units	Process Capacity for each Sump	25 m ³ (As per MHPS Standard practice and in line with all current ongoing FGD Projects) ①
				Retention Time	Batch Operation
				Required volume	25 m ³



SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.

4-FW-000-00877

Customer Document No.

0270-109-PVM-U-009

S.No	Item No	Service	Design Spec	Process Parameter	Design Basis
9	00-HTT-02-BB-001	Lime Stone Area Drain Sump	4000mm W X 4000mmL X 4000mmH Quantity = 1 no.(Common for four units)	Process Capacity	25 m ³ (As per MHPS Standard practice and in line with all current ongoing FGD Projects) ①
				Retention Time	Batch Operation
				Required volume	25 m ³



SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.

4-FW-000-00877

Customer Document No.

0270-109-PVM-U-009

S.No	Item No	Service	Design Spec	Process Parameter	Design Basis
1	00-HTQ-00-BB-001/002	Process Water Tank A/B	5000 mmD X 5700 mmH Quantity = 2 nos. (common for all four Units)	Process Capacity	274.56m³/h (Refer Mass Flow Balance (Design Point) data stream no. (<801> + <802> + <803> + <804> + <805>/2 + <806>) x 4 units).
				Retention Time	0.25 hr (As per NTPC Contract specification Part B Clause: 13.01.00) ①
				Required volume	274.56m³/h x 0.25 hr = 68.64 m³
				<	



SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.

4-FW-000-00877

Customer Document No.

0270-109-PVM-U-009

S. No	Item No	Service	Design Spec	Process Parameter	Design Basis
2	00-HTQ-01-BB-001/002	Cake wash (Clarified water) Tank	3000mmDX 3500 mmH Quantity = 2 nos. (Common for all four Units)	Process Capacity for each tank	11.2 m ³ /h (Refer Mass Flow Balance Design Point data stream no.(805 /2) x 4 units
				Retention Time	1hr (As per NTPC Contract specification Part B Clause: 7.04.07) 1
				Required volume	11.2 m ³ /h x 1hr =11.2 m ³
				<	



SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.

4-FW-000-00877

Customer Document No.

0270-109-PVM-U-009

S.No	Item No	Service	Design Spec	Process Parameter	Design Basis
3	00- HTM- 01- BB- 001/0 02	Belt Filter Wash Tank	3000 mm D X 3500 mm H Quantity = 2 nos. (Common for all four Units)	Process Capacity for each tank	11.2 m³/h (Refer Mass Flow Balance Design Point data stream no.(<805>/2) x 4 units.
				Retention Time	1hr (In line with clarified water tank and followed the same for all current ongoing projects) ①
				Required volume	11.20 m³/h x 1hr = 11.20 m³
				<	

Reference Documents

- Mass Flow Balance data – 0270-109-PVM-W-002



TITLE:

**4 X250 MW NABINAGAR TPP
TECHNICAL SPECIFICATION FOR
MISC. FGD TANKS**

SPECIFICATION No: PE-TS-463-167-A101

SECTION-I, SUB-SECTION- D

REV. 00

DATE: MAY 2020

SHEET : 1 OF 1

ANNEXURE-IV

MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION



TITLE:	4x250 MW NABINAGAR TPP TECHNICAL SPECIFICATION FOR FGD TANKS	SPEC. NO.: PE-TS-463-167-A101
		SECTION-I, SUB-SECTION- D, ANNEXURE-IV
		REV. NO.: 00 DATE MAY 2020

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-V0-434-167-A001	FABRICATION DRAWING OF MISC. FGD TANK	5 weeks	Within 1 week
2	PE-V0-434-167-A002	DESIGN CALCULATION OF MISC. FGD TANKS INCLUDING ROOF STRUCTURE WITH STAAD CALCULATION	3 weeks	Within 1 week
3	PE-V0-434-167-A003	GA DRAWING OF MISC. FGD TANKS	4 weeks	Within 1 week
4	PE-V0-434-167-A004	DATASHEET & GA DRAWING OF RUBBER LINING/GLASS FLAKE LINING FOR MISC. FGD TANKS	6 weeks	Within 1 week
6	PE-V0-434-167-A006	QAP OF RUBBER LINING/GLASS FLAKE LINING FOR MISC. FGD TANKS	6 weeks	Within 1 week
7	PE-V0-434-167-A007	QAP OF COMPONENTS FOR MISC. FGD TANKS	6 weeks	Within 1 week
8	PE-V0-434-167-A008	SUB VENDOR LIST WITH INSPECTION CATEGORY FOR MISC. FGD TANKS	3 weeks	Within 1 week
9	PE-V0-434-167-A009	SURFACE PREPARATION AND LINING PROCEDURES FOR MISC. FGD TANKS	7 weeks	Within 1 week
10	PE-V0-434-167-A010	O&M MANUAL FOR RUBBER/GLASS FLAKE LINING	8 weeks	Within 1 week
11	PE-V0-434-167-A011	O&M MANUAL FOR MISC. FGD TANKS	8 weeks	Within 1 week



TITLE:

**4x250 MW NABINAGAR TPP
TECHNICAL SPECIFICATION FOR
FGD TANKS**

SPEC. NO.: PE-TS-463-167-A101

SECTION-I, SUB-SECTION- D, ANNEXURE-IV

REV. NO.: 00

DATE MAY 2020

NOTE:

1. Drwg/ Document shall be uploaded by the successful bidder on WRENCH /DMS.Procedure for the same will be informed after award of contract.
2. Any other dwrgs/docs indicated else where in the specification shall be submitted by vendor for approval of BHEL/customer.

COMPANY SEAL

SIGNATURE: _____

NAME : _____

DESIGNATION: _____

COMPANY: _____

DATE: _____



TITLE:

**4 x 250MW NABINAGAR TPP
TECHNICAL SPECIFICATION FOR
MISC. FGD TANKS**

SPECIFICATION No: PE-TS-463-167-A101

SECTION-I, SUB-SECTION- D

REV. 00

DATE: MAY 2020

SHEET : 1 OF 1

ANNEXURE-V

SEA-WORTHY PACKING PROCEDURE



Mechanical Auxiliaries Department,
PEM, PPEI Building,
NOIDA

Ref No.: PEA00-Misc/PKD

Date: 12/08/10

Sub: Technical specification for Seaworthy Packing for Export Jobs

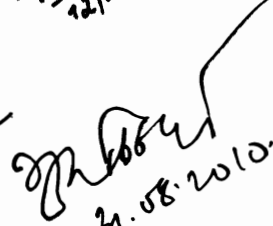
A taskforce was constituted vide order dated 21/06/2010 for finalization of seaworthy packing specification for export jobs with the following members.

Mr. SK Anand,
Mr. Ashwani Khanna
Mr. Rajnish Goyal
Mr. PK Das

After several rounds of discussions among task force members it was decided to have latest practices being followed in other industries for export packing. Same was arranged from few industries.

A detailed specification for seaworthy packing for export jobs has been prepared taking care of latest practices being followed and requirements in our existing specification for wooden box/crates. Same is enclosed for reference and final issue.


(PK DAS)
Convener (Task Force)

GM/MAX 
ED/PEM 
31.08.2010

VOLUME IIB

**TECHNICAL SPECIFICATION
FOR
SEAWORTHY PACKING FOR EXPORT JOBS**

SPECIFICATION NO. PE-TS-888-100-A001



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NEW DELHI, INDIA**

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
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1.0 Purpose

The purpose of this specification is to describe minimum packing requirements for the different items/equipment for all export Project and also to define marking and shipping requirements during transportation by ship, road and air for all export jobs.

2.0 SCOPE

For export jobs, sea worthy packing capable of performing all necessary functions like prevention of damage to the contents, sufficient to support frequent handling and lengthy period of outdoor storage in adverse weather conditions are required. Workmanship and materials used shall be of high standard meeting the technical requirements and in accordance with best commercial export packing practices. Vendor shall be responsible for sea worthy export packing, however it shall meet the minimum requirements specified herein. Equivalent or better packing methods may be deployed subject to approval of the BHEL/Purchaser. Vendor shall submit the packing procedure for its equivalent for purchaser's approval during detailed engineering.

The scope this specification is to define VENDOR's responsibilities in terms of:

- Preservation of the GOODS/items/equipments before packing.
- Packing of the GOODS for road, rail, sea and/or air transportation to desired destination i.e. project site
- Making cases/crates
- Chemical Treatment/Fumigation before packing to prevent fungus, damage due to termite, borer, rats, etc.
- Marking of cases/crates.
- Other Services required.

3.0 Application

This specification is applicable to all the goods to be transported to project site and requires to be in transit for longer duration. *However, for "Misc cable erection items", "Fire sealing system" & "Exothermic welding material", the packing requirements shall be as per the procurement specification.*

4.0 Definitions

- "BHEL" : Main EPC vendor
- "OWNER" : Customer for a particular export project.
- "VENDOR" : Company(ies)/VENDOR(s) to whom the BHEL has placed Purchase Order for GOODS/ items/system/package.
- "GOODS": means all or part of the articles, material, equipment supplies including technical documentation, as described in the Purchase Order, to be supplied by VENDOR.
- "PACKER": Packaging Company to whom VENDOR intends to sub-contract the packing in case they do not have own packing capability/facilities .
- "FREIGHT FORWARDER" : Means the Company responsible for performing freight forwarding activities.

5. General Information

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The following requirements are intended as minimum requirements, and compliance to these requirements in no way absolves or relieves **VENDOR** of any responsibility or obligation outlined in the Purchase Order. In all circumstances, the packing will be designed and constructed in order to support **GOODS** during transportation as well as to prevent the Goods from damage due to impact, extreme climatic conditions, sun and rain. It must be ensured that the delivery of the **GOODS** to the jobsite by sea, road or air, in good condition.

GOODS shall be export packed in compliance with the best-established practices for international projects, in accordance with the following instructions. In the event of any conflict between these specified requirement and the established practices, specification requirement shall govern.

Due to climatic conditions and the complex transport operation(s), it is essential that protection and packing is of the highest standard. Packing means to efficiently protect the **GOODS** during the total transport operation; from the moment they leave the factory until they are delivered to the jobsite, including handling operations (loading/unloading) and storage.

When **VENDOR** do not have packing capabilities/facilities of their own and therefore intends to sub-contract, **VENDOR** have to inform **BHEL/Purchaser** of the name and address of proposed **PACKER(s)** for approval.

6.0 Criteria for Selection of Packaging

Packages are to be made according to categories, described in articles 8.1 to 8.5, depending on the type of materials, their fragility and size.

These categories have been established for the protection of equipment and material during multi-mode transports, i.e.: combination of overland and sea transport; containerization, air transportation.

In a general manner, the **GOODS** have to be packed in such a way that crates, bundles, pallets can be stored into General Purpose containers, wherever possible.

If **VENDOR** has any doubt about the correct method of protection or packing, he should contact **BHEL/Purchaser** in order to mutually agree on the adequate type of packing to be used.

Materials can be classified in following categories

- Hazardous Material
- Non-Hazardous Material
-

Further to above categorisation, non-hazardous materials can be sub- categorised for selection of packing.

6.1 Hazardous Materials

Though handling of hazardous material may is not applicable in the scope of this specification. All hazardous material must be packed in adherence to the detailed requirement relating to packing, marking and labelling set out in the most recent report of the Board's Standard Advisory Committee on the Carriage of Dangerous Goods in Ships for sea freight, and the Restricted Articles Regulations, laid down by the International Air Transport Association for airfreight.

6.2 Non-Hazardous GOODS

The scope of this specification is to provide necessary guidelines for packing for power plant equipment, components, Pipings & Valves, Fittings, other structural items, electrical items, spare parts and erection materials. The procedure is defined in subsequent paragraphs in details in clause no. 8.0.

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7.0 Marking Instructions & Despatch details, Storage Code

7.1 Marking Instructions & despatch details

Packages and crates will be marked with indelible black paint, resistant to seawater. Marking must be perfectly legible.

The shipping marks, which will be as per fig-13, shall be stencilled on two sides and one end in clear characters at least 5 centimetres high (where crate size permits, otherwise use optimum size for each package dimension).

When the GOODS are to be shipped in containers then marking may be stencilled on one end only. However, packages must be stowed in a manner that shows these marks.

Crates containing fragile articles must be packed with special precaution against risk of breakage and must be stencilled on all sides "FRAGILE - HANDLE WITH CARE". Where crates are not to be overturned, VENDOR must show on the crates, clear and readily visible identification as per fig-12, to ensure they are kept in the correct position.

Packages/equipment of 2,000 kg or more must be marked with slinging points on all sides, in addition to the centre of gravity marks.

Number packages consecutively i.e. 1 of 10, 2 of 10, etc. Do not duplicate package numbers. VENDOR is responsible for any loss or damage caused by incorrect marking.

All cases/crates shall also be marked with the appropriate international standard graphic symbols for handling as shown in Fig 12.

As a minimum, all cases/crates are to be marked clearly on all four sides with:

- "HANDLE WITH CARE"
- "RIGHT SIDE UP"
- "KEEP DRY"

In the case of packages with a single gross weight totalling 2,000 kg and/or a height of more than 1m, the centre of gravity shall be clearly marked with the symbol on two adjoining sides. For all items of equipment with an eccentric centre of gravity this symbol shall be marked at the bottom, side and top of the package.

The slinging and lashing points shall be marked with a chain symbol.

When packing in cases/crates, these packages shall also have metal corners at the slinging points. (Fig-11)

External front and rear sides of the boxes to be planed for writing instructions.

Dispatch details such as consigner/consignee address, contract and case details, country of origin, port of delivery, stacking instructions shall be written on one side of the boxes. An anodized aluminum plate as per details and specifications given in fig-13 shall be provided on one side of the boxes.

One copy of packing slip wrapped in polyethylene bag covered with aluminum packing slip holder to be nailed on the external surface of the box. One more copy of the packing slip wrapped in polyethylene bag is to be kept inside the box at the pertinent place.

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7.2 Storage Code

The type of storage required is required to be specified, it will be shown on each packaging in **RED colour**.

- X Crates or packages to be stored outdoor without covers
- XX Crates or packages to be stored under tarpaulin
- XXX Crates or packages to be stored in covered or enclosed premises
- XXXX Crates or packages which must be stored in air-conditioned premises

8.0 GUIDELINES FOR PACKING GOODS

8.1 In the subsequent paragraphs details of different types of packings for different types of GOODS are defined. Vendor shall make packing details/procedure based on the guidelines and submit for approval.

8.1.1 Packing for Pipe, Fittings, Flanges and Valves, Structural Steel

Particular attention should be brought to pipe, fittings, flanges, valves and structural steel. Packing categories for piping and fittings will differ according to the diameter and wall thickness of these products. VENDOR shall comply with the following established practice.

IMPORTANT NOTE:

Depending on the project schedule and availability of ocean vessels, the piping and structural steel may be shipped in containers. In this event, VENDOR has to arrange the packages in such a way it allows the stuffing into Open Top in gauge containers.

8.1.2 Pipe

Where practicable, pipe lengths shall be limited to 11.8 meters.

All pipes 2" included and below shall be packed in crates. All pipes to be capped and ends sealed with waterproof tape.

Pipes over 2" up to 6", shall be bundled and banded in bundles of uniform length. Bundling is carried out with U-IRON or traversal planks, joined with threaded connecting rods with locknuts. Quantities and strapping positions depend on the lengths, with a 120 cm spacing to prevent distortion. Bundle weight shall not exceed 2,000 kg. All pipes are to be capped and ends sealed with waterproof tape (tape is not necessary if end caps are of the pre-shrunk or self-sealing type).

Pipes larger than 6" shall be shipped as single lengths with the ends capped. End caps are to be of the recessed type to enable the use of soft faced hooks, but still completely sealing the end and also protecting the weld.

All stainless steel piping must be packed separately in wooden crates. Any banding of bundles is to be with the same material.

8.1.3 Pipe Fittings, Flanges and Valves

All pipe fittings, flanges and valves up to 6", are to be packed in cases/crates. For items over 6", these may be fixed securely to a pallet base and enclosed in a crate, for protection. Where valves have actuators attached, rigidity must be ensured for the valve and actuator. The vulnerable parts of the actuator are to be completely protected within a wooden crate.

All stainless steel fittings, flanges and valves of all sizes, must be packed separately in wooden crates. Any strapping is to be with the same material.

8.1.4 Structural Steel

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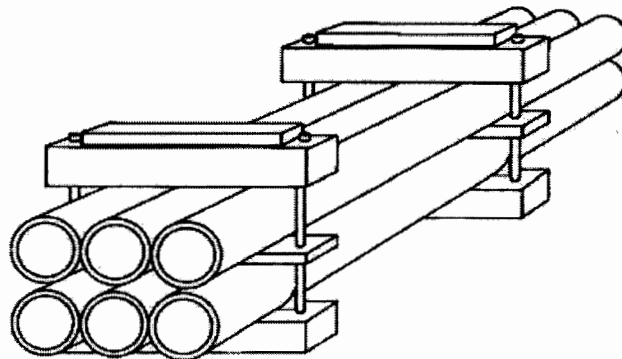
Structural Steel, reinforcing rods, bars, etc., should be packed in bundles of uniform length. Refer to articles 8.1.2, for strapping requirements. Bundle weight not normally to exceed 2,000 kg. Fabricated structures and structural steelwork, etc, should be bundled and packed using wooden beams and long bolting to secure the load.

8.2 Bundling – Packing Category I

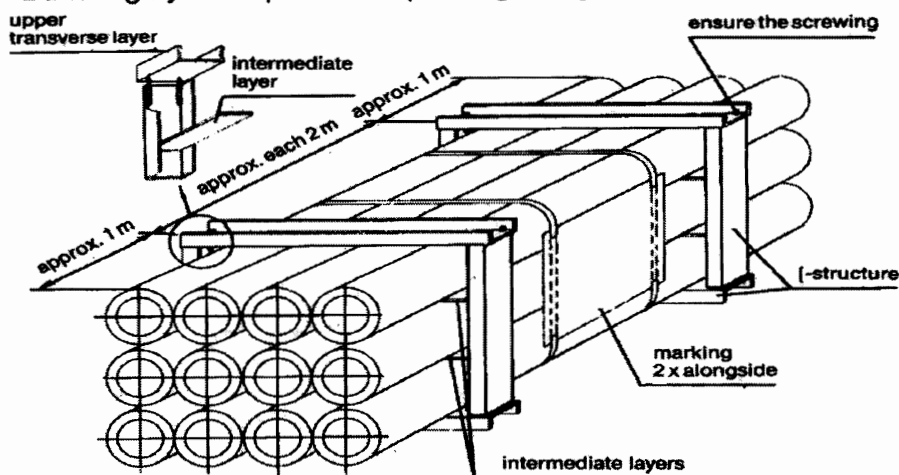
8.2.1 Type of Equipment

Equipment which is not subject to damage by corrosion or mechanical effect, i.e. pipes, piping, structural steel.

Packing category I



Bundling by U-shaped iron – packing category I A



8.2.2 Type of Construction

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- Bundling has to be effected
- By squared timber and threaded rods.
- With an intermediate layer (threaded on tightening bolts) according to the weight of the package.
- Wedge-shaped timbers must be added at the outer points of lower layer.
- Between the bolts a spacer must be nailed.
- The bolts must be secured (e.g. by locking nut).
- If single parts could protrude, an appropriate protection must be installed (flat iron or plates).
- Bundling with steel straps or PVC straps is not accepted.

8.3 Skids, Square Timber Constructions, Casings – Packing (Category II)

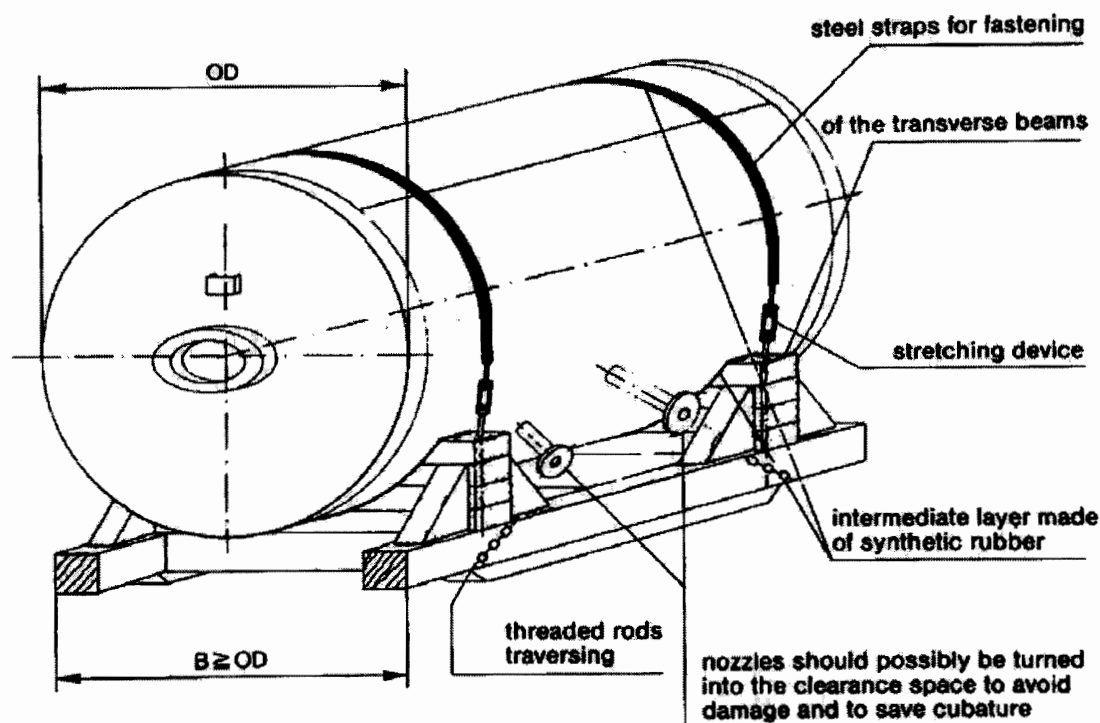
8.3.1 Type of Equipment

Voluminous apparatus, tanks and/or heavy pieces those are not vulnerable to mechanical or corrosive effects.

8.3.2 Type of Construction

- The construction skid can be made of wood or of metal.
- The fastening of the packages on the skid will be made by steel straps (flat iron) which have to be elastically lined, non-slip and securely bolted onto the skids.
- Flange openings have to be closed with gaskets and blind flanges or, if necessary, provided with cover.
- Skid constructions may not be less than the dimensions of the package in length or in width.
- Tanks and apparatus with their own support cradles must be supplied with an anti-slip lining.

PACKING CATEGORY-II



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8.4 Packing of GOODS in Wooden Crates/Cases/Boxes

The construction of wooden crate/cases/boxes shall be as per the details indicated in clause 9.0 & Fig 1 to 11. Details indicated in the sketches for different categories Packing crates/boxes are only for a typical equipment considered for illustration.

8.4.1 Packing Category III

8.4.1.1 Type of Equipment

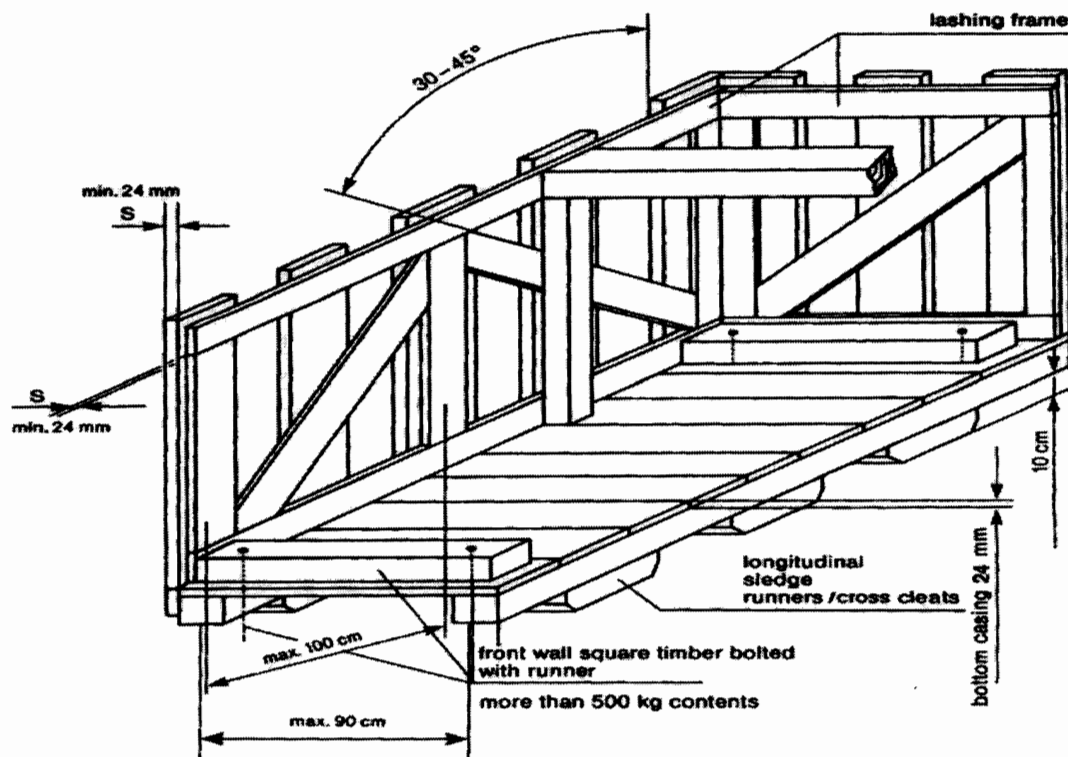
Fabricated equipment, which cannot be transported on cradles; frame-works, prefabricated piping and fittings, mechanical and electrical assemblies. *This type of packing is recommended where many parts of the equipment/component/assembly are not protruding out.*

8.4.1.2 Type of Construction

The equipment must be safely fastened to the bottom with bolts, possibly by the runners or to be spread in such a manner that no protruding parts are possible. For parts, sensitive to rainwater and/or debris, a protection has to be made by a foil cap.

If it is possible that single part could protrude through the front/back side wall, they shall be closed completely. The marking of the package shall be done on plywood plates at the prescribed sides.

Packing Category III



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8.4.2 Cases with Lining – Packing Category IV

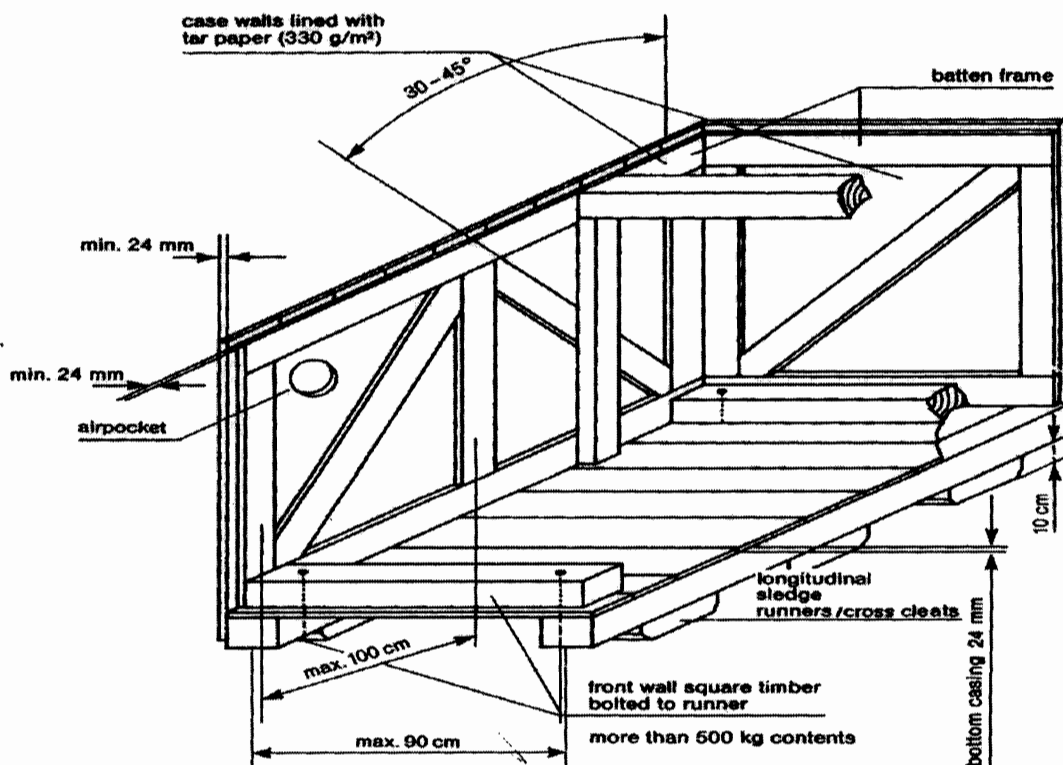
8.4.2.1 Type of Equipment

Recommended for equipment and mechanical parts Equipment sensitive to mechanical damage or parts and components that are particularly at risk of theft or loss; pumps, elbows, flanges, fittings, tools, erection materials, etc.

8.4.2.2 Type of Construction

The same type of construction as article 8.4.1.2, but with all sides completely boarded without space between the boards. Sides to be provided with waterproof lining; fabric-reinforced waterproof tar paper or polyethylene-foils resistant to ultraviolet rays can be used. Polyethylene-foil shall be fixed under the lid cover to avoid penetration of water. At weights of more than 500 kg the longitudinal runner must be bolted to the front all square timber. For ventilation inside the case, an opening in the waterproof lining must be placed between the diagonal battens and diagonal joists.

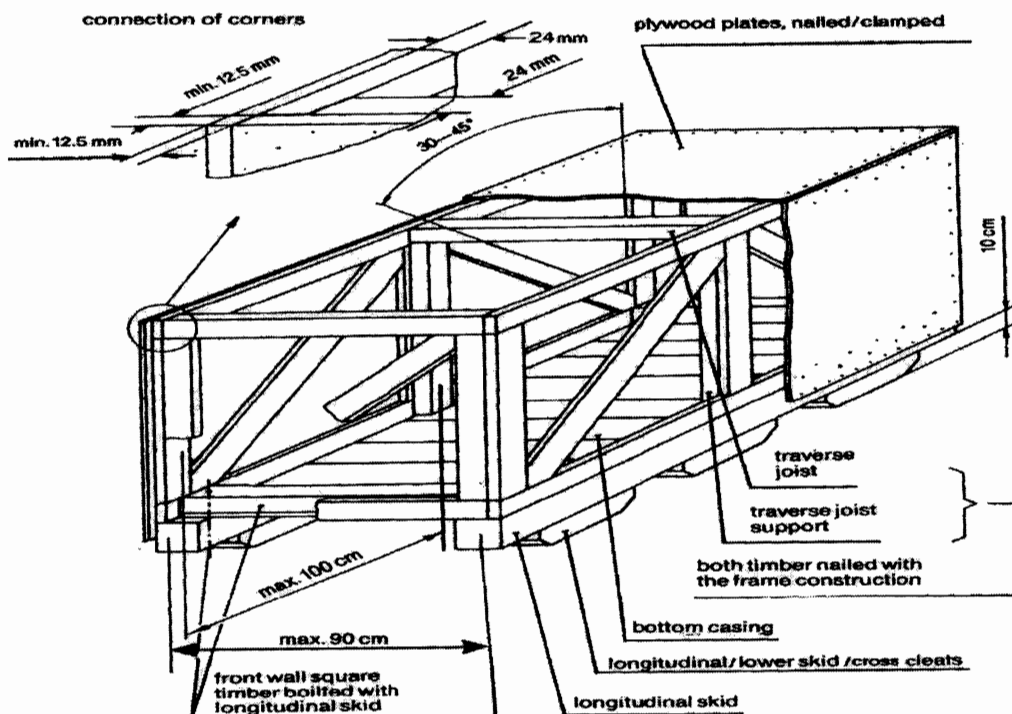
Packing Category IV



8.4.3 Cases with Alternative Surface Materials

8.4.3.1 Plywood Box – Packing Category IV A

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Case constructed of 5 layers of watertight, glued plywood with a total thickness of 12.5 mm. The frame must be constructed from minimum 24 mm timber or as per guide lines given above against clause 8.0, Fig 1 to 11 and must be suitable for the weight and nature of the parts to be packed. Planed square timber must be bolted with longitudinal skid and covered with diagonal joists. If applicable, construction of the cover and sides is to include diagonal bracing. Covers consisting of several layers of plywood are to be sealed with durable elastic putty or additional water-resistant sheets to be fixed.

8.4.4 Case with Barrier Material – Polyethylene Foil – Packing Category V

8.4.4.1 Type of Equipment

Sensitive equipment, simple electrical equipment, insulation materials, fire-resistant materials, with non-corrosion- guarantee for a period up to twelve (12) months.

8.4.4.2 Type of Construction

Preservation by welding in polyethylene-foil with addition of desiccants and if necessary, application of non-corrosive contact agents, otherwise, type of construction as indicated in article 8.4.2.2.

Additional marking:

- Case with desiccants.

8.4.5 Case with Barrier Material – Aluminium Compound Foil – Packing Category VI

8.4.5.1 Type of Equipment

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Electrical equipment such as, switchboards, electric motors, sensitive equipment, with non-corrosion guarantee, for a period up to twelve (12) months.

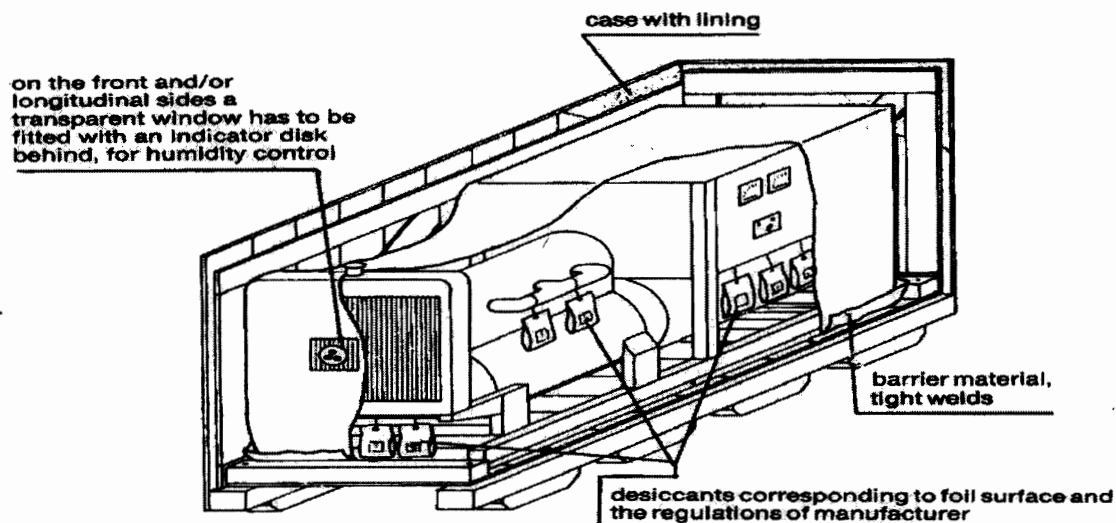
8.4.5.2 Type of Construction

Type of construction as indicated in article 8.4.2.2. Preservation by sealing an aluminium compound foil, with the addition of desiccants. Humidity indicators, if required and installed in the barrier wrapping, shall allow easy control from the outside.

Additional marking:

- Case with desiccants.

Packing Category V/VI



8.4.6 Double Case – Packing Category VII

8.4.6.1 Type of Equipment

GOODS which are of high sensitivity to shock, impact and vibration, for instance, special electrical equipment like computers, switchboards, laboratory instruments

8.4.6.2 Type of Construction

Case construction as indicated in article 8.4.2.2, with additional floating inner packing (case-in-case principle), padding corresponding to weight and sensitiveness. Preservation by sealing in aluminium compound foil with the addition of desiccants. The inner case has to be made of plywood or equivalent material with a thickness of 8-12 mm, depending on the weight of the GOODS to be packed. The inner buckles and/or frame borders have to be dimensioned so that the full stability of the inside case will be reached and no twisting is possible. The inner sides of the inside case will be lined with bituminous kraft paper on all sides (except bottom).

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8.4.7 Cable Drum – Packing Category VIII

8.4.7.1 Type of Equipment

All type of cables, wires, ropes, hoses.

8.4.7.2 Type of Construction

For all type of cables refer clause no. 11.1. For other items (wires, ropes, hoses) new or practically new drums are to be used. Planking of the e drums by use of boards, thickness minimum 20 mm, with additional double steel strapping, nailed, and carefully preserved/protected cable ends prior to packing.

8.4.8 Hazardous Materials – Packing Category IX

8.4.8.1 Type of Equipment

Hazardous materials according to the law are explosives, compressed gases, liquefied gases dissolved under pressure or deeply refrigerated, flammable liquids, flammable solids: substances liable to spontaneous combustion; substances which, on contact with water, emit flammable gases, oxidizing substances, organic peroxides, poisonous (toxic) and infectious substances; radioactive materials, corrosives, miscellaneous dangerous goods.

8.4.8.2 Type of Construction

Hazardous materials shall always be packed and documented separately from any other material. Selection of packaging materials, execution of packing and marking as well as documentation shall always be in compliance with the applicable laws and regulations. Any certificates required for transportation or for authorities to be supplied before shipment of the GOODS.

8.4.9 Wooden Floor as a Transport Support – Packing Category X

8.4.9.1 Type of Equipment

Any materials to be stuffed in containers or on flat racks and that are not stowed on standard pallets or otherwise suitably packed

8.4.9.2 Type of Construction

- Longitudinal internal square timbers bolted to the front wall runners, longitudinal skid.
- Maximum distance between longitudinal runners 90 cm (middle to middle of the runner).
- Full boarding of the floor.
- Attaching of lifting lugs and/or iron ropes for lifting/pulling the units off the transport equipment.
- If applicable, preservation of the equipment by sealing in polyethylene-foil or aluminium compound foil and the addition of desiccants.

8.5 Air Transport Packing

8.5.1 General

Certain types of material may have to be shipped by air from their country of origin. This means of transport will be exceptional, and will be used only:

- For GOODS, which are highly sensitive to shock or vibrations, such as computers, electronic instruments, or those of small dimensions and weight.
- For GOODS urgently required at the module yard(s) and/or jobsite.

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8.5.2 Type of Packing

Depending on the goods to be packed, VENDOR may use one of the following types:

- A triple-corrugated cardboard container made with waterproofed glue and a barrier layer of polyethylene on the outsides to keep out humidity.
- Wooden/cardboard packing cases: the wood being used for the framework and base of the cases, waterproofed triple-corrugated cardboard being used for the sides and top. These cases are of the "Bell" type, and used for material of small or medium dimensions.
- For larger dimensions, plywood cases are acceptable. The timber characteristics, cross-sections and thickness will be systematically determined by the nature of the loads to be packed.

8.5.3 Dimensions

In order to optimize the existing transport facilities (passenger or cargo aircraft), the dimensions of:

- Triple-corrugated containers.
 - Wooden/cardboard packing cases.
 - Plywood cases.
- Are to be adapted to pallets used for air transportation.

9.0 Detailed specification for Wooden Crates/Boxes/Cases and other packing materials

9.1 Technical specification for wood

The wood shall be Fir, Chir, Silver Oak (Gravillea Robusta), chemically treated mango and Pinewood with moisture content not exceeding 50%. The wood shall have flexural and compressive strength, stiffness, shock absorption and nail retention properties. The wood shall be free from common defects such as warp, bone, twist, knot, cracks, splits, end splits, bend, visible sign of infection and any kind of decay caused by insects or fungus, etc. Surface cracks with maximum depth of 3mm are permissible. A continuous crack of any depth all along the length is not allowed.

9.2 Chemical Treatment of Wood:

The wood shall be chemically treated to provide protection against deterioration due to fungi and attack by termites, borers, marine organism and any other kind of infection. It shall be treated only after final processing like cutting, planning, joint grooving, etc.

9.3 TYPE, DESIGN & DIMENSION OF WOODEN PACKING CASES:

9.3.1 PACKING OF EQUIPMENTS

Various mechanical, electrical and C&I equipment e.g. Pumps, motors, equipment skids, heat exchangers, control panels, switch gears, transformers, etc. shall be wrapped in weather proof packing and then secured in wooden packing cases. The construction of wooden packing cases/crates shall be as per details given below and also given in figure 1 to 11.

9.3.1.1 Bottom Frame

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The construction of bottom frame shall be as per Fig-2. The No. of slides/runners for bottom frames shall be selected depending upon the weight and overall dimensions of the load to be carried. The equipment shall be secured by fixing their base frame/plate with the help of bolt and nuts etc. to bottom frame of the wooden packing cases/crates. The equipment not provided with base frame/plate like cylindrical vessels, etc to be secured to the bottom frame of the wooden cases with "C" clamps fabricated from steel channels/ angle iron.

9.3.1.2 TOP FRAME

The construction of top frame shall be as per fig-3.

9.3.1.3 END PANELS

The dimension of the end and lateral panels shall be calculated according to overall dimensions of the items to be packed. Diagonal braces shall be used for packing cases having height exceeding 500mm. Details of bracings shall be as per fig 5 to 9.

9.3.1.4 Sling Plate

To facilitate lifting of cases, longitudinal under slide boards shall be fixed. To avoid damage to the box while lifting sling plates shall be provided. Refer fig-11.

9.3.1.5 Angle Iron Cleats

Angle iron cleats shall be used for strengthening the joints as indicated in fig-10

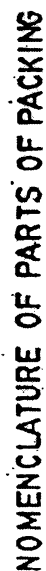
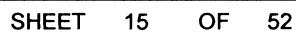
9.3.1.6 Other Requirements

- The thickness of planks for top, bottom, side and end panels shall be at least 25mm. Planks used for this purpose shall be joined with each other by tongue and groove joint. The groove dimension shall be such that tongue fits tightly into groove to make the joint.
- Runners/slides, traverse bars, etc shall be of single length i.e. without any joint. Planks for sheathing, diagonal bracing etc shall also be of single length up to 2400mm, proper jointing is permitted for planks for sheathing and diagonal bracings.
- Each equipment to be individually covered with double polyethylene petticoat. Sheet thickness of polythene sheet shall not be less than 0.175 mm (175 microns). The sealing shall be such so as not to allow moisture inside.
- The inner surface of 4 sides of shooks shall be nailed with bituminized water proof craft paper. Wherever 2 pieces of kraft paper are used, joint shall have an overlap of minimum 20 mm.
- All the inner sides of the box shall be nailed with bitumen coated HESSIAN POLYTHYLENE KRAFT PAPER. For top frame it shall project on all sides by 100mm and shall be nailed on sides. Wherever 2 pieces of kraft paper are used, joint shall have an overlap of minimum 20 mm.
- For delicate equipment like control panels and switchgears, lighting panels and lighting transformers, suitable cushioning material like rubberised coir (min. 50 mm thick and 100 mm wide) shall be provided on their bottom support and the gap between the panel and casing

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shall be filled with rubberized coir with distance between consecutive supports less than 500 mm (ref fig15). For other equipment suitable support from sides of the casing shall be provided.

- Switchgear cubicles, control panels and control desks shall be packed and shipped in separate convenient sections. The components e.g. circuit breakers relays and instruments etc. which are removed from panels for shipping purpose and shall be separately packed and shipped as per packing instructions in clause 10.4.
- Packing case for control panels and switchgear panels shall be finally covered with GI sheet of minimum thickness of 0.4mm.
- Packing cases shall be bound at edges by nailing MS clamps/brackets at sufficient intervals. Further heavier boxes shall be strapped with C clamps (ref fig-4) fabricated from steel channels/angles and lighter boxes shall be strapped with hoop iron strips.
- Silica gel is used for this purpose to protect contents over sufficiently long time from corrosion. Silica gel shall be indicating type confirming to IS-304 (1979) packed in cotton bags placed at different positions inside the packing for absorbing moisture and shall not come into directly contact with equipment/material inside the package. The quantity of silica gel shall be adequate for storage period of one year, however it shall not be less than 4 gm. per ltr. Volume of case subject to minimum 400 gm. Per case.





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BOTTOM FRAME ARRANGEMENTS

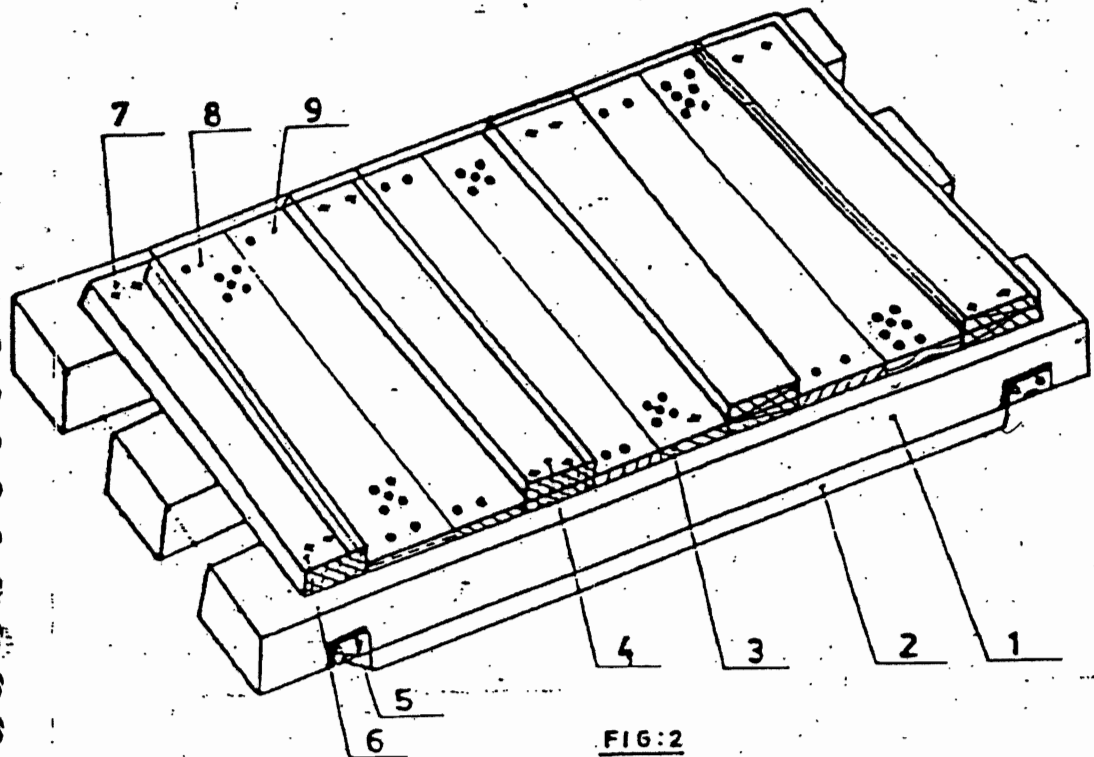


FIG:2

Nos. of slides: Minimum 2 Nos.
For length more than 1800 mm or
load more than 1000kg, Nos. of
slides shall be minimum 3 Nos.
For dimensions of slides, refer Table 1
Cross section of end transverse bar; 100 x 100 mm.
(minimum)

1. SLIDE
2. UNDER SLIDE BOARD
3. BOTTOM BOARD
4. CARRIER TRAVERSE BAR
5. SLING PLATE
6. TRAVERSE BAR
7. BOLT, NUT & WASHER
8. DRAINAGE HOLES
9. NAILS

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TOP FRAME ARRANGEMENT

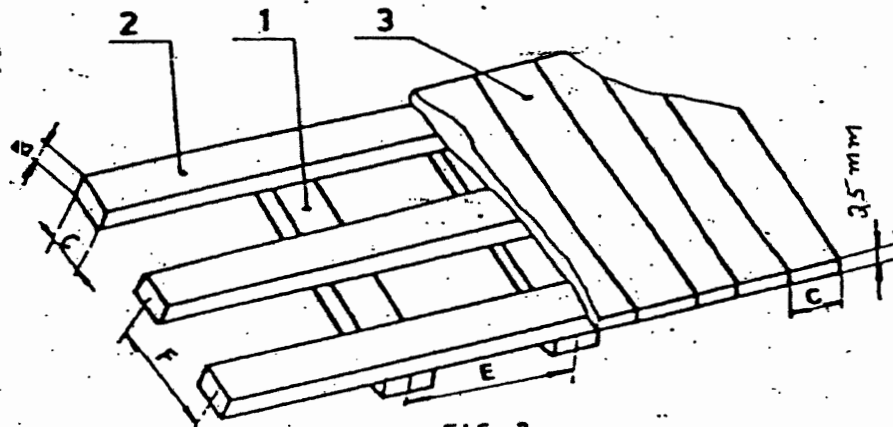
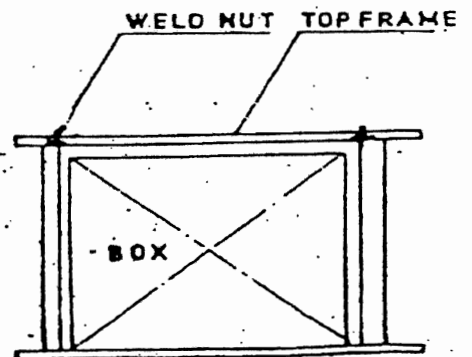
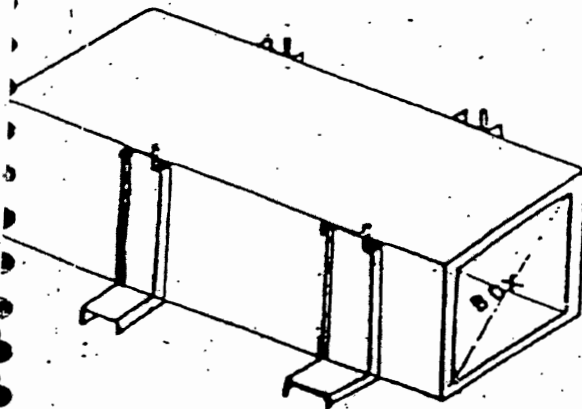


FIG-3

F : 700 to 1000 mm
E : 500 to 900 mm
30 x 100 mm.

- 1 - Traverse Bars
- 2 - Horizontal Soans
- 3 - Top Board

ARRANGEMENT OF C-CLAMPS AROUND CASES



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ARRANGEMENT OF DIAGONAL BRACING AND HORIZONTAL SUPPORT

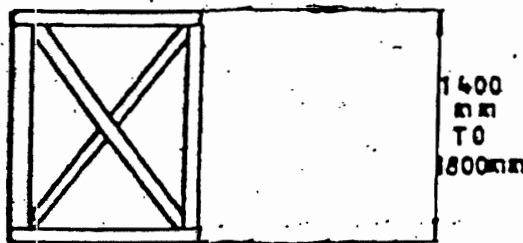


FIG:6

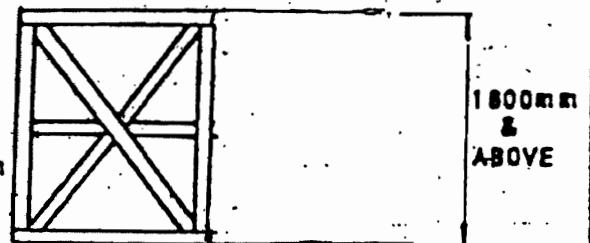


FIG:8

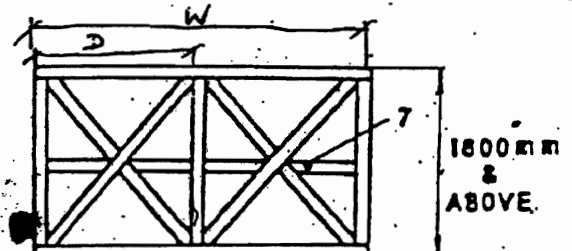


FIG:7

7- Middle Horizontal Support

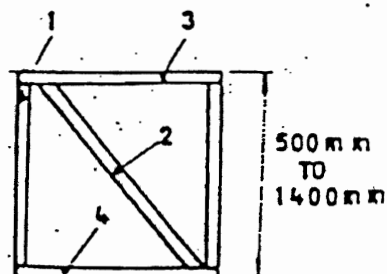


FIG:5

1- Vertical Support

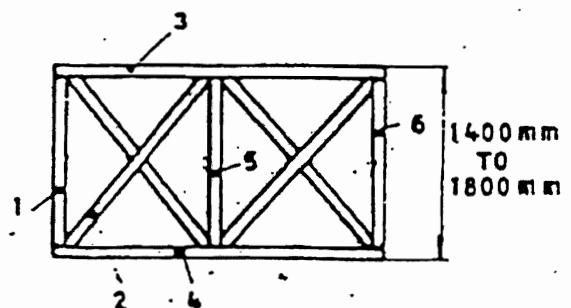


FIG:7

1, 5, 6 - Vertical Support

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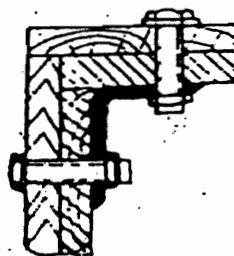
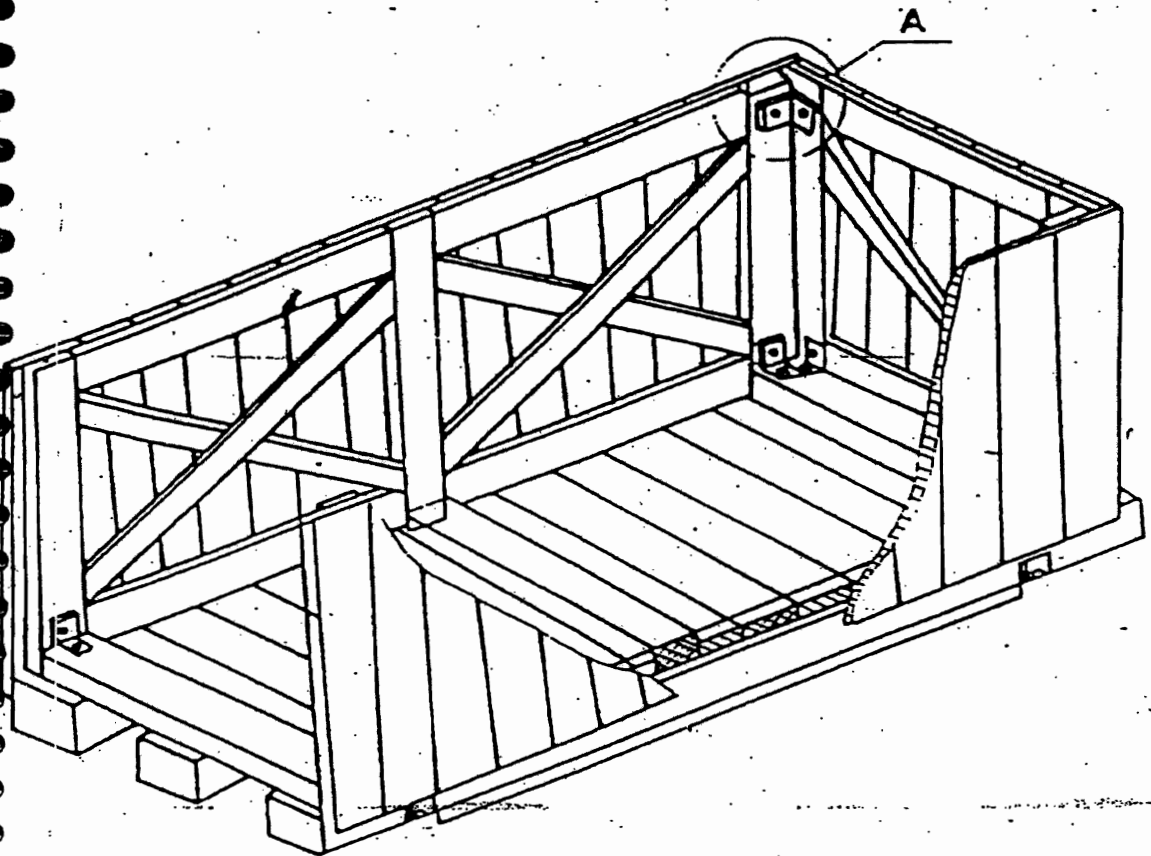
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ARRANGEMENT OF PACKING CASE



DETAIL-A

HOLE DIAMETER
MUST CONFORM
TO BOLT DIA

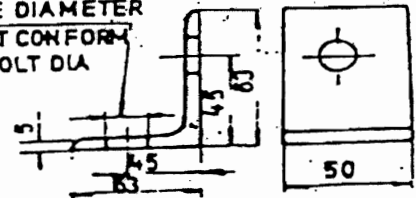


FIG:10

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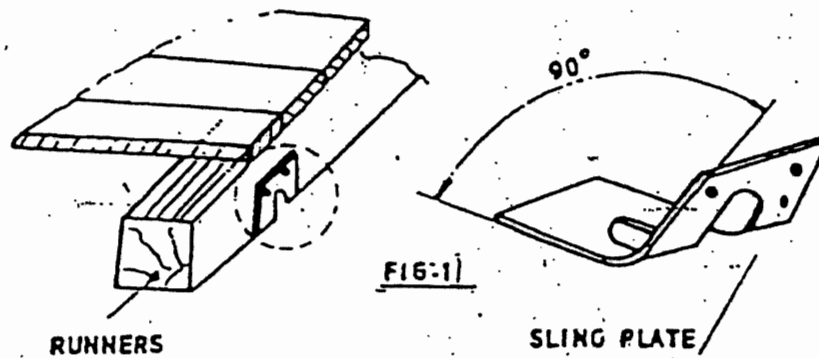
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**ARRANGEMENT OF SLING & PLATE ON
CASES**

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TABLE-1

LOADS	LENGTHS OF SLIDES						
	600	800	1000	1200	1300	1500	2000
	Cross section b x c				c b		
500	50 X 100	50 X 100	50 X 100	50 X 100	75 X 100	75 X 100	100 X 100
800	50 X 100	50 X 100	75 X 100	75 X 100	75 X 100	75 X 100	100 X 100
1000	75 X 100	75 X 100	75 X 100	100 X 100	100 X 100	100 X 110	100 X 150
1500	75 X 100	75 X 100	100 X 100	100 X 100	100 X 100	100 X 150	100 X 150
2000	75 X 100	100 X 100	100 X 100	100 X 150	100 X 150	100 X 150	150 X 150
2500	75 X 100	100 X 100	100 X 150	100 X 150	100 X 150	150 X 150	150 X 150
3000	100 X 100	100 X 150	150 X 150	150 X 150	150 X 150	150 X 150	150 X 150

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Table-2

End and side panels	Width of the panel "W"	Distance between longitudinal support (Dimension "D")						
		600	800	1000	1200	1400	1600	1800
		Cross section b x c				Item 1 to 7		
Fig- 5 to Fig-9	600 to 1200	30	30	30	30	30	30	30
		X	X	X	X	X	X	X
	1201 to 1600	100	100	100	130	130	130	130
		30	30	30	30	30	30	30
	1601 to 2000	X	X	X	X	X	X	X
		130	130	130	130	130	130	130
	2001 to 3000	30	30	30	30	30	30	40
		X	X	X	X	X	X	X
	3001 to 4000	130	130	130	130	130	130	150
		40	40	40	40	40	40	40
		X	X	X	X	X	X	X
		150	150	150	150	150	150	150

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INDICATION MARKS ON CASES/BOXES/CRATES

Designation	Symbol	Explanation
Fragile, Handle with care		The symbol should be applied to easily broken cargoes. Cargoes marked with this symbol should be handled carefully and should never be tipped over or slung.
Use no hooks		Any other kind of point load should also be avoided with cargoes marked with this symbol. The symbol does not automatically prohibit the use of the plate hooks used for handling bagged cargo.
Top		The package must always be transported, handled and stored in such a way that the arrows always point upwards. Rolling, swinging, severe tipping or tumbling or other such handling must be avoided.
Keep away from heat (solar radiation)		Compliance with the symbol is best achieved if the cargo is kept under the coolest possible conditions. In any event, it must be kept away from additional sources of heat. It may be appropriate to enquire whether prevailing or anticipated temperatures may be harmful.
Protect from heat and radioactive sources		Stowage as for the preceding symbol. The cargo must additionally be protected from radioactivity.
Sling here		The symbol indicates merely where the cargo should be slung, but not the method of lifting. If the symbols are applied equidistant from the middle or center of gravity, the package will hang level if the slings are of identical length. If this is not the case, the slinging equipment must be shortened on one side.
Keep dry		Cargo bearing this symbol must be protected from excessive humidity and must accordingly be stored under cover. If particularly large or bulky packages cannot be stored in warehouses or sheds, they must be carefully covered with tarpaulins.

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Center of gravity		This symbol is intended to provide a clear indication of the position of the center of gravity. To be meaningful, this symbol should only be used where the center of gravity is not central. The meaning is unambiguous if the symbol is applied onto two upright surfaces at right angles to each other.
No hand truck here		The absence of this symbol on packages amounts to permission to use a hand truck on them.
Stacking limitation		The maximum stacking load must be stated as "... kg max.". Since such marking is sensible only on packages with little loading capacity, cargo bearing this symbol should be stowed in the uppermost layer.
Clamp here		Stating that the package may be clamped at the indicated point is logically equivalent to a prohibition of clamping anywhere else.
Temperature limitations		According to regulations, the symbol should either be provided with the suffix "...°C" for a specific temperature or, in the case of a temperature range, with an upper ("...°C max.") and lower ("...°C min.") temperature limit. The corresponding temperatures or temperature limits should also be noted on the consignment note.
Do not use forklift truck here		This symbol should only be applied to the sides where the forklift truck cannot be used. Absence of the symbol on other sides of the package amounts to permission to use forklift trucks on these sides.
Electrostatic sensitive device		Contact with packages bearing this symbol should be avoided at low levels of relative humidity, especially if insulating footwear is being worn or the ground/floor is nonconductive. Low levels of relative humidity must in particular be expected on hot, dry summer days and very cold winter days.

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Do not destroy barrier		A barrier layer which is (virtually) impermeable to water vapor and contains desiccants for corrosion protection is located beneath the outer packaging. This protection will be ineffective if the barrier layer is damaged. Since the symbol has not yet been approved by the ISO, puncturing of the outer shell must in particular be avoided for any packages bearing the words "Packed with desiccants".
Tear off here		This symbol is intended only for the receiver.

FIG-12

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BHEL-PEM-DELHI-INDIA	
CONSIGNEE	
MATERIAL	
CUSTOMER REF.	MO. NO.
DESPATCH ADVICE NOTE NO.	CASE NO.
DIMENSIONS(MM) LXBXH	NET WT -KGS
	GROSS WT -KGS
SPECIAL INSTRUCTIONS	HANDLE WITH CARE -- KEEP DRY DO NOT DROP -- DO NOT TILT

FIG-13: MARKING PLATE



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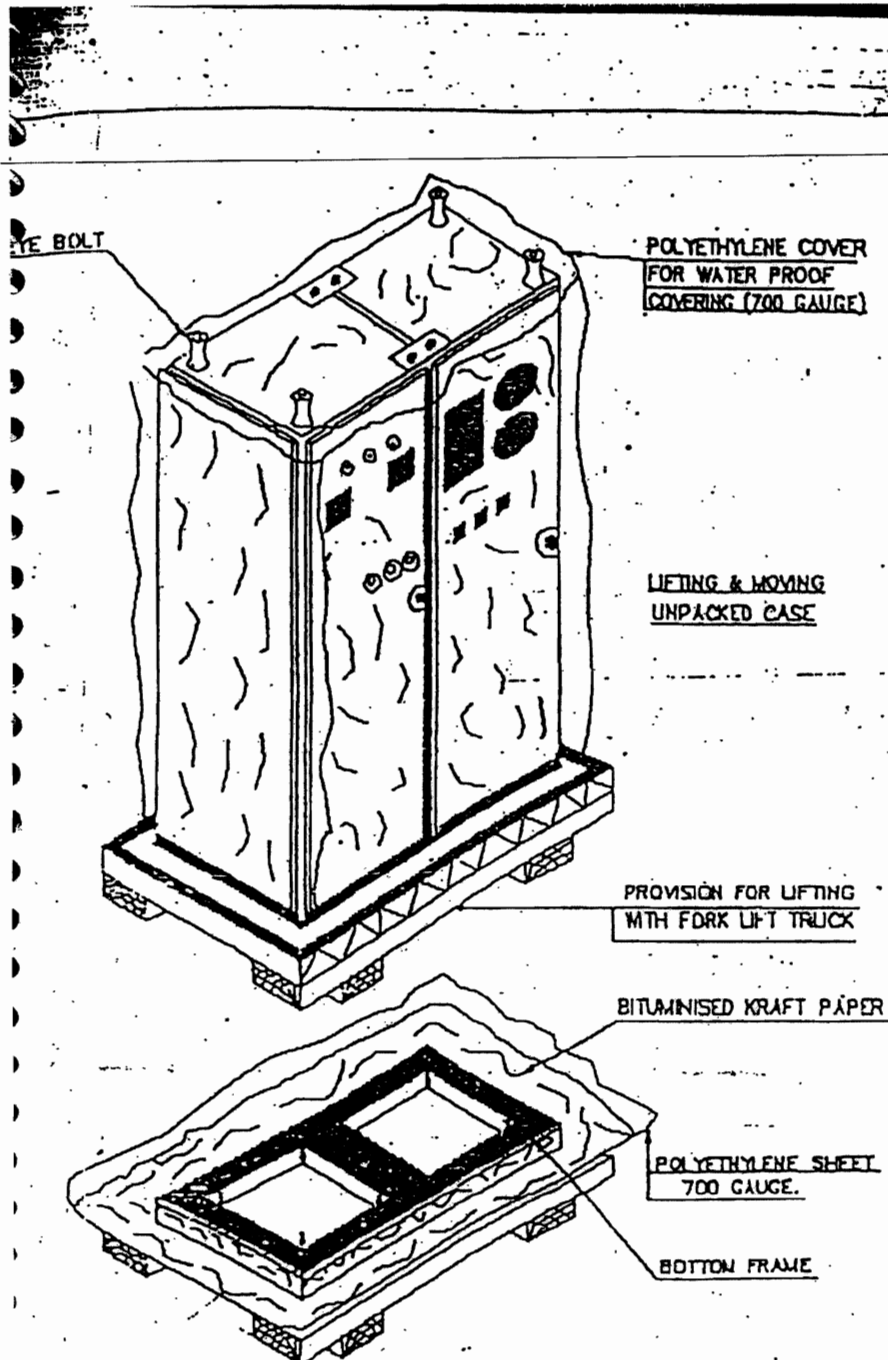


FIGURE-14



TITLE

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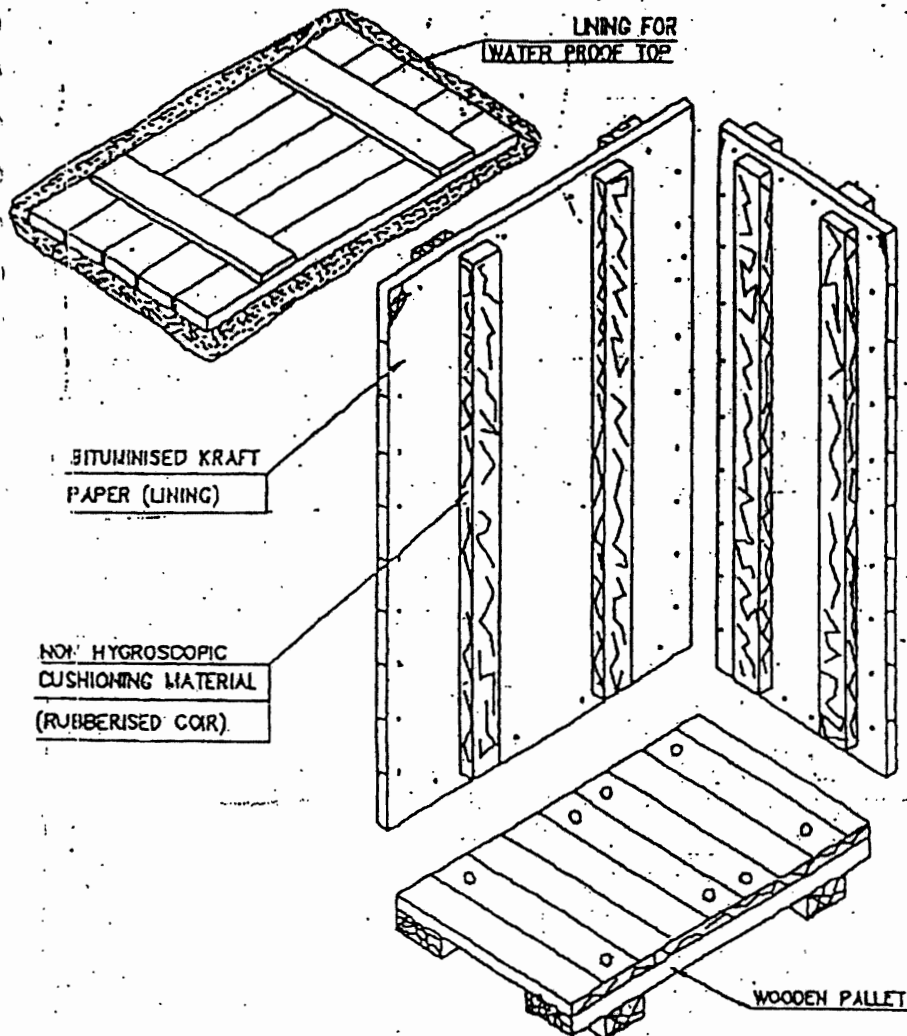
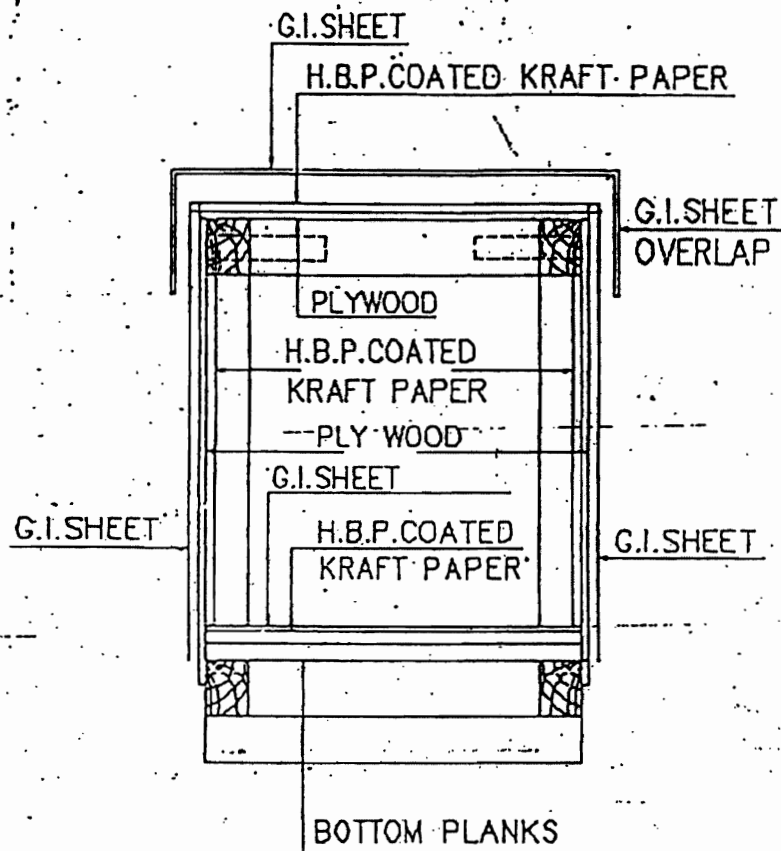


FIGURE-15

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**FIG-16 : CLOSED PACKING CASE WITH G.I.SHEET
SHOWING LAYERS OF PACKING MATERIALS.**

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10.0 TYPICAL PACKING DETAILS/PROCEDURE FOR MECHANICAL ITEMS

10.1 INSULATION MATERIAL (MINERAL WOOL MATTRESSES)

This specification covers the requirements of seaworthy packing and marking for bonded mineral (rock) wool mattresses having metallic hexagonal wire netting as facing on one or both sides.

10.1.1 TYPE OF CONSTRUCTION

Mattress shall be packed in Polythene (of 0.2 mm thickness) all around and sealed to prevent moisture absorption during transit and storage. Further it shall be wrapped with Bitumen coated Polythene bonded/lined Hessian and stitched and then packed in 5 ply DFC carton box.

Silica gel is used for this purpose to protect contents over sufficiently long time from corrosion. Silica gel shall be of indicating type conforming to IS:304-1979 packed in cotton bags placed at different positions inside the packing for absorbing moisture and shall not come into direct contact with the material inside the package. The quantity of silica gel shall be enough for storage period of one year. However, it shall not be less than 4 gms per litre volume of case subject to minimum of 400 gms per case.

Each mattress as well as the packages shall be serial numbered. Also, printed sheets indicating the nominal thickness, density and wire netting details (i.e. material and size) shall be placed below the wire netting.

Following details shall be legibly written on the packages. The details shall also be typed on a sheet of paper & kept in a sealed Polythene cover, inside the packages

- a) Project Name
- b) Purchase Order No.
- c) Sl. No. of package
- d) Size of mattress (Thickness x Length x Width)
- e) Density
- f) Wire netting material and size
- g) Weight of the package

10.2 INSULATION MATERIAL (ALUMINIUM COIL)

Heavy Gauge Aluminium Coil Packaging are done by Eye-to-Sky packaging or by Eye to eye packaging as per the proven practice being followed by manufacturer of Aluminium sheets.

10.2.1 Type of construction for Eye to Sky packaging

- a. Strapping of coil with polyester strap around circumference at one place.
- b. Putting paper I. D. Edge protector.
- c. Wrapping the coil with VCI stretch film after putting silica gel bags (4 nos.) Inside the coil.
- d. Wrapping the coil with HDPE film.
- e. Covering the coil including its build up & bore with masonite / particle board.
- f. Putting metallic I. D on coil.
- g. Putting O.D edge protector (paper) on coil.

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- h. Putting circumferential polyester strap (3 nos.) & eye polyester strap (4 nos.).
- i. After placing the coil on coil tilter ply wood (10mm thick) of suitable size along with wooden pallet is to be put at the bottom side of the coil.
- j. Coil is to be tilted to eye-to-sky position.
- k. Final strapping with metallic strap to unit coil and skid at 2 places with top cover of plywood.
- l. Fixing the coil with wooden blocks at 4 corners.
- m. Labeling 2 nos.(one metallic & one adhesivetype) For specification, net wt. & gross wt.

10.2.2 Type of construction for Eye to Eye packaging

- a. Strapping of coil with polyester strap around circumference at one place.
 - b. Putting paper I. D. Edge protector.
 - c. Wrapping the coil with VCI stretch film after putting silica gel bags (4 nos.) Inside the coil.
 - d. Wrapping the coil with HDPE film.
 - e. Covering the coil including its build up & bore with masonite / particle board.
 - f. Putting metallic I. D on coil.
 - g. Putting O.D edge protector (paper) on coil.
 - h. Putting circumferential polyester strap (3 nos.) & eye polyester strap (4 nos.).
 - i. Placing of coil on wooden skid Coil is to be tilted to eye-to-sky position.
 - j. Final strapping of coil and skid at 2 places with steel strap. Fixing the coil with wooden blocks at 4 corners.
- Labeling 2 nos.(one metallic & one adhesive type) For specification net wt. & gross wt.

10.3 Packing Procedure for Online Tube Cleaning System and accessories

This procedure is applicable for the shipment of Onload Tube Cleaning System and accessories by sea.

10.3.1 Packing details:

- The Packing case shall be made of treated rubber wood. The design of the case shall be as per Annexure IIIA & IIIB.
- The Equipments shall be placed on the wooden base of the Packing case and fastened if required to arrest the movement of the same.
- Equipment shall be covered by Polythene sheet and inside wall surfaces of the wooden cases also shall be covered by polythene sheet.
- All Nozzles shall be closed with plywood dummies.
- All electrical components assembled or loose shall be covered with polythene sheets along with silica gel pack.
- Silica gel desiccants shall be kept inside each case in sufficient quantities in order to absorb the moisture.

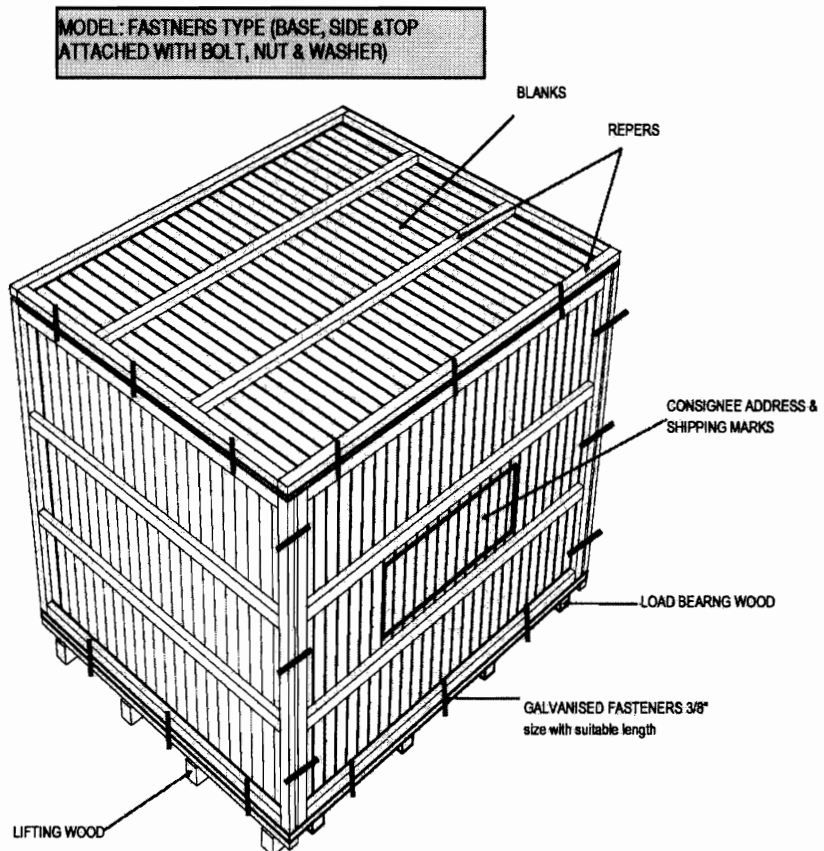
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- Thermocol packing shall be made for glass items like Ball vessel sight glass, Vpiece
- sight glass & pressure gauge.
- Silica gel desiccants shall be kept inside of each case to absorb the moisture.
- A Packing list covered in a polythene envelope shall be fixed inside and outside of each packing case.
- Shipping marks and consignee address shall be painted on the outer surface of the case.
- All handling instruction required for the case like top, sling, rain, handle with care etc, shall be marked on the case as per the symbol attached.
- Machined surface will be applied with Anti rust oil and covered by polyurethane sheet to protect from external oxidation.
- All valves will be closed with dummies to protect the internals and placed in the wooden case which will covered by polyurethane sheet.

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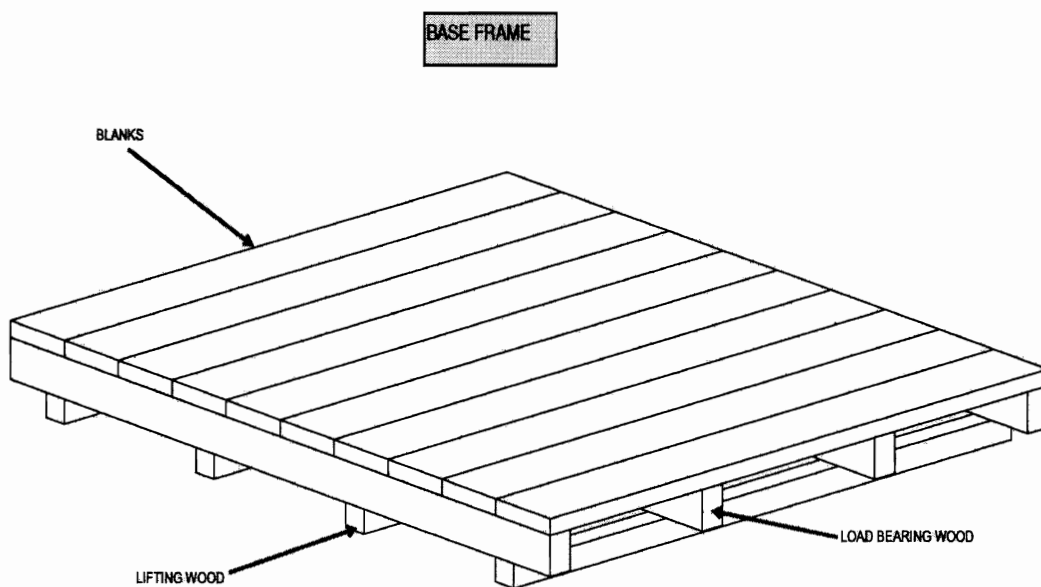
This Type of case to be used for following items:

1. BALL SEPERATOR
2. BALL COLECTOR SKID



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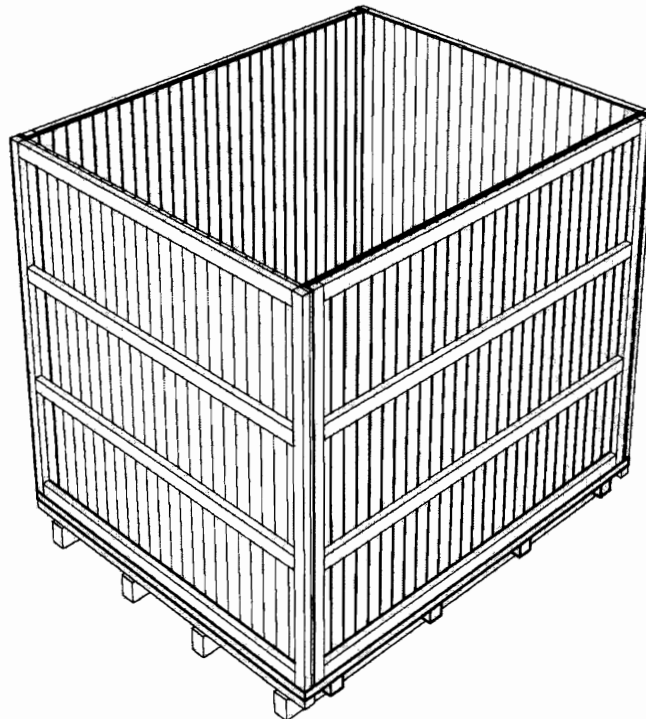
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FOR EXPORT JOBS**SPECIFICATION NO. **PE-TS-888-100-A001**

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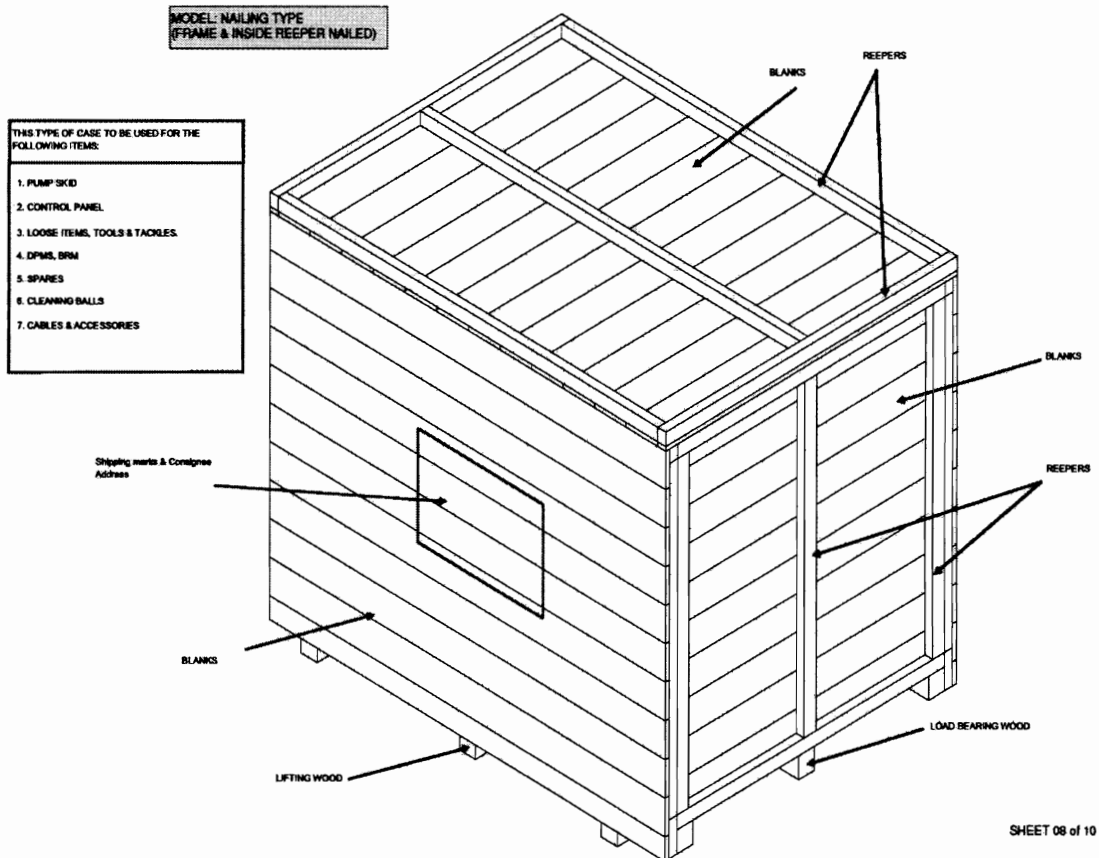
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MODEL: FASTNERS TYPE - WITHOUT TOP

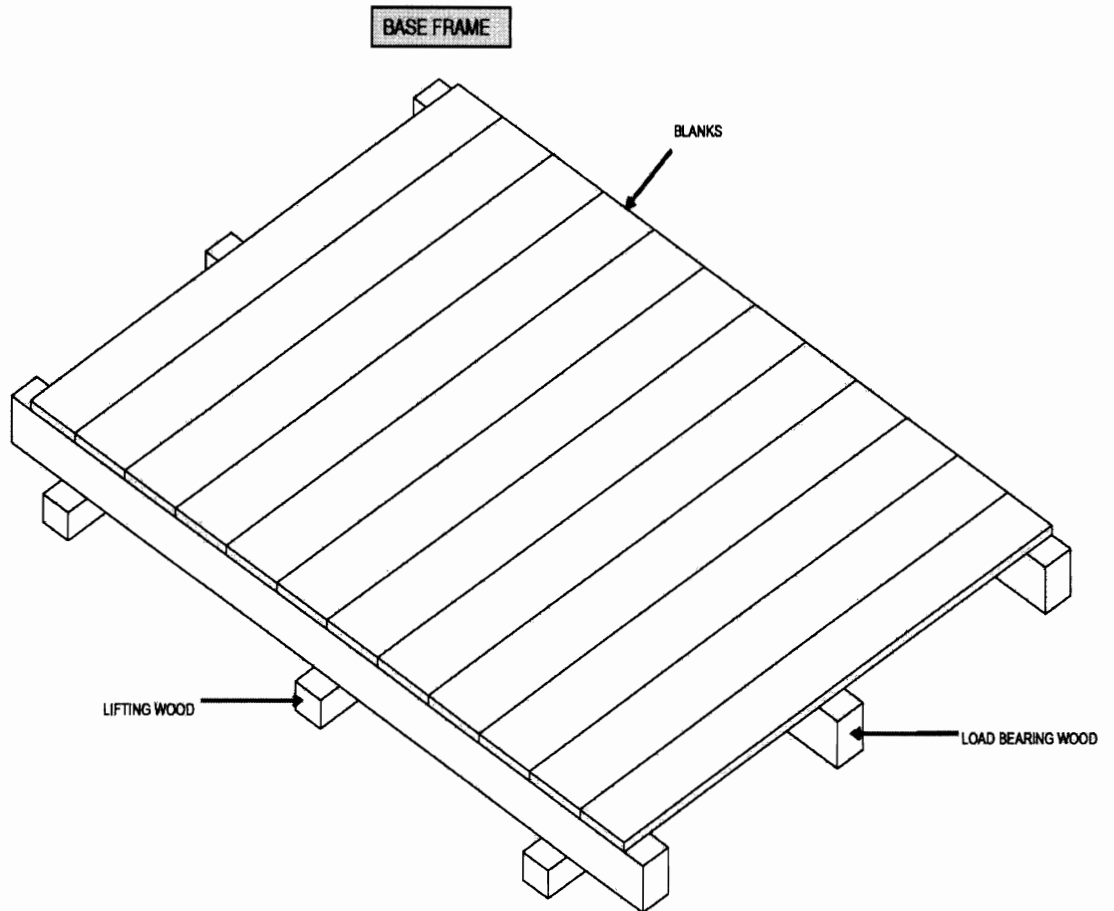
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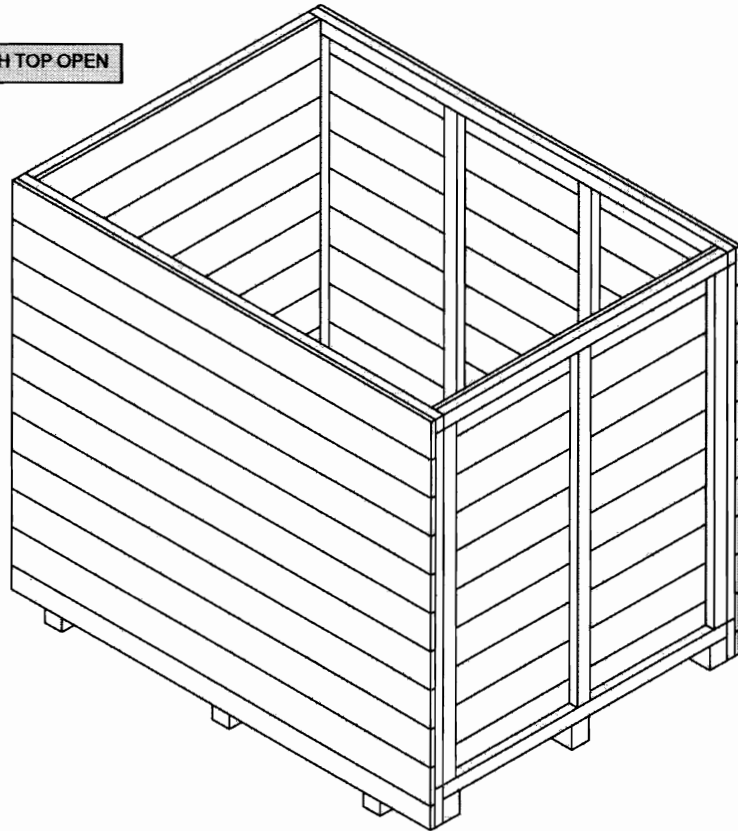
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NAILING TYPE MODEL WITH TOP OPEN



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10.4 PACKING OF LOOSE ITEMS

Loose mechanical, electrical and C&I items e.g. valves, fittings, pressure/temperature gauges/switches, circuit breakers, relays etc shall be individually wrapped using polyethylene sheets/U foam/ thermocol sheets/air bubble sheets depending upon the items and then packed in wooden boxes. The left out spaces and top of the boxes shall be filled with rubberized coir to get proper cushioning effect, Special attention shall be paid to relays, instruments etc for arresting the movements of their operating mechanism during transportation.

The construction of wooden packing cases shall be as per clause 9.3.1 retaining its all features concerning strength of the box. The construction of wooden packing case for electrical and C&I items shall be as per fig-16.

Inner surface of 6 sides of the box shall be lined with bitumen coated hessian polyethylene kraft paper. Rubberized coir of min. 25mm thickness and 100 mm width shall be nailed to inner surfaces of bottom and 4 sides of the boxes.

11.0 PACKING OF ELECTRICAL ITEMS

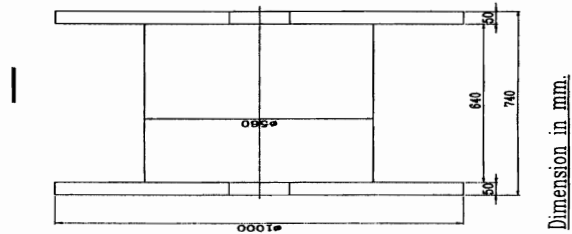
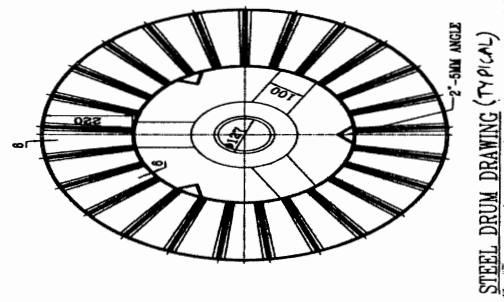
11.1 CABLES

11.1.1 Type of Equipment All type of cables..

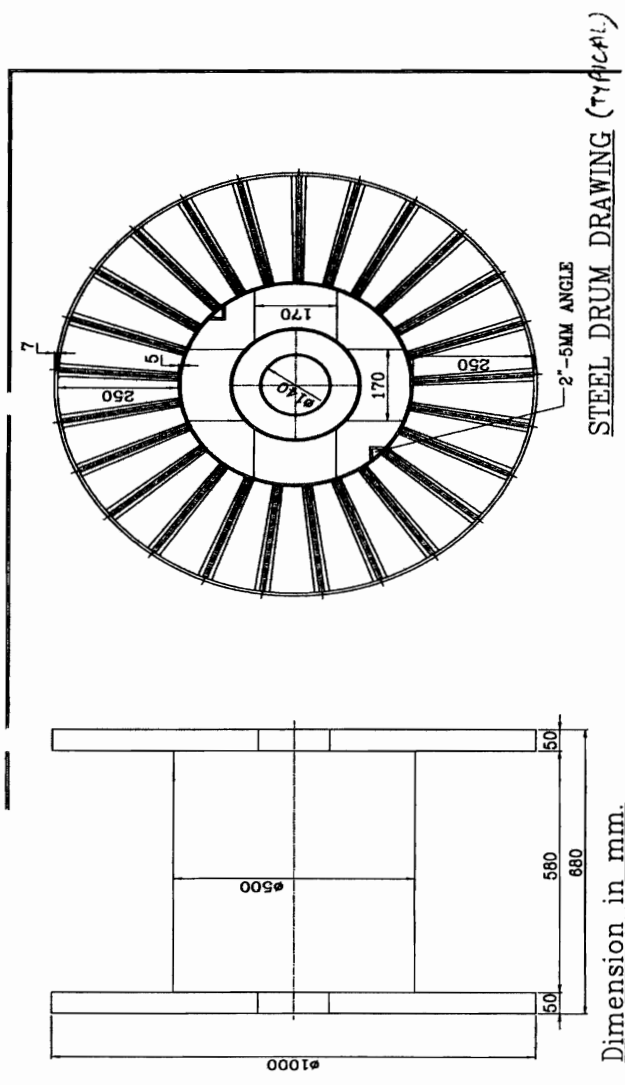
11.1.2 Type of Construction

New or practically new cable drums made of steel and painted with epoxy resin paint are to be used. Cable ends are carefully protected before packing. Over the cables polyethylene sheet shall be wrapped and then sealed properly. Cable drum can be put in wooden crates for ease in transportation and handling. (Wooden cable drum is also acceptable, however vendor to furnish constructional details for approval).

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11.2 PACKING OF CABLE TRAYS & ACCESSORIES AND CABLE TRAY SUPPORT MATERIAL

11.2.1 Cable trays can be packed in wooden boxes as per fig 1 to 11 or in steel boxes. Details of steel box construction is as indicated below.

- 1) All Dimensions are in "mm" unless otherwise stated.
- 2) Packing Box shall be fabricated using 50x50x6mm MS Angle, 50x3mm Flat, 2.5 mm thick C Channel, 1mm & 1.6mm Thick sheet.
- 3) Finish of Packing Box Shall be Galvanized.
- 4) Angle & Channel Section forming part of the Main frame shall be welded thoroughly with each other to give a rigid structure.
- 5) Sheet Section and Flat section shall be bolted/ Riveted/ Welded suitably to the Main frame stated in '4' above.

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- 6) Welding Portion on galvanized surfaces shall be painted with Zinc Rich Paint.
- 7) Dispatch details such as consignor/consignee address, contract and case details, 'country of origin, port of delivery, stacking instructions shall be written on one of the side of boxes. An anodized aluminium plate as per details and specifications given in page 3 of 5 shall be provided on the boxes
- 8) One copy of packing slip wrapped in polythylene bag covered with suitable aluminium .packing slip holder to be nailed on the external surface of the box. One more copy 9f the packing Slip wrapped in polythylene bag to be kept inside the box at the prominent place.
- 9) **INDICATION MARKS ON THE BOXES:** Markings shall be provided on the boxes indicating position of Boxes for handling, storage and nature of consignment. For guidelines referred page 4 of 5. The ink issued for this purpose as well as for marking dispatch instruction shall be indelible/non-washable marking ink.
- 10) Each item as mentioned in BOQ shall be packed & supplied as a set comprising of required numbers of associated fasteners & hardware etc



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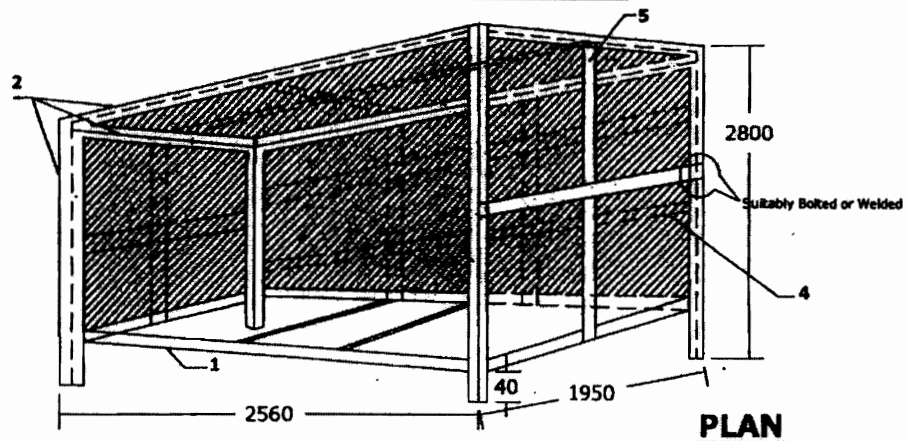
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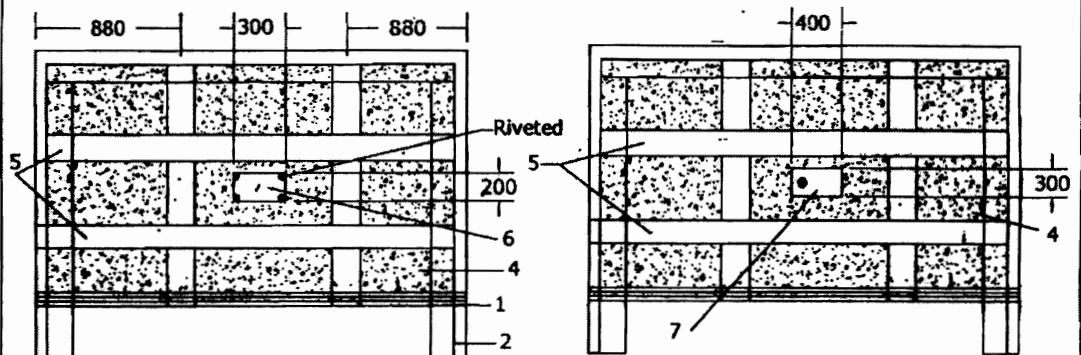
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STEEL PACKING (TYPICAL DETAILS)

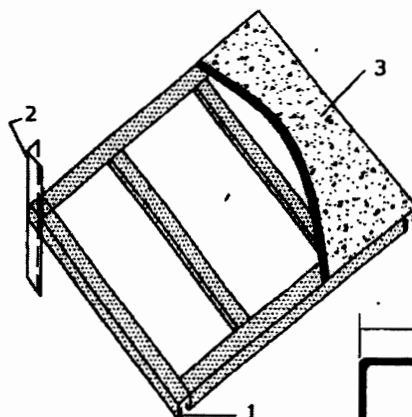


PLAN



FRONT SIDE OF BOX

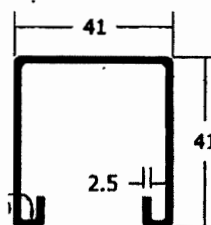
BACK SIDE OF BOX



BOTTOM FRAME ARRANGEMENT

Note:

1. "C" Channel to be used on Bottom Frame.
2. 50x50x6 Angle to be used Vertically on four sides of the Box and Horizontally on four sides on the top Frame.
3. 1.6mm thick sheet (plain) on Bottom Plate.
4. 1.0mm thick sheet to cover top & four sides of BOX.
5. 50x3 Flat as additional cross members to be used Horizontally & Vertically on top & Four Sides of Box.
6. Anodised Aluminium Plate for Marking.
7. Hinged Inspection Window.



DETAILS OF "C" CHANNEL

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11.3 PACKING FOR STATION LIGHTING SYSTEM

Aspects of packing specific to equipments / items of station lighting system are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

11.3.1 For LIGHTING TRANSFORMER, DISTRIBUTION BOARDS, LIGHTING PANELS,

- Construction of packing case for LIGHTING DISTRIBUTION BOARDS, LIGHTING PANELS, TRANSFORMER . shall be EITHER as per FIGURE 1,2,3,5,6,7,8,9,10,11 OR FIGURE 14,15,16.
- Each Panel/Transformer shall be individually covered with double polythene sheet of thickness 175 microns minimum.
- All the 6 inner surfaces of packing shall be nailed with bitumen coated hessian polythene craft paper. Wherever 2 pieces of craft paper are used, the joint shall have minimum overlap of 20mm.

For the top frame it shall be project on all sides by 100mm and shall be nailed on sides .

- The gap between the panels and packing case shall be filled with rubberized coir of thickness 50mm minimum and width 100mm. The distance between two consecutive supports of rubberized coir shall be less than 500mm.
- Silica get packed in cotton bags shall be placed at different positions inside the packing.
- Packing case shall be finally covered with GI sheet of thickness 0.4mm minimum.

11.3.2 For LUMINARIES, RECEPTACLES. EMERGENCY LIGHT, 240/24V TRANSFORMER, CEILING FAN, SWITCH BOARDS, FLEXIBLE CONDUIT, WIRES, EARTH WIRE. JUNCTION BOXES, ERECTION COMMISSIONING SPARES, RECOMMENDED SPARES , ERECTION MATERIAL AND CONSUMABLES

- Construction of packing case for THE ABOVE MATERIAL shall be as per FIGURE 1to11.
- Items placed inside the case shall be covered with double polythene sheet of thickness 175 microns minimum.
- All the 6 inner surfaces of packing shall be nailed with bitumen coated hessian craft paper. wherever 2 pieces of craft paper are used, the joint shall have minimum overlap of 20mm. For the top frame it shall be project on all sides by 100mm and shall be nailed on sides.
- Silica get packed in cotton bags shall be placed at different positions inside the packing.

11.3.3 For CONDUIT PIPE

As per international practice pipes are shipped in open bundles with metal strapping. Packing as per attached figure A shall be provided which is described as following:

- Each bundle shall be wrapped with 2 layers of 175 microns thick polythene sheet.
- Then bundle will be wrapped with bitumen coated hessian craft paper.
- Bundle shall be strapped with steel straps.
- An anodized aluminium packing description plate as per Figure No. 13 shall be provided.

11.3.4 For POLES

Poles will be wrapped with 2 layers of minimum 175 microns thick polythene sheet and then with bitumen coated hessian craft paper, packed as per Figure – C i.e. bundling.

11.3.5 For STRUCTURAL STEEL

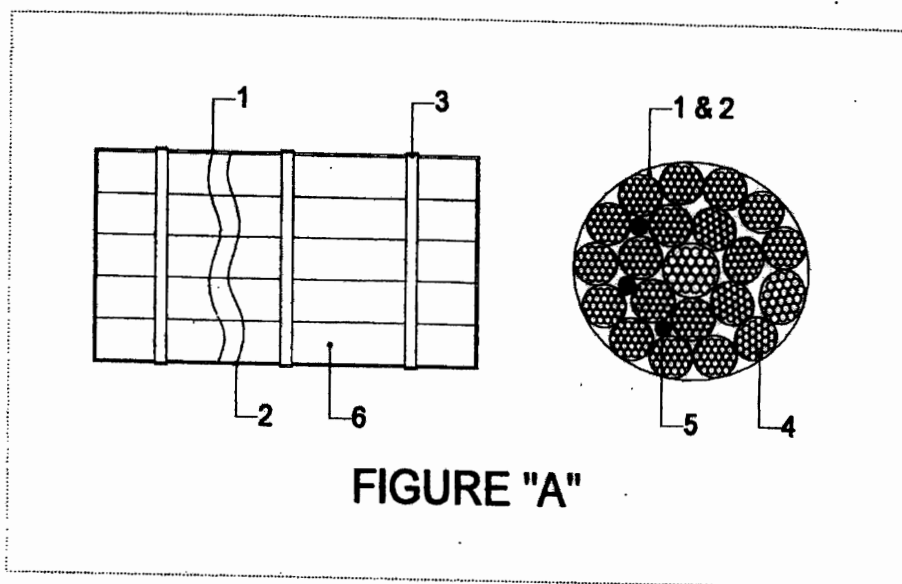
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Structural steel will be different sizes and shapes. Hence it will be packed as per Figure No. B and described as following :

- a) Each bundle shall be wrapped with 2 layers of 175 microns thick polythene sheet.
- b) Then bundle will be wrapped with bitumen coated hessian craft paper.
- c) Bundle shall be strapped with steel straps.
- d) An anodized aluminium packing description plate as per Figure No. 13 shall be provided.

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PACKING PROCEDURE FOR CONDUIT PIPE



- 1) LAYER OF BITUMEN COATED HESSIAN KRAFT PAPER.
- 2) LAYER OF POLYTHENE SHEET.
- 3) METAL STRAPPING.
- 4) CONDUIT PIPES.
- 5) SILICA GEL POUCHES.
- 6) BUNDLES OF CONDUIT PIPES.

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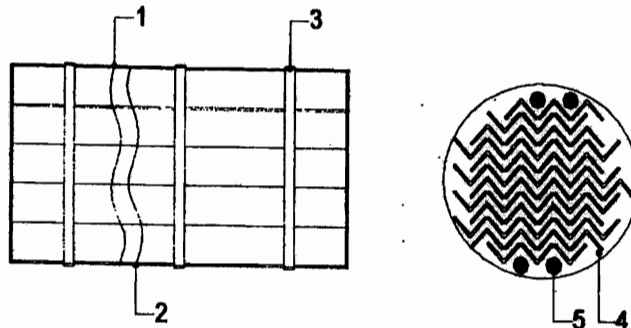
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PACKING PROCEDURE FOR STRUCTURAL STEEL**FIGURE "B"**

- 1) LAYER OF BITUMEN COATED HESSIAN KRAFT PAPER.
- 2) LAYER OF POLYTHENE SHEET.
- 3) METAL STRAPPING.
- 4) STRUCTURAL STEEL.
- 5) SILICA GEL POUCHES.



TITLE

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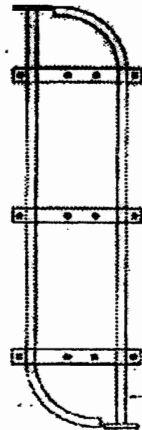
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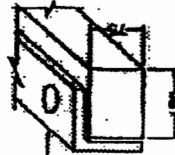
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packing procedure for poles



POLES WRAPPED WITH POLYTHENE SHEET &
EXTRUDED COATED HESSIAN CLOTH



TOP WOODEN BATTEN TO BE
FIXED WITH L90x80x6 MM ON TOP
OF IT FOR TIEING THE ROD
25 MM DIA



BOTTOM WOODEN BATTEN TO BE
FIXED ON L90x80x6 MM ANGLE

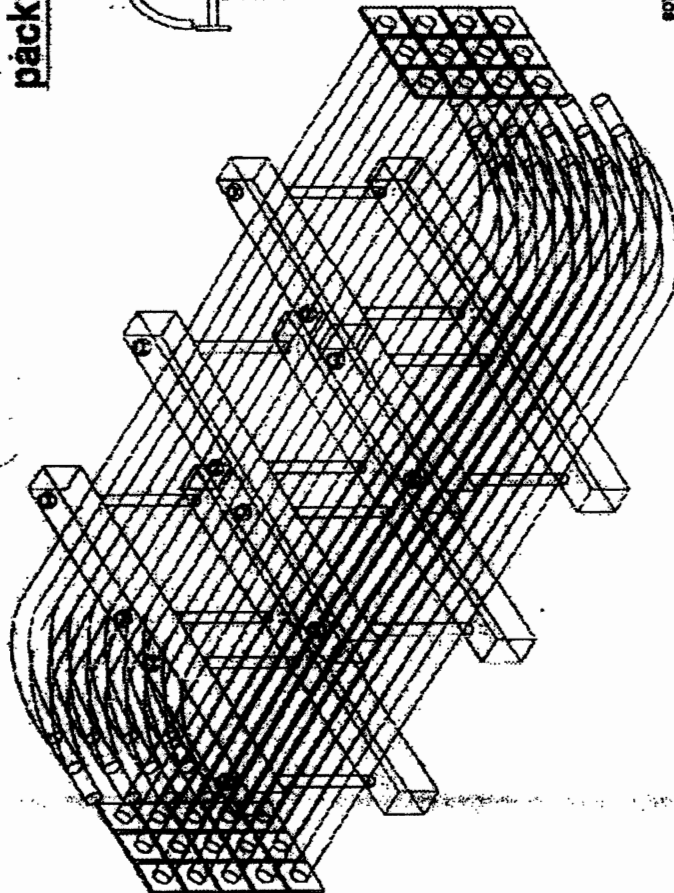


FIGURE "C"

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11.4 PACKING FOR DC BATTERY

The packing procedure for seaworthy packing of DC Battery is defined below, which is capable of withstanding impacts, compression, vibration, toppling, sea water spray, prevention against rust, temperature and extreme atmospheric conditions. Aspects of packing specific to equipments / items of DC Battery are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

The packing procedure consists of various stages namely primary packing, cushioning, securing, desiccant, outside packing box, Runners/ sliders/ transverse bars of plywood, etc., provided for each movement.

- a) The packing boxes shall be made up of plywood boxes (thickness 9mm min.) with blocks at the bottom of the box for provision for handling the boxes using the forklift. The packing boxes sizes are generally standardized to half-euro size (capable of handling equipment's weight).
- b) Rubberized coir of 25mm thickness shall be provided as cushioning material at the bottom and thermocole of 20mm shall be provided inside on all four sides. Other than this polyethylene film wrap or cover also will be provided. Left out spaces to be filled with rubberized coir/ thermocol to get cushioning effect.
- c) Silica gel in dust free air permeable cotton/paper bag shall be placed in the packing boxes for storage period of 1 year as per IS 304 (1979)
- d) While packing the cells, transit caps (polypropylene) of red and blue shall be used for big size cells for ensuring that cells does not get damaged during the transport due to vibrations etc.
- e) The battery accessories shall be packed with suitable precautions as follows:
 - i) Copper connectors shall be packed after making bunches with lead wire seals to avoid misplacement.
 - ii) Hardware items shall be packed in polyethylene bags (Thickness $\geq 0.175\text{mm}$) with item slip
 - iii) Battery rack shall be packed in dismantled condition, wrapped with polyethylene sheet
 - iv) For Ni-Cd type battery, electrolyte in solid form for dry cells shall be packed in cans with KOH, LiOH being packed separately.
 - f) Galvanized Steel straps are provided for binding the packing box sides.
 - g) The handling instructions shall be marked in indelible/ non-washable ink, indicating the upright position.

11.5 PACKING OF SERVICE TRANSFORMERS(OIL FILLED) & ACCESSORIES

This instruction is applicable for packing of transformers (oil filled), its accessories and components so as to ensure safe delivery to end user. Aspects of packing specific to equipments / items of transformers(oil filled) are given here. All other instructions / aspects as per the main specification of export packing which are not covered here shall also be applicable.

11.5.01 PACKING DETAILS :

- a) Items shall be packed in case / crates as per the shipping list.
- b) All fragile items and small items shall be packed in cases and to be marked as "Fragile, handle with care Fragile items".
- c) Fragile accessories are to be first packed in their original boxes (VENDOR's packing). Very

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- d small / delicate items such as glass thermometer, door keys shall be packed in separate box.
- d In case original box is found damaged, suitable alternate box or packing method using felt or foam sheet and polythene wrap to be used.
- e These boxes are then placed in identified wooden boxes. Inside of such boxes are lined with a layer of polythene sheet, packing wool / grass and another layer of polythene sheet before placing the boxes. All boxes are then wrapped with this polythene sheet before closing the box. Fragile items shall not be placed loose, one above the other inside the case.
- f All wiring cables, connection flats of non-ferrous materials, CTs, valves bellows shall also be packed.
- g Items like CTs, Oil communicating bushings, insulators, wired equipments and housings such as RTCC Panel, M. Box, Drive Mechanism, thermometers, gauges shall be wrapped in polythene from all around.
- h Buchholz relay and OSR relay openings will be blanked using covers, before putting them in the box
- i Items shall be carefully lowered and arranged inside the crate / case and each item shall be locked from all sides in such a way to avoid its movement in any way. Wooden stoppers and separators shall be provided for this and nailed to the crate / case wood.
- j Wooden planks and batons in contact with fragile items shall be provided with kit foam at the locations of contact.
- k Oil communication bushings shall be packed in separate case on V or U shape wooden felted supports, as in case of condenser bushings.
- l While placing and arranging the items inside the crates / cases, these shall be verified for correctness and then the packing note shall be signed. The cover top of the crate / case shall then be closed.
- m The main equipment like transformer tank shall be packed suitably to prevent any damage during transit / storage. Support structures like frame, header supports etc. shall be crated. Conservator headers shall also be crated. Radiators pipe work and other instruments & components shall be packed in cases. All the cases shall be lined with polythene from inside.

11.6 ALTERNATIVE PACKING CASES FOR CONTROL PANELS AND SWITCH GEARS

For Control and switch gear panels, construction of wooden packing cases may be provided as per fig 14 & 15 and as detailed below.

Thickness of planks for all sides, binding and jointing battens shall be at least 25 mm. Width of the plank shall be at least 125mm and that of binding and jointing planks shall be at least 100mm.

Top frame shall be suitable so that it does not collapse due to sandwiching between slings while lifting. Longitudinal and traverse bars for the bottom wooden pallet to be suitably selected.

Diagonal bracings shall be as per cl 9.3.1.3 and all other requirements shall be as per clauses 9.3.1.4 to 9.3.1.6.

12.0 Containerization

As required by BHEL, the VENDOR shall stuff the GOODS into 20 or 40 foot containers (dry, open top, flat racks, etc.).

The maximum inside dimensions of containers are to be considered:

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- 40 foot containers: 11.80 m x 2.20 m x 2.05 m
- 20 foot containers: 5.80 m x 2.20 m x 2.05m
-

The present definition of containerization is valid for sea containers only. Vendor to check the size of containers before start of packing of equipment.

12.1 Protection of Cases/Crates

Since shipping containers are in general not water tight, packing in contact with the floor of the container shall be raised in order to prevent it from being damaged by the accumulation of water.

12.2 Mechanical Constraints

The mechanical constraints for "general use" closed containers are of a different nature (height of "stacking" being limited inside the containers), the packing for the GOODS may be of a lighter structure. However, it is necessary that the packing be appropriate so as to protect the GOODS on site during the storage period, as required after discharging of the GOOD'S from the containers.

Note:

It is the responsibility of the VENDOR to ensure that the cases/crates are stowed, secured and fastened inside the container. The VENDOR will take all necessary precautions to conform to the maximum weight allowed and the centre of gravity of the container. The securing and fastening of the cases/ crates can be carried out by nailing timbers on the bottom or on the vertical sides of the container.

13.0 Other Services to be provided by Vendor

In addition to the packing and shipping documents, VENDOR must also carry out the following services, which shall be included in his quotation:

Carriage of VENDOR's sub-contracted equipment and material, which must be re-grouped in VENDOR's or PACKER's workshops, whilst waiting for packaging.

BHEL reserves the right to postpone the shipping of the GOODS. In this event, any storage and insurance costs during the first ninety (90) days shall be borne by the VENDOR.

Loading, including lifting, securing, lashing, and stowing, of all cases, crates, or packages onto means of transportation such as, but not limited to, trailers, containers, etc.

14.0 Responsibilities and Guarantees

VENDOR is responsible for the choice of category for packing according to the transport facilities used, and on the basis of the present document. In case of doubt or disagreement regarding the choice, VENDOR must inform BHEL prior to packing and await BHEL's approval. All phases of packaging, marking, loading, etc. will be subject to BHEL inspection.

BHEL reserves the right to reject the packing when the packing does not conform to these instructions and/or when the packing does not ensure perfect protection of the GOODS. VENDOR is responsible for the weights and dimensions declared, and the marking of the packages.

The documents must be in strict conformity with the packing contents.

The packing specified in these "Packing, Marking and Shipping Instructions" is guaranteed for a twelve (12) months storage period after delivery on site.

VENDOR is responsible for providing storage recommendation adapted to the GOODS. According to this guarantee, VENDOR is held responsible in the event of goods becoming

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useless, damaged or broken, as a result of poor packing and/or stowing, or due to corrosion, subsequent to insufficient or inadequate protection. All direct or indirect costs resulting thereof, will be back-charged to VENDOR.



4X250 MW NABINAGAR TPP

SPECIFICATION No: PE-TS-463-167-A101

**MISC. FGD TANKS
TECHNICAL SPECIFICATION**

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SECTION-II



4X250 MW NABINAGAR TPP

SPECIFICATION No: PE-TS-463-167-A101

**MISC. FGD TANKS
TECHNICAL SPECIFICATION**

SECTION-II

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SUB-SECTION-A

STANDARD TECHNICAL SPECIFICATIONS- MECHANICAL



STANDARD TECHNICAL SPECIFICATION FOR MISCELLANEOUS TANKS

SPECIFICATION NO. PE-TS-STD-167-A101

SECTION II

SUB-SECTION A

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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.

- I. IS-800: Code of practice for use of steel in general building construction
- II. IS-803: Code of practice for design, fabrication and erection of vertical mild steel cylindrical welded oil storage tank.
- III. IS-804: Specification for rectangular pressed steel tanks
- IV. IS-805: Code of practice for use of steel in gravity water tank.
- V. IS-816: Code of practice for metal arc welding for general construction in MS.
- VI. IS-817: Code of practice for training and testing for metal arc welder
- VII. IS-2825: Code of practice for unfired pressure vessel
- VIII. BS-2594: Specification for carbon steel welded horizontal cylindrical storage tank
- IX. BS-2654: Specification for vertical steel welded storage tanks with butt welded shells for the petroleum industry
- X. Indian Factories Act
- XI. American code for oil tanks API 650
- XII. Material Specification as per relevant IS / or approved equal
- XIII. 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.



STANDARD TECHNICAL SPECIFICATION FOR MISCELLANEOUS TANKS

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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 this specification. The 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 **1.5 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/m² 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 specification. Material of construction for structure (angles, channels etc.) shall be IS 2062 Gr. A.

3.2 Alignment

3.2.1 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.

3.2.2 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



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

- 3.2.3 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.

3.3 WELDING

- 3.3.1 Tanks and other attachments shall be welded as per IS-816.
- 3.3.2 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.
- 3.3.3 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.
- 3.3.4 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.
- 3.3.5 Each tank shall be complete with access staircase, ladder and safety cage and fittings like drain connection, overflow connection(pipe) till bottom of tank, 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.
- 3.3.6 All openings in tank plate shall be well reinforced in approved manner by adding pad plates of adequate size and / or structural sections.

3.4 STAIRCASE / ACCESS LADDER AND HAND RAILING

- 3.4.1 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. 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 1200 mm clear width.
- 3.4.2 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.



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3.4.3 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.

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

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

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

3.4.7 Void.

3.4.8 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.

3.5 VERTICAL CYLINDRICAL STORAGE TANKS

3.5.1 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. 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.

3.5.2 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.

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

3.5.4 All bottom plates shall have butt weld joints to adequately support lining.

3.5.5 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.

3.5.6 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



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in upper courses depending on design requirements but in no case the plate thickness shall be less than 6 mm.

3.5.7 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.

3.5.8 Tank roof shall be either self-supported or supported from 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.

3.5.9 Roof plates shall have butt-joints to adequately support lining. No joint of roof plate over the supporting frame shall be made.

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

3.5.11 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.

3.6 RECTANGULAR TANKS

3.6.1 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.

3.6.2 Tank bottom and / or side plates shall be of minimum 8 mm thick plate. Corrosion margin of at least 1.5 mm shall be provided over the design thickness of bottom and / or side plates.

3.6.3 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.

3.6.4 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, shall be provided below the tank bottom for proper draining of the tank.

3.6.5 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



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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.

3.6.6 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.

3.6.7 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.

3.6.8 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.

3.9 HORIZONTAL CYLINDRICAL TANK

3.9.1 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. 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.

3.9.2 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.

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

3.9.4 All tank shall be supplied with integral saddle support and shall be designed in accordance with BS-2594 / IS – 2825 / ASME as specified.

4.0 TESTING AND INSPECTION AT MANUFACTURER'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.



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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-penetrant or magnetic particle inspection. For all fillet welds the final run shall be subjected to dye-penetrant / 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.



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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.



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- 4.3.3 In all other joints, whether between shell plates or bottom plates or both, leak shall be repaired only by 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.



4x250 MW NABINAGAR TPP

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**GUIDANCE FOR DESIGNING AND FABRICATION OF STEEL CONSTRUCTIONS
FOR RUBBERLINING**



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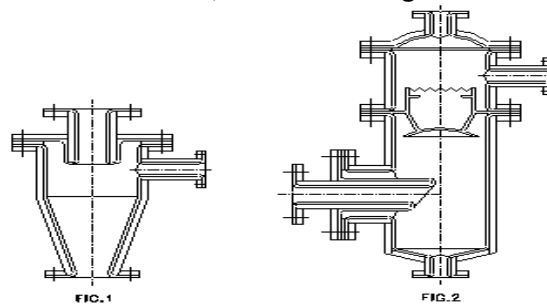
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1. INTRODUCTION:

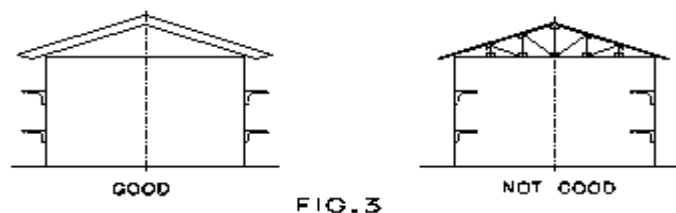
This guidance covers the minimum requirements for the design and fabrication of carbon steel vessels, equipments and pipes for rubber lining.

2. GENERAL:

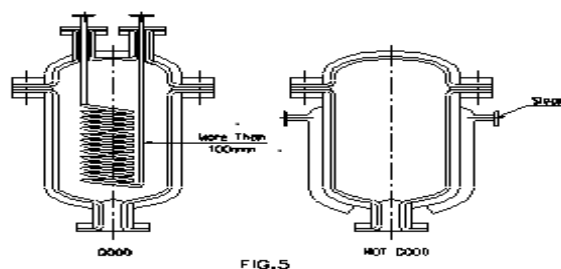
- 2-1 : Structure of steel constructions should be designed to withstand mechanical shocks under transportation and service. Particularly, hard rubber lined vessels should be paid full attention because these vessels are liable to cause cracks when transported or installed.
- 2-2 : As the lining process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

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Fig. 6.

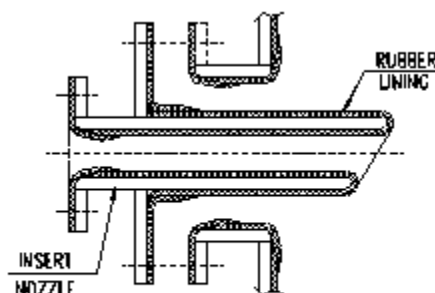


FIG.6

3. WELDING AND FINISHING:

In order to get the optimum adhesion between the base metal and rubber sheet, 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.

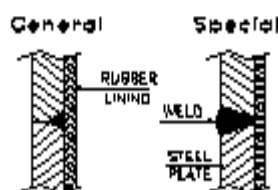


FIG.7

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

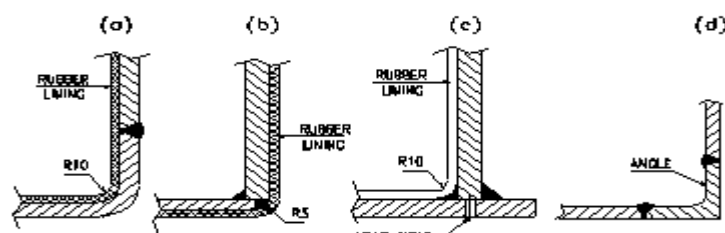


FIG.8

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

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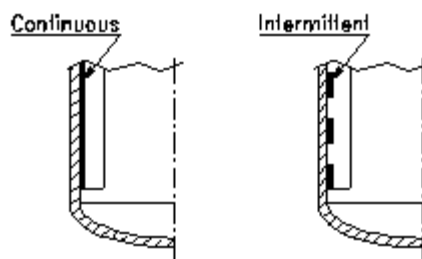


FIG.9

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.

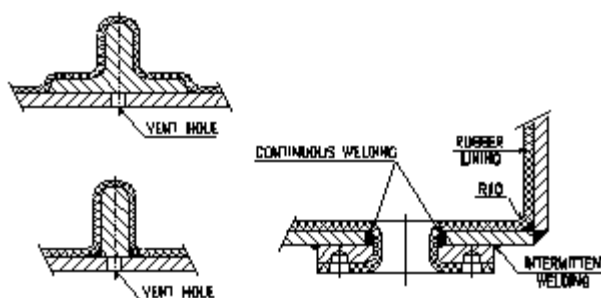


FIG.10

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 than 3 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



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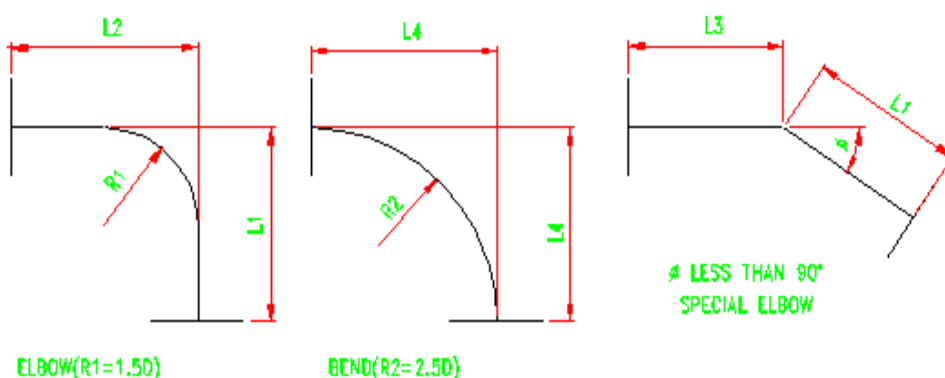
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4-2. STRAIGHT PIPES:

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:

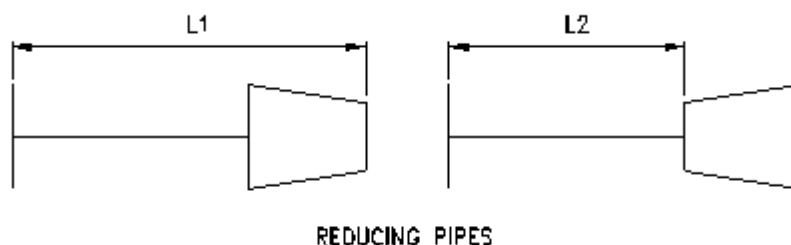
NOM DIA.	MAX L1	MAX L2, L3	MAX. L4
25	90	300	175
32	95	300	210
40	100	300	250
50	115	500	280
65	130	2000	325
80	150	3000	400
90	170	3000	450
100	190	3000	500
125	195	3000	
150	230	3000	
200	310	3000	
250	385	3000	
300	465	3000	
350	540	3000	
400	615	3000	
450	692	1000	
500	770	1000	
550	838	5500	
600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

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

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DIMENSIONS OF REDUCING PIPES (STEEL) FOR RUBBER LINING FEASIBILITY of CONCENTRIC AND ECCENTRIC REDUCING PIPES.**4-3 REDUCING PIPES:**

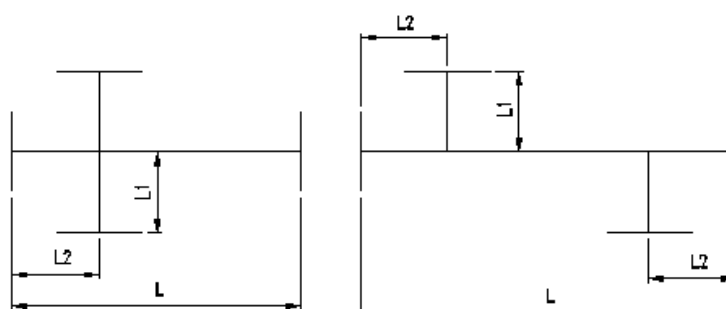
The dimensions of concentric and eccentric reducing pipes which can be satisfactorily lined are given below. Pipes should be reduced by mechanical process or by high-frequency reducers.

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 RUBBERLINING FEASIBILITY.

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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.

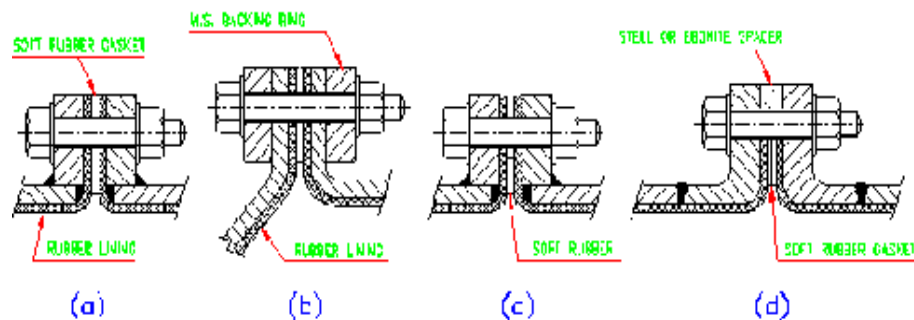


FIG.11

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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.

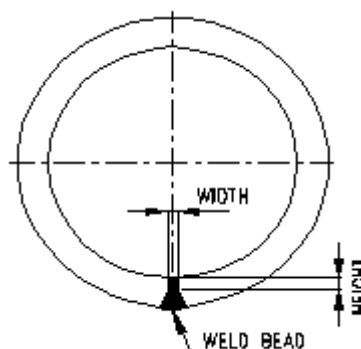
b) Check Curved faces at corner :

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:
Height - 0.1 ~ 0.2 mm
Width - 1.5 ~ 2.0 mm

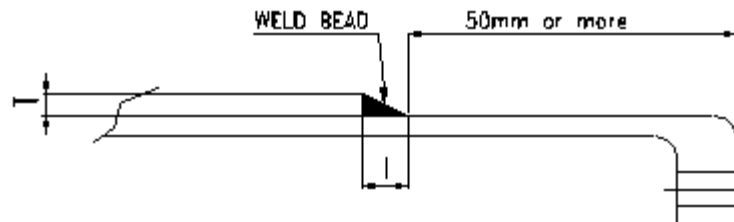
Diameter 600 mm or larger:
Height - 1.0 ~ 1.5 mm
Width - not specified



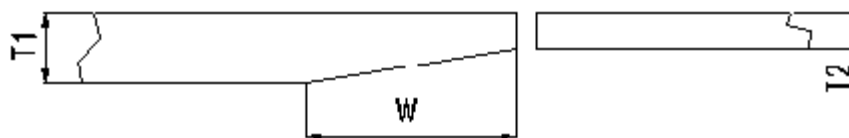


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d) Check finish of bead end:



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



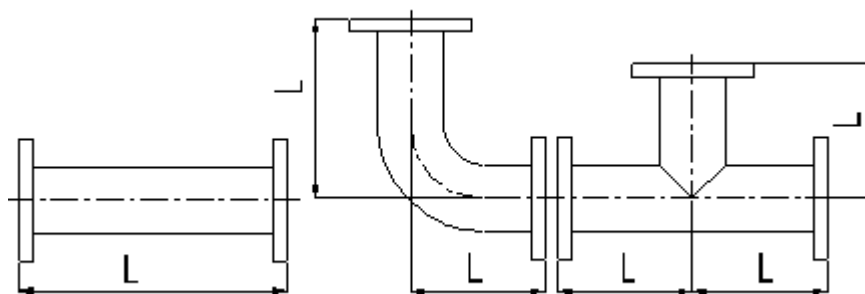
$$W = (T_1 - T_2) \times 10 \text{ mm or longer}$$

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 :



$$L = + 0, - 3 \text{ (for length of 1000 mm and less)}$$

$$L = + 0, - 3 \text{ (for length over 1000 mm)}$$

b) Inclination of flange:

$$A = \pm 1/2^\circ$$

$$B = \text{max. 5 mm}$$

c) misalignment of bolt holes :

$$A = \pm 1.5 \text{ mm}$$



4x250 MW NABINAGAR TPP

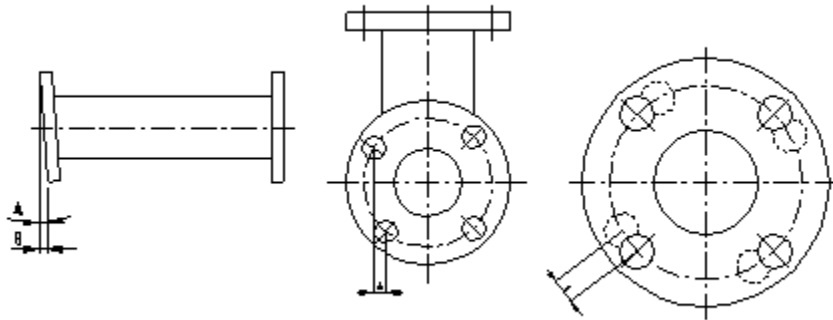
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It should be noted that some tanks designed for operation, in vertical position, are to be handled in horizontal position during the various stages of lining. Hence, such vessels should be designed accordingly.

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 equipments, 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.



4X250 MW NABINAGAR TPP

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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				



4X250 MW NABINAGAR TPP

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**MISC. FGD TANKS
TECHNICAL SPECIFICATION**

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SUB-SECTION-C
SITE STORAGE AND PRESERVATION GUIDELINES

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHANICAL 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 ₂ SO 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.

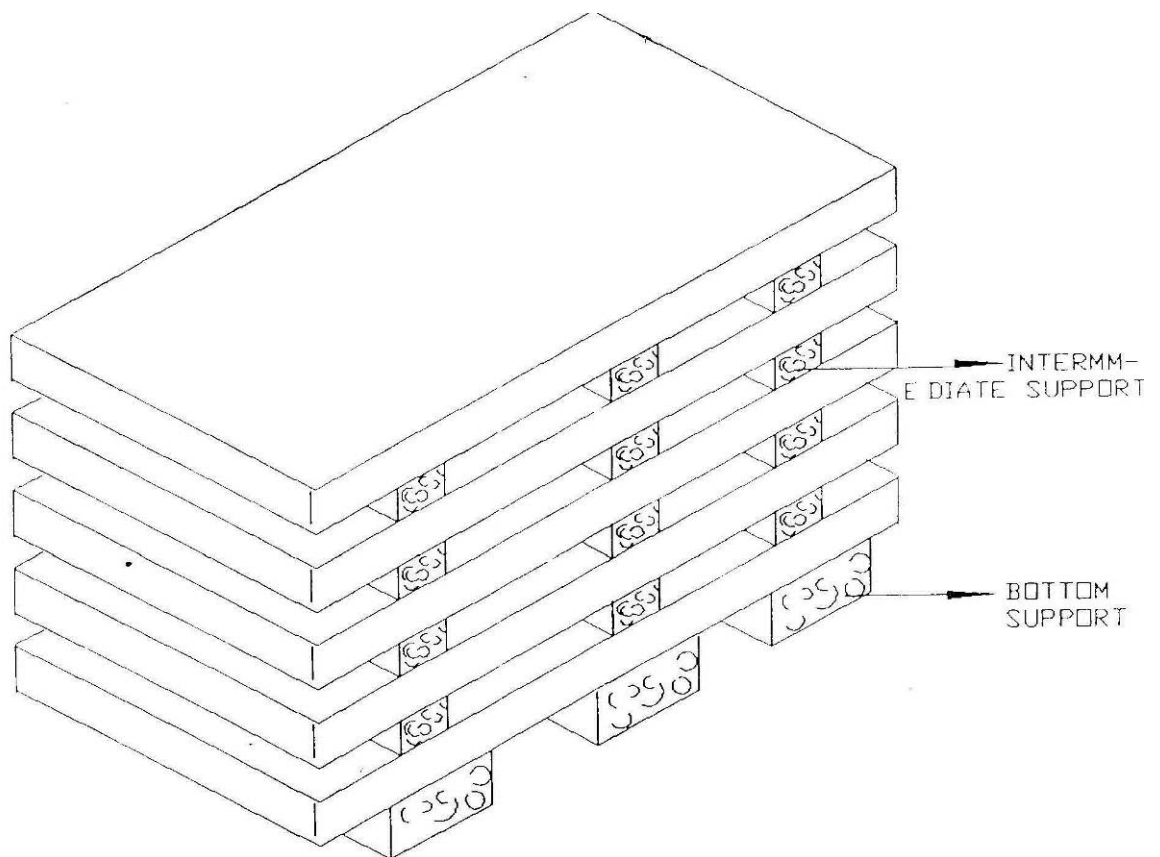


Figure – 1 – PLATE STACKING ARRANGEMENT

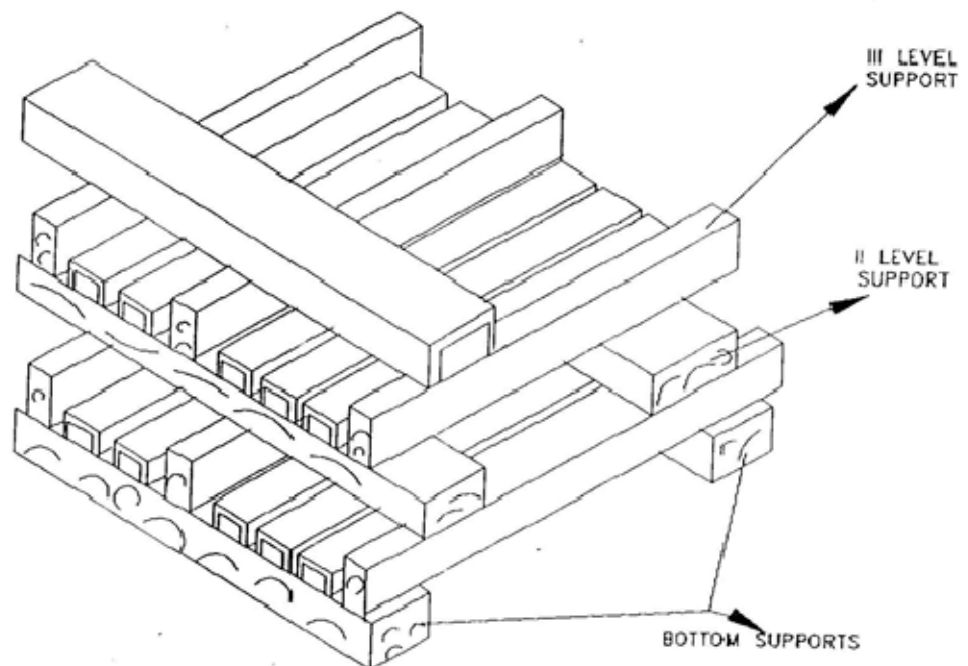


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT



**4X250 MW NABINAGAR TPP
TECHNICAL SPECIFICATION FOR FGD
TANKS**

SPECIFICATION No: PE-TS-463-167-A101

SECTION-III

REV. 00

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SECTION-III



**4X250 MW NABINAGAR TPP
TECHNICAL SPECIFICATION FOR
FGD TANKS**

SPECIFICATION No: PE-TS-463-167-A101

SECTION : III

REV: 00

DATE: MAY 2020

SHEET 1 OF 1

**ANNEXURE-1
LIST OF DOCUMENTS TO BE SUBMITTED WITH THE BID**

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-5 of section-III)
8. FGD Tanks Schedule & GA Drawing (Typical) with Agitator Platform (refer Annexure-8 of section-III)



**4x250 MW NABINAGAR TPP
TECHNICAL SPECIFICATION FOR
MISC. FGD TANKS**

SPECIFICATION No:PE-TS-463-167-A101

SECTION : III

REV. NO. 00

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SHEET: 1 OF 2

ANNEXURE-2

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



**4x250 MW NABINAGAR TPP
TECHNICAL SPECIFICATION FOR
MISC. FGD TANKS**

SPECIFICATION No:PE-TS-463-167-A101

SECTION : III

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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.

SIGNATURE: _____

NAME : _____

DESIGNATION: _____

COMPANY: _____

DATE: _____

COMPANY SEAL



**4X250 MW NABINAGAR TPP
MISC. FGD TANKS**

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ANNEXURE - 3

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

ANNEXURE-4 (DEVIATION SHEET WITH COST OF WITHDRAWL)									
 TITLE: TECHNICAL SPECIFICATION FOR MISC FGD TANKS PACKAGE PROJECT:-4 X250 MW NABINAGAR TPP									
TECH SPC NO: PE-TS-463-167-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.									



**4 X 250 MW NABINAGAR TPP
MISC. FGD TANKS
TECHNICAL SPECIFICATION**

SPECIFICATION NO. PE-TS-463-167-A101

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ANNEXURE -5

LIST OF MAKES OF SUB VENDOR ITEMS

<u>S.N.</u>	<u>ITEM NAME</u>	<u>MANUFACTURER</u>	<u>LOCATION</u>



**4 X 250 MW NABINAGAR TPP
TECHNICAL SPECIFICATION FOR
MISC. FGD TANKS**

SPECIFICATION NO. PE-TS-463-167-A101

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ANNEXURE - 6

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

SECTION- III

4 X 250 MW NABINAGAR TPP- MISC. FGD TANKS PACKAGE

LIST OF COMMISSIONING SPARES

Sl. no	Description	Qty.	Unit	Unit price	Total Ex- Works Prices duly packed
1	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.



TITLE:

**4 X250 MW NABINAGAR TPP
TECHNICAL SPECIFICATION FOR
MISC. FGD TANKS**

SPECIFICATION No: PE-TS-463-167-A101

SECTION-III

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DATE: MAY 2020

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ANNEXURE-8

FGD TANKS SCHEDULE

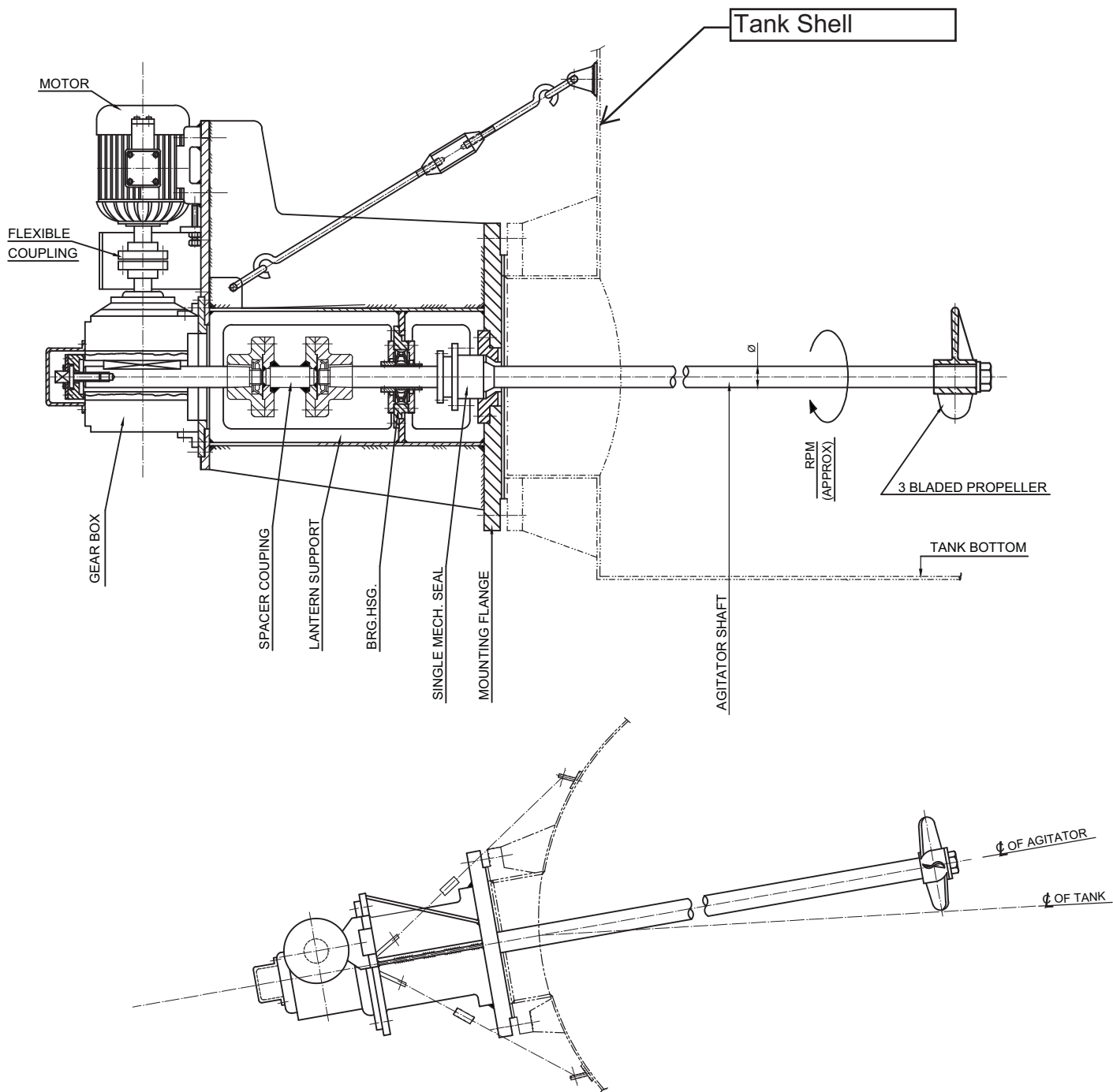
&

GA DRAWING (TYPICAL) WITH AGITATOR PLATFORM

TANK SCHEDULE (Signed and Stamped copy to be submmitted 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 filter wash tank	Cake wash(clarified water) tank	Absorber Area Drain Pit	Gypsum Area Drain Pit	Limestone Area Drain Pit
1	Tank SI 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 Water	Process Water	Gypsum slurry	Gypsum slurry	Gypsum slurry
4	Agitator Location	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Not applicable	Not applicable	Not applicable	Outdoor	Outdoor	Outdoor
5	Agitator Operation	Continuous	Continuous	Continuous	Continuous	Continuous	Whenever FGD is under maintenance	Not applicable	Not applicable	Not applicable	Continuous	Continuous	Continuous
6	Tank details												
a)	Tank Shape	Vertical cylindrical	Vertical cylindrical	Vertical cylindrical	Vertical cylindrical	Vertical cylindrical	Vertical cylindrical	Vertical cylindrical	Vertical cylindrical	Vertical cylindrical	Rectangular (RCC sump)	Rectangular (RCC sump)	Rectangular (RCC sump)
b)	Tank Material	IS:2062 E250 GR.BR	IS:2062 E250 GR.BR	IS:2062 E250 GR.BR	IS:2062 E250 GR.BR	IS:2062 E250 GR.BR	IS:2062 E250 GR.BR	IS:2062 E250 GR.BR	IS:2062 E250 GR.BR	IS:2062 E250 GR.BR	RCC (refer note-1)	RCC (refer note-1)	RCC (refer note-1)
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 filter wash tank	Cake wash(clarified water) tank	Absorber Area Drain Pit	Gypsum Area Drain Pits	Limestone Area Drain Pit
d)	Tank/Sump Quantity (in No.)	1	1	1	1	2	1	2	2	2	4	1	1
	Capacity of Tank (in m3)												
e)	Capacity (Hold Volume)	140.0	71.5	92.0	215.0	1162.0	694.3	102.0	21.2	21.2	56.0	56.0	56.0
f)	Capacity (Effective)	106.8	47.7	64.8	169.2	1017.4	680.0	68.7	11.3	11.3	27.2	27.2	27.2
	Dimension (in m)												
g)	Diameter	5.5	4.5	5.0	6.5	11.5	9.5	5.0	3.0	3.0	-	-	-
h)	Length	-	-	-	-	-	-	-	-	-	4	4	4
i)	Breadth	-	-	-	-	-	-	-	-	-	4	4	4
j)	Height	6.4*	5.0*	5.2*	7.0*	11.7*	10.3*	5.7*	3.5*	3.5*	4	4	4
7	Quantity of Agitator per tank	1	1	1	1	1	3 (Refer note-2)	Not applicable	Not applicable	Not applicable	1	1	1
8	Total quantity of Agitators (for four units)	1	1	1	1	2	3 (Refer note-2)	Not applicable	Not applicable	Not applicable	4	1	1
9	Agitator Loads												
a)	Static Load (per agitator assembly) (in Tonnes)	1.01	0.65	0.65	1.28	2.9	1.35	Not applicable	Not applicable	Not applicable	0.5	0.5	0.5
b)	Dynamic load (per agitator assembly) (in Tonnes)	2.02	1.30	1.30	2.56	5.8	2.7	Not applicable	Not applicable	Not applicable	1.1	1.1	1.1
10	Tentative Nozzle size for Agitator (in NB)	300	300	300	350	450	300	-	-	-	-	-	-
11	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 (75 μ)	200 mesh (75 μ)	200 mesh (75 μ)	200 mesh (75 μ)	200 mesh (75 μ)	200 mesh (75 μ)	-	-	-	6-7 mm	6-7 mm	6-7 mm
c)	Normal solid particle size, d50	325 mesh (43 μ)	325 mesh (43 μ)	325 mesh (43 μ)	325 mesh (43 μ)	325 mesh (43 μ)	325 mesh (43 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 30000 ppm	max 30000 ppm	max 30000 ppm	max 30000 ppm	max 1000 ppm	max 30000 ppm	-	-	-	max 30000 ppm	max 30000 ppm	max 1000 ppm
f)	Hardness of particle	5-7 mho scale	5-7 mho scale	5-7 mho scale	5-7 mho scale	5-7 mho scale	5-7 mho scale	-	-	-	5-7 mho scale	5-7 mho scale	5-7 mho 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	1.069	1.112	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 -62 deg C; Design-70 deg C.	Normal -62 deg C; Design-70 deg C.	Normal -62 deg C; Design-70 deg C.	Normal -45 deg C; Design-55 deg C.	Normal -62 deg C; Design-70 deg C.	Normal -62 deg C; Design-70 deg C.	-	-	-	Normal -62 deg C; Design-70 deg C.	Normal -62 deg C; Design-70 deg C.	Normal -45 deg C; Design-55 deg C.
12	Process water Analysis												
a)	Calcium as CaCO ₃ (mg/l)	-	-	-	-	-	-	131	131	131	-	-	-
b)	Magnesium as CaCO ₃ (mg/l)	-	-	-	-	-	-	52	52	52	-	-	-
c)	Sodium + Potassium as CaCO ₃ (mg/l)	-	-	-	-	-	-	65	65	65	-	-	-
d)	Total Cations as CaCO ₃ (mg/l)	-	-	-	-	-	-	248	248	248	-	-	-
e)	Chlorides as CaCO ₃ (mg/l)	-	-	-	-	-	-	20	20	20	-	-	-
f)	Sulphate as CaCO ₃ (mg/l)	-	-	-	-	-	-	93	93	93	-	-	-
g)	Nitrate as CaCO ₃ (mg/l)	-	-	-	-	-	-	10	10	10	-	-	-
h)	Alkanity as CaCO ₃ (mg/l)	-	-	-	-	-	-	125	125	125	-	-	-
i)	Total Anions as CaCO ₃ (mg/l)	-	-	-	-	-	-	248	248	248	-	-	-
j)	Iron(total) as Fe (mg/l)	-	-	-	-	-	-	0.3	0.3	0.3	-	-	-
k)	Total Silica as SiO ₂ (mg/l)	-	-	-	-	-	-	125	125	125	-	-	-
l)	pH	-	-	-	-	-	-	7.0 – 8.2	7.0 – 8.2	7.0 – 8.2	-	-	-
m)	Turbidity (NTU)	-	-	-	-	-	-	10	10	10	-	-	-
13	Inside Lining of tank/sumps												
a)	Lining specification / Painting specification of interior surface	Bromobutyl rubber lining with Shore A hardness as 55±5 and min 4 mm thickness as per CI 4.0, sub section C1-B, Sec-I of specification.	Vinyl ester-based Glass Flake lining of min 3 mm thickness as per Clause no 4.0, Sub section C1-C, Section-I of specification.			Bromobutyl rubber lining with Shore A hardness as 55±5 and min 4 mm thickness as per CI 4.0, sub section C1-B, Sec-I of specification.		Epoxy lining of minimum 150 micron thickness (3 coats of 50 micron each)			Vinyl ester-based Glass Flake lining of min 3 mm thickness as per Clause no 4.0, Sub section C1-C, Section-I of specification.		
14	Size and Number of Anchor Bolts per tank	M20 x 12 nos	M16 x 8 nos	M16 x 8 nos	M20 x 12 nos	M32 x 20 nos	M28 x 20 nos	M20 x 8 nos	M12 x 4 nos	M12 x 4 nos	-	-	-
15	Mateial Specification	For material of construction for Plates, Structure, Pipes, Fittings, Flanges, Gasket, Anchor bolts amd Fasteners, refer Annexure-9, Section-III.											
16	Nozzles required on tanks	Refer Nozzle Schedule under Annexure - 10, Section -III											
Notes													
1	The absorber area Drain Pit, Gypsum area Drain Pit, Limestone area Drain Pit is exluded from bidder scope of work. However, the supply, erection and commissioning of the 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. BHEL shall also arrange the supervision of Erection and commissioining activity.												
2	The number of agitators is indicative and for estimation purpose. The same shall be finalized during detail engineering.												
3	For detailed scope of work refer the technical specification.												
4	*Although the height of all tanks is fixed above, final height shall be as per design calculation of tanks during detailed engineering.												
5	The outside surface of the tanks shall be coated with paint as approved by the BHEL/Customer.												
6	Agitator loads provided at S.N.9 above are for estimation purpose only. The final loads shall be furnished during detail engineering.												
7	The Nozzle sizes provided for Agitators at S.N. 10 are for estimation purpose only. The final nozzle sizes shall be furnihsd during detailed engineering.												

1) ABSORBER TANK AGITATOR



NOTES:

- 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.

INDICATIVE SKETCH
FOR REFERENCE ONLY

TYPICAL MOUNTING ARRANGEMENT OF SIDE MOUNTED AGITATOR-SKETCH-002

PROJECT : 4X250 MW NABINAGAR TPP			
ANNEXURE-9			
Material of construction for pipes, fittings and other items			
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

PROJECT : 4 x 250 MW NABINAGAR TPP

ANNEXURE- 10

1.PRIMARY HYDRO CYCLONE FEED TANK

S.N.	NOZZLE MARK	SIZE (NB)	QTY (NOS)	SERVICE
1	N1 A/B/C/D	80	4	INLET TO TANK ON ROOF
2	A1	300	1	AGITATOR NOZZLE ON ROOF
3	MH1/MH2	800	2	MANHOLE ON SHELL AND ROOF
4	N2	350	1	TANK OVERFLOW
5	LT-1/LT-2	80	2	LEVEL TRANSMITTER ON ROOF
6	N3	80	1	VENT(WITH BIRD SCREEN) ON ROOF
7	N4	150	1	TANK DRAIN
8	N5 A/B	250	2	PUMP SUCTION (OUTLET)

2.FILTERATE WATER TANK

S.N.	NOZZLE MARK	SIZE (NB)	QTY (NOS)	SERVICE
1	N1 A/B/C/D	200	4	INLET TO TANK ON ROOF
2	N2 A/B/C	150	3	INLET TO TANK ON ROOF
3	N3	100	1	INLET TO TANK ON ROOF
4	N4	80	1	INLET TO TANK ON ROOF
5	A1	300	1	AGITATOR NOZZLE ON ROOF
6	MH1/MH2	800	2	MANHOLE ON SHELL AND ROOF
7	N5	300	1	TANK OVERFLOW
8	LT-1/LT-2	80	2	LEVEL TRANSMITTER ON ROOF
9	N6	80	1	VENT(WITH BIRD SCREEN) ON ROOF
10	N7	100	1	TANK DRAIN
11	N8 A/B	200	2	PUMP SUCTION (OUTLET)

3.SECONDARY HYDRO CYCLONE FEED TANK

S.N.	NOZZLE MARK	SIZE (NB)	QTY (NOS)	SERVICE
1	N1 A/B	250	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	250	1	TANK OVERFLOW
6	LT-1/LT-2	80	2	LEVEL TRANSMITTER ON ROOF
7	N4	100	1	TANK DRAIN
8	N5 A/B	200	2	PUMP SUCTION (OUTLET)
9	N6	80	1	VENT(WITH BIRD SCREEN) ON ROOF

4. WASTE WATER TANK

S.N.	NOZZLE MARK	SIZE (NB)	QTY (NOS)	SERVICE
1	N1 A/B	200	2	INLET TO TANK ON ROOF
2	N2	100	1	INLET TO TANK ON ROOF
3	N3	65	1	INLET TO TANK ON ROOF
5	A1	350	1	AGITATOR NOZZLE ON ROOF
6	MH1/MH2	800	2	MANHOLE ON SHELL AND ROOF
7	N4	200	1	TANK OVERFLOW
8	LT-1/LT-2	80	2	LEVEL TRANSMITTER ON ROOF
9	AT-1/AT-2	80	2	ANALYSER TRANSMITTER ON ROOF
10	N5	80	1	VENT(WITH BIRD SCREEN) ON ROOF
11	N6	150	1	TANK DRAIN
12	N7 A/B	150	2	PUMP SUCTION (OUTLET)

5. LIMESTONE SLURRY STORAGE TANKS - 2 NOS

S.N.	NOZZLE MARK	SIZE (NB)	QTY (NOS)	SERVICE
1	N1 A/B	200	2	INLET TO TANK ON ROOF
2	N2 A/B/C/D	80	4	INLET TO TANK ON ROOF
3	A1	450	1	AGITATOR NOZZLE ON ROOF
4	MH1/MH2	800	2	MANHOLE ON SHELL AND ROOF
5	N3	150	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	N4	80	1	VENT(WITH BIRD SCREEN) ON ROOF
9	N5	200	1	TANK DRAIN
10	N6 A/B/C/D	100	4	PUMP SUCTION (OUTLET)

6. AUXILIARY ABSORBENT TANK

S.N.	NOZZLE MARK	SIZE (NB)	QTY (NOS)	SERVICE
1	N1 A/B/C/D/E/F/G/H	150	8	INLET TO TANK ON ROOF
2	N2 A/B/C/D	250	4	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	250	1	TANK OVERFLOW
6	LT-1	80	1	LEVEL TRANSMITTER ON ROOF
8	N4	80	1	VENT(WITH BIRD SCREEN) ON ROOF
9	N5	200	1	TANK DRAIN
10	N6 A/B	150	2	PUMP SUCTION (OUTLET)

7. PROCESS WATER TANKS - 2 NOS

S.N.	NOZZLE MARK	SIZE (NB)	QTY (NOS)	SERVICE
1	N1	250	1	INLET TO TANK ON ROOF
2	N2 A/B/C/D	50	4	INLET TO TANK ON ROOF
3	N3 A/B/C/D	80	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(WITH BIRD SCREEN) 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	40	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	N4	50	1	VENT(WITH BIRD SCREEN) ON ROOF
7	N5	80	1	TANK DRAIN
8	N6 A/B	65	2	PUMP SUCTION (OUTLET)

8. CAKE WASH (CLARIFIED WATER) TANKS - 2 NOS

S.N.	NOZZLE MARK	SIZE (NB)	QTY (NOS)	SERVICE
1	N1	150	1	INLET TO TANK ON ROOF
2	N2	80	1	INLET TO TANK ON ROOF
3	N3	50	1	INLET TO TANK ON ROOF
6	MH1/MH2	800	2	MANHOLE ON SHELL AND ROOF
7	N4	200	1	TANK OVERFLOW
8	LT	80	1	LEVEL TRANSMITTER ON ROOF
9	N5	50	1	VENT(WITH BIRD SCREEN) ON ROOF
10	N6	80	1	TANK DRAIN
11	N7 A/B	100	2	PUMP SUCTION (OUTLET)

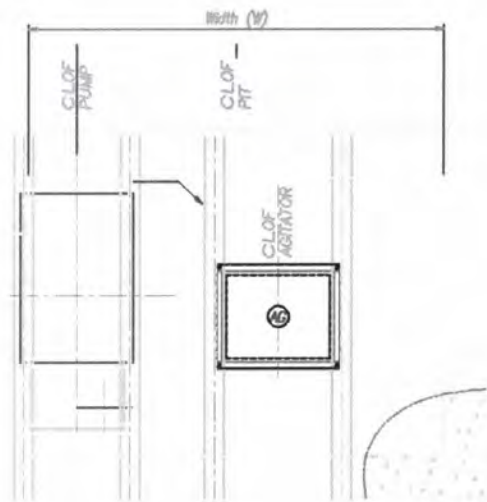
Notes

1: The above shown sizes and number of nozzles are indicative and for estimation purpose only. Final number and sizes of nozzles shall be furnished during detailed engineering.

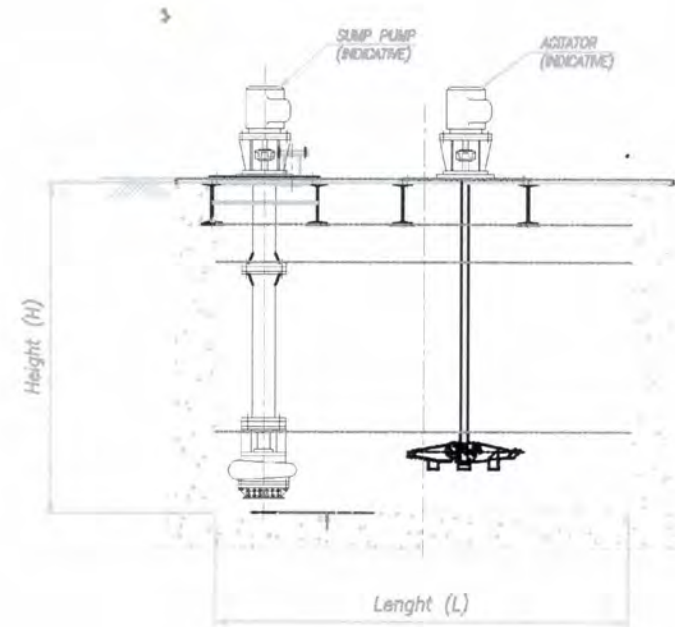
ANNEXURE -11

All dimensions are in mm

Sketch of Drain Pit (Typical)



Plan



Elevation

Note:

For dimension, please refer clause no: 5.1 Table No: 4 of technical specification

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