

BHILAI FGD (2X250MW)

**OF
NTPC Limited
(A Government of India Enterprise)**

TECHNICAL SPECIFICATION FOR AGITATORS

SPECIFICATION NO.: PE-TS-468-571-18000-A001



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



2 X 250 MW BHILAI FGD

AGITATORS

TECHNICAL SPECIFICATION

SPECIFICATION No: PE-TS-468-571- 18000-A001

SECTION-I & SECTION-II

REV. 00

Date: April, 2020.

CONTENTS

SECTION - I

SUB- SECTIONS	TITLE	Page No.
Sub-Section-A	INTENT OF SPECIFICATION	3
Sub-Section-B	PROJECT INFORMATION WITH WIND AND SEISMIC DESIGN CRITERIA	7
Sub-Section-C	TECHNICAL SPECIFICATIONS	
Sub Section-C1	SPECIFIC TECHNICAL REQUIREMENT– MECHANICAL	37
Sub Section-C2	CUSTOMER SPECIFICATION	56
C2 - A	TECHNICAL REQUIREMENT	
C2 - B	PROJECT SPECIFIC GENERAL REQUIREMENTS INCLUDING:	
	GENERAL TECHNICAL REQUIREMENT	
	QUALITY ASSURANCE	
	FUNCTIONAL GUARANTEES	
C2 - C	PAINTING SPECIFICATION	
Sub Section-C3	TECHNICAL SPECIFICATION (ELECTRICAL PORTION)	205
Sub Section-D	ANNEXURE-I LIST OF MAKES OF SUB-VENDOR ITEMS	253
	ANNEXURE-II MANDATORY SPARE LIST	256
	ANNEXURE-III INPUT DRAWINGS	259
	ANNEXURE-IV MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION	270
	ANNEXURE-V SEA-WORTHY PACKING	274

SECTION - II

SUB SECTIONS	TITLE	Page No.
Annexure-1	LIST OF DOCUMENTS TO BE SUBMITTED WITH BID	329
Annexure-2	COMPLIANCE CUM CONFIRMATION CERTIFICATE	331
Annexure-3	PRE BID CLARIFICATION SCHEDULE	334
Annexure-4	DEVIATION SHEET (COST OF WITHDRAWAL)	336
Annexure-5	ELECTRICAL LOAD DATA	338
Annexure-6	LIST OF MAKES OF SUB VENDOR ITEMS	340
Annexure-7	LIST OF TOOLS & TACKLES	342
Annexure-8	AGITATOR SCHEDULE	344
Annexure-9	LIST OF COMMISSIONING SPARES	348
Annexure-10	SCHEDULE OF GUARANTEES	350
Annexure-11	ATTACHMENT -3K	352-364.

5897/2020/PS-PEM-MAX



TITLE:

2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATIONS FOR
AGITATORS

SPECIFICATION No: PE-TS-468-571-18000-A001

SECTION-I, SUB-SECTION-A

REV. 00

Date: April, 2020

**SECTION-I,
SUB-SECTION-A**

INTENT OF SPECIFICATION

	TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATIONS FOR AGITATORS	SPECIFICATION No: PE-TS-468-571-18000-A001	
		SECTION-I, SUB-SECTION-A	
		REV. 00	
		Date: April, 2020	

1.0 SCOPE OF ENQUIRY/ INTENT OF SPECIFICATION

- 1.1 The specification covers Supply part, Services part and Mandatory spares 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, fill of lubricants & consumables till handing over, mandatory spares along with spares for erection, start-up and commissioning, forwarding, proper packing, shipment and delivery at site, assembly and services part covers supervision services for erection & commissioning, trial run at site and carrying out Performance guarantee tests at site, training of customer/ client O&M staff covering all aspects of the Agitator- Operation & Maintenance, Troubleshooting etc., training of customer at manufacturer's works (3 persons for 2 days including lodging and boarding) & handover in flawless condition of the package to the customer complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order for Agitators for 2 X 250 MW BHILAI FGD. The following points may be noted.
- Agitators are envisaged in various tanks, details of which are given in Technical Information of Agitators.
 - Bidder shall assume full unit responsibility for the entire equipment assembly and make all possible efforts to comply strictly with the requirements of this specification and other specifications/attachments to inquiry/order.
 - The Bidder shall offer only proven design which meets the Provenness /Pre-qualification requirement of NTPC. Necessary document evidences as per Attachment-3K for qualification shall be submitted along with the bid. If bidder doesn't meet the specified provenness criteria, their offer will be rejected.
- 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, supervision services for erection and commissioning, performance and guarantee/demonstration testing of **Agitators**.
- 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

	TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATIONS FOR AGITATORS	SPECIFICATION No: PE-TS-468-571-18000-A001	
		SECTION-I, SUB-SECTION-A	
		REV. 00	
		Date: April, 2020	
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.			
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 specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Sec.-III of the 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 along with cost of withdrawal in the enclosed schedule (in Section -III); otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/it's customer.		
1.9	In the event of any conflict between the requirements of two clauses of this specification & requirements of different codes/standards and between respective clauses of sub-section C & sub-section D, more stringent clause as per the interpretation of the owner shall apply.		
1.10	In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.		
1.11	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.		
1.12	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.		

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		SECTION-I, SUB-SECTION-A	
		REV. 00	
		Date: April, 2020	

1.13 BHEL’s along with its 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.

1.14 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.

1.15 All text/ numeric in the document / drawings to be generated by the successful bidder will be in English language only.

1.16 The bidder’s offer shall not carry any sections like clarification, interpretations and /or assumptions.

Note:

a) 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.bhelpem.com/Wrench%20Web%20Access/Login.aspx>).



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SECTION-I, SUB-SECTION-B

PROJECT INFORMATION WITH WIND AND SEISMIC DESIGN CRITERIA

CLAUSE NO.	PROJECT INFORMATION			
1.00.00	BACKGROUND NSPCL has setup coal based thermal power plant of 2X250 MW capacity at BHILAI in Chhattisgarh primarily to meet captive power requirement of SAIL, NSPCL is supplying balance power to the beneficiaries in the western region. Both the units have been commissioned during 2008-09 and commercialized during 2009-10.			
1.01.0	LOCATION AND APPROACH The NSPCL site is located at District Durg, Bhilai (East) having latitude and longitude of 21° 11' 25" N and 81°26'05" E, respectively. The nearest railhead on the Raipur- Nagpur section of South Eastern Central Railway is Bhilai which is approx. 4 km from site. The site is approachable from National Highway -6 which connects the site with both Durg and Raipur. The nearest- airport is at Raipur, about 35kms away from the site. The nearest town is Bhilai, approx. 10 km from the project site. Vicinity plan of the proposed project is placed at Annexure-I .			
1.02.00	LAND Total land area for plant & dyke is 659 acres. Ash Dyke is constructed in 221 Acre land.			
1.03.00	WATER The make- up water requirement for the plant has been met from the existing system of Bhilai CPP-1, CPP-2 and BSP i: e Maroda Tank-II, which is fed by Tandula Main Canal.			
1.04.00	Coal Quality Parameters / Fuel Oil Characteristics& Plant Water details: (i) The coal quality parameters and Fuel oil Characteristics are indicated in Table-1 & Table-2 respectively below. (ii) Process water: Process water quality based on COC given in Table-4. (iii) Clarified water: Clarified water quality is indicated in Table-4. (iv) DM water for Equipment cooling water system. DM water quality is indicated in Table-5.			
1.05.00	STEAM GENERATOR AND ESP DATA: Refer Table-6			
~~1.06.00~~	~~Drawings are enclosed as per Table-7 for initial overview to the Bidder.~~			
2.00.00	NOT USED			
3.00.00	Capacity Present proposal : 2 X 250 MW			
4.00.00	Metrological Data The metrological data from nearest observatory is placed at Annexure-II .			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-II-A5 PROJECT INFORMATION (BHILAI 2X250 MW)	PAGE 1 OF 30

CLAUSE NO.	PROJECT INFORMATION 		
5.00.00	CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND a) Steel structures : 2% b) Reinforced Concrete structures : 5% c) Reinforced Concrete Stacks : 3% d) Steel stacks : 2% 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 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:		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-II-A5 PROJECT INFORMATION (BHILAI 2X250 MW)	PAGE 2 OF 30

CLAUSE NO.	PROJECT INFORMATION 		
	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). 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. 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.		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-II-A5 PROJECT INFORMATION (BHILAI 2X250 MW)	PAGE 3 OF 30

CLAUSE NO.	PROJECT INFORMATION 		
	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 : 0.10g 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 special moment resisting steel frames designed and detailed as per IS:800 : 0.025 b) For special concentrically braced steel frames designed and detailed as per IS:800 : 0.019 c) For special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 : 0.015 d) for RCC chimney, RCC Natural Draft Cooling Tower : 0.05 e) for liquid retaining tanks : 0.03 f) for steel chimney, Absorber tower, Vessels : 0.038 g) for design of structures not covered under 2 (a) to 2 (f) above and under 3 below, in general (excluding special structure/ configuration/materials) : 0.025 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 : 0.05 Note: g = Acceleration due to gravity The horizontal seismic acceleration spectral coefficients are furnished in Annexure-A.		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-II-A5 PROJECT INFORMATION (BHILAI 2X250 MW)	PAGE 4 OF 30

CLAUSE NO.	PROJECT INFORMATION																																																																																																																																																		
	Annexure-A HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS (In units of 'g') <table><tr><th rowspan="2">Time Period (Sec)</th><th colspan="3">Damping Factor (as a percentage of critical damping)</th></tr><tr><th>2%</th><th>3%</th><th>5%</th></tr><tr><td>0.000</td><td>1.000</td><td>1.000</td><td>1.000</td></tr><tr><td>0.030</td><td>1.000</td><td>1.000</td><td>1.000</td></tr><tr><td>0.050</td><td>1.810</td><td>1.679</td><td>1.509</td></tr><tr><td>0.098</td><td>3.935</td><td>3.325</td><td>2.596</td></tr><tr><td>0.101</td><td>3.935</td><td>3.438</td><td>2.660</td></tr><tr><td>0.107</td><td>3.935</td><td>3.438</td><td>2.789</td></tr><tr><td>0.150</td><td>3.935</td><td>3.438</td><td>2.789</td></tr><tr><td>0.200</td><td>3.935</td><td>3.438</td><td>2.789</td></tr><tr><td>0.250</td><td>3.935</td><td>3.438</td><td>2.789</td></tr><tr><td>0.300</td><td>3.935</td><td>3.438</td><td>2.789</td></tr><tr><td>0.350</td><td>3.935</td><td>3.438</td><td>2.789</td></tr><tr><td>0.400</td><td>3.935</td><td>3.438</td><td>2.789</td></tr><tr><td>0.450</td><td>3.935</td><td>3.438</td><td>2.789</td></tr><tr><td>0.485</td><td>3.935</td><td>3.438</td><td>2.789</td></tr><tr><td>0.503</td><td>3.791</td><td>3.438</td><td>2.789</td></tr><tr><td>0.531</td><td>3.591</td><td>3.254</td><td>2.789</td></tr><tr><td>0.600</td><td>3.178</td><td>2.880</td><td>2.467</td></tr><tr><td>0.650</td><td>2.934</td><td>2.658</td><td>2.277</td></tr><tr><td>0.670</td><td>2.846</td><td>2.579</td><td>2.209</td></tr><tr><td>0.700</td><td>2.724</td><td>2.469</td><td>2.114</td></tr><tr><td>0.750</td><td>2.543</td><td>2.304</td><td>1.973</td></tr><tr><td>0.800</td><td>2.384</td><td>2.160</td><td>1.850</td></tr><tr><td>0.850</td><td>2.244</td><td>2.033</td><td>1.741</td></tr><tr><td>0.900</td><td>2.119</td><td>1.920</td><td>1.644</td></tr><tr><td>0.950</td><td>2.007</td><td>1.819</td><td>1.558</td></tr><tr><td>1.000</td><td>1.907</td><td>1.728</td><td>1.480</td></tr><tr><td>1.050</td><td>1.816</td><td>1.646</td><td>1.410</td></tr><tr><td>1.100</td><td>1.734</td><td>1.571</td><td>1.345</td></tr><tr><td>1.150</td><td>1.658</td><td>1.503</td><td>1.287</td></tr><tr><td>1.200</td><td>1.589</td><td>1.440</td><td>1.233</td></tr><tr><td>1.250</td><td>1.526</td><td>1.382</td><td>1.184</td></tr><tr><td>1.300</td><td>1.467</td><td>1.329</td><td>1.138</td></tr><tr><td>1.350</td><td>1.413</td><td>1.280</td><td>1.096</td></tr><tr><td>1.400</td><td>1.362</td><td>1.234</td><td>1.057</td></tr></table>				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	1.810	1.679	1.509	0.098	3.935	3.325	2.596	0.101	3.935	3.438	2.660	0.107	3.935	3.438	2.789	0.150	3.935	3.438	2.789	0.200	3.935	3.438	2.789	0.250	3.935	3.438	2.789	0.300	3.935	3.438	2.789	0.350	3.935	3.438	2.789	0.400	3.935	3.438	2.789	0.450	3.935	3.438	2.789	0.485	3.935	3.438	2.789	0.503	3.791	3.438	2.789	0.531	3.591	3.254	2.789	0.600	3.178	2.880	2.467	0.650	2.934	2.658	2.277	0.670	2.846	2.579	2.209	0.700	2.724	2.469	2.114	0.750	2.543	2.304	1.973	0.800	2.384	2.160	1.850	0.850	2.244	2.033	1.741	0.900	2.119	1.920	1.644	0.950	2.007	1.819	1.558	1.000	1.907	1.728	1.480	1.050	1.816	1.646	1.410	1.100	1.734	1.571	1.345	1.150	1.658	1.503	1.287	1.200	1.589	1.440	1.233	1.250	1.526	1.382	1.184	1.300	1.467	1.329	1.138	1.350	1.413	1.280	1.096	1.400	1.362	1.234	1.057
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CLAUSE NO.	PROJECT INFORMATION 		
6.00.00	CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT 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: a) Welded steel structures : 1.0% b) Bolted steel structures : 2.0% c) Reinforced concrete structures : 1.6% : As per IS:6533 & CICIND Model Code whichever is more critical.		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-II-A5 PROJECT INFORMATION (BHILAI 2X250 MW) PAGE 8 OF 30

CLAUSE NO.	PROJECT INFORMATION			
	ANNEXURE-B SITE SPECIFIC DESIGN PARAMETERS The various design parameters, as defined in IS: 875 (Part-3), to be adopted for the project site shall be as follows: a) The basic wind speed “V_b” at ten metres above the mean ground level : 44 metres/second b) The risk coefficient “K₁” : 1.06 c) Category of terrain : Category-2			
7.00.00	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.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-II-A5 PROJECT INFORMATION (BHILAI 2X250 MW)	PAGE 9 OF 30

CLAUSE NO.	PROJECT INFORMATION			
7.02.00	Foundation System The requirements for the foundation system to be adopted are as given in subsequent clauses. Depending upon the depth of competent strata/stratum, type of structures, functional requirement of facility, extent of cutting / filling, suitable foundation, open or pile shall be adopted with approval of owner.			
7.02.01	General Requirements a) All structures/equipment shall be supported either on suitable open foundations (isolated, combined, raft) or pile foundations depending on type of structures/facilities, sub-strata, topography etc. b) The roads, ground floor slabs, trenches, pipe pedestals, channels/drains and staircase foundation with foundation loading intensity less than 4 T / M2 may be supported on open / shallow foundations resting on virgin / controlled compacted filled up soil. c) No other foundation (other than as mentioned in (b) above) shall rest on the filled up ground / soil. d) No foundation shall rest on the black cotton soil. e) Before execution of work the bidder shall ensure that there is no obstruction to underground/overground facilities like sewer lines, pipe lines etc. Any such damage and remedial/ rectification measures shall be at the contractors cost. f) Bidder shall also ensure that there is no damage to existing nearby foundations and the foundations pertaining to this package are not placed at shallower depth than the nearby foundations. If required depth of foundation is deeper than the existing foundations, proper protection shall be provided to existing foundations. g) All foundations shall be designed in accordance with relevant parts of the latest revisions of Indian Standards. h) The water table for design purpose shall be considered at Finished Ground Level. i) A combination of open and pile foundations shall not be permitted under the same equipment / structure / building. j) Foundation for equipments on ground floor For equipments of static weight upto 1.5 T, the equipment may be supported on the ground floor slab by locally thickening the slab. Thickening of the ground floor slab shall be done upto an extent of about 0.6 m beyond the plan area of the equipment on all the sides. Further, the load intensity below the equipment shall be limited to 4T/m2. Other requirements of floor slab and compaction below the floor slab shall be adhered, as specified elsewhere in the specifications. For equipment's of static weight between 1.5 T and 20 T, the equipment may be supported on compacted sand filling with the load intensity below the equipment limited to 4T/m2. The minimum depth of foundation is 1.0m below FFL. Other requirements of sand compaction below the foundation shall be adhered, as specified elsewhere in the specifications.			
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CLAUSE NO.	PROJECT INFORMATION			
7.02.02	For equipment of static weight more than 20 T, the equipment foundation shall be taken to the founding level or shall be built up with PCC from the level as mentioned in the Table 2. The pedestal of equipment foundation or the foundation Block shall be isolated from the adjoining floor slab by providing bitumen impregnated fiber board of minimum 50 mm thick, conforming to IS: 1838 all around the equipment pedestal for the full depth of the floor slab. 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. However, conventional tripod rig may be allowed in inaccessible areas subject to site specific conditions. 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.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-II-A5 PROJECT INFORMATION (BHILAI 2X250 MW)	PAGE 11 OF 30

CLAUSE NO.	PROJECT INFORMATION			
	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 pile capacity. In case of vertical compression test (initial test) the method of loading shall be cyclic as per IS:2911 (relevant part). 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.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-II-A5 PROJECT INFORMATION (BHILAI 2X250 MW)	PAGE 12 OF 30

CLAUSE NO.	PROJECT INFORMATION			
	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 carry out 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.			
7.03.00	Special Requirements			
7.03.01	Details of treatment for foundations / underground structures required to counteract soil / water chemical environment shall be as per detailed geotechnical investigation to be carried out by			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-II-A5 PROJECT INFORMATION (BHILAI 2X250 MW)	PAGE 13 OF 30

CLAUSE NO.	PROJECT INFORMATION			
7.04.00 7.04.01 7.04.02 7.04.03 7.04.04 7.04.05 7.04.06 7.05.00 7.05.01 7.05.02	contractor. Contractor shall carry out chemical analysis during detailed geotechnical investigation and required treatment shall be provided accordingly. Excavation, Filling and Dewatering 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. 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. 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. 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. 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. 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. 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. 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). 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 operation. All blasting shall be done			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-II-A5 PROJECT INFORMATION (BHILAI 2X250 MW)	PAGE 14 OF 30	

CLAUSE NO.	PROJECT INFORMATION 
	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.
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9 SUB-SECTION-II-A5 PROJECT INFORMATION (BHILAI 2X250 MW) PAGE 15 OF 30

CLAUSE NO.	PROJECT INFORMATION													
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. 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.													
7.07.02.05	Geotechnical investigation (field & laboratory) shall be carried out in accordance with the provisions of relevant Indian Standards. 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.													
7.07.03.00	Geotechnical investigation work shall be got executed by the Contractor through the following agencies. 1. C.E.TESTING COMPANY Pvt. Ltd, Kolkata 2. Cengrs Geotechnica Pvt. Ltd, New Delhi 3. KCT Consultancy Services, Ahemdabad 4. M.K. Soil Testing Laboratory, Ahemdabad													
7.08.00	Geotechnical Investigation Scheme a) Boreholes (Minimum) <table><tr><th>S.No</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 boreholes</td></tr></table>				S.No	Structure	Spacing/Number of borehole	Depth of borehole	Remarks	1	FGD	Minimum 14 Nos.	Depth of boreholes shall be 25m to 35m.	Depth of boreholes
S.No	Structure	Spacing/Number of borehole	Depth of borehole	Remarks										
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LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-II-A5 PROJECT INFORMATION (BHILAI 2X250 MW)	PAGE 16 OF 30										

CLAUSE NO.	PROJECT INFORMATION					
	2	Crusher House	Minimum 2 Nos.	Depth of boreholes shall be 25m to 35m.	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)	3 nos	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.					
	LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9		SUB-SECTION-II-A5 PROJECT INFORMATION (BHILAI 2X250 MW)	PAGE 17 OF 30

[illegible]

CLAUSE NO.	PROJECT INFORMATION																						
	 Annexure-III SOIL DATA AND FOUNDATION SYSTEM Employer has carried out geotechnical investigation in vicinity to the proposed area. Logs of available boreholes for bidder's solely information in the vicinity of proposed area are enclosed with this Annexure. The bidder is required to carry out geotechnical investigation as per Clause No 7.08.00 and ascertain the bearing capacity. The onus of correct assessment / interpretation and understanding of the existing subsoil condition / data is on the Bidder. The existing ground level (EGL) 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 – 1 below Table – 1: Net Allowable Bearing Pressure <table border="1" style="width: 100%;"> <thead> <tr> <th>STRUCTURE</th> <th>TYPE OF FOUNDATION TO BE ADOPTED</th> </tr> </thead> <tbody> <tr> <td>FGD and related structures</td> <td>Open</td> </tr> </tbody> </table> b) Bidder is required to carry out geotechnical investigation in this area. The allowable bearing pressure shall be adopted after approval of geotechnical investigation report by owner. However, the maximum allowable bearing pressure shall be as per the approved geotechnical report and shall be limited to the values as furnished in Table-2. Table – 2: Net Allowable Bearing Pressure <table border="1" style="width: 100%;"> <thead> <tr> <th>Founding Depth/ Stratum</th> <th colspan="3">Net Allowable Bearing PressureT/m2</th> </tr> </thead> <tbody> <tr> <td></td> <td>Isolated and combined footings including raft for 25mm permissible settlement in case of soil and 12mm in case of rocky strata</td> <td>Isolated and combined footings for 40mm permissible settlement in case of soil and 12mm in case of rocky strata</td> <td>Rafts (width > 6m) for 75mm permissible settlement in case of soil and 12mm in case of rocky strata</td> </tr> <tr> <td></td> <td colspan="3" style="text-align: center;">Width upto 6.0m</td> </tr> <tr> <td colspan="4">In case of Soil</td> </tr> </tbody> </table>			STRUCTURE	TYPE OF FOUNDATION TO BE ADOPTED	FGD and related structures	Open	Founding Depth/ Stratum	Net Allowable Bearing PressureT/m2				Isolated and combined footings including raft for 25mm permissible settlement in case of soil and 12mm in case of rocky strata	Isolated and combined footings for 40mm permissible settlement in case of soil and 12mm in case of rocky strata	Rafts (width > 6m) for 75mm permissible settlement in case of soil and 12mm in case of rocky strata		Width upto 6.0m			In case of Soil			
STRUCTURE	TYPE OF FOUNDATION TO BE ADOPTED																						
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In case of Soil																							
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-II-A5 PROJECT INFORMATION (BHILAI 2X250 MW)	PAGE 20 OF 30																				

CLAUSE NO.	PROJECT INFORMATION																							
	<table><tr><td>2.0m below NGL</td><td>12</td><td>14</td><td>20</td></tr><tr><td>3.0m below NGL</td><td>15</td><td>20</td><td>25</td></tr><tr><td colspan="4">In case of rocky strata</td></tr><tr><td>0.5m embedment into rock</td><td>30</td><td>30</td><td>30</td></tr><tr><td>1.0m embedment into rock</td><td>35</td><td>35</td><td>35</td></tr></table>				2.0m below NGL	12	14	20	3.0m below NGL	15	20	25	In case of rocky strata				0.5m embedment into rock	30	30	30	1.0m embedment into rock	35	35	35
	2.0m below NGL	12	14	20																				
	3.0m below NGL	15	20	25																				
	In case of rocky strata																							
	0.5m embedment into rock	30	30	30																				
	1.0m embedment into rock	35	35	35																				
	- For NGL, topographical survey drawing along with borehole details carried out by bidder shall be referred.																							
	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:																							
<table><tr><td>Isolated, Strip & Raft (Mill foundations/machine foundation)</td><td>25 mm</td></tr><tr><td>Isolated & Strip (Other than Mill foundations/machine foundation)</td><td>40 mm</td></tr><tr><td>Raft (widths greater than 6 m) (Other than Mill foundations/machine foundation)</td><td>75 mm</td></tr><tr><td>Foundations in rock</td><td>12 mm</td></tr></table>				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	Foundations in rock	12 mm													
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																							
Foundations in rock	12 mm																							
In case the total permissible settlement is to be restricted to less than as above specified from functional requirements, then the net allowable bearing pressure shall be reduced after review in consultation with Engineer.																								

CLAUSE NO.

PROJECT INFORMATION

Annexure-IV

M.K.SOIL TESTING LABORATORY - CAMP : BHILAI																												
PROFORMA FOR PRESENTING DRILLING INFORMATION																												
PROJECT : GEOTECHNICAL INVESTIGATION OF PF2										GEOLOGICAL LOG OF DRILL HOLE										FEATURE								
HOLE NO : BH 31										LOCATION : MAIN PLANT AREA PP 2										TOTAL DEPTH: 30 MTR.								
BEARING OF HOLE : -										CD ORDNATES : X 2200 Y 9100										GROUND WATER TABLE: 130 MTR. SEEPAGE WATER								
COLLAR ELEVATION : -										ANGLE WITH HORIZONTAL VERTICAL										TYPE OF CORE BARREL USED : DOUBLE TUBE								
STARTED : 08.08.2003										GROUND RL : 296.815m										DATE OF COMPLETION 17.08.2003								
DEPTH IN MT	DATE	LITHOLOGY	LOG	PIECES WITH SIZES					STRUCTURAL	SAMPLING SITE RUN	RECOVERY					ROOTS	RATE	CASING	WATER LOSS					COLOUR OF MUD	WASH	DESCR	SPECIAL OBSERVATION AND	
0.00	0.00	Reddish brown clay with organic materials and kankers		4 to 10 mm	10 to 20 mm	20 to 40 mm	40 to 75 mm	75 to 150 mm			20	40	60	80	100					NO PARTIAL	25	50	75	100				
0.50	1.50	Reddish brown clay with kankers and gravels								UCS																		
1.50	2.25	Reddish brown clay with kankers and gravels								SPT 4.8, 10 N = 16																		
2.25	3.00	Reddish brown clay with kankers and gravels								DS																		
3.00	3.75	Reddish brown clay with kankers and gravels								UCS/CS																		
3.75	4.50	Yellowish brown clay with kankers and gravels								DS																		
4.50	5.25	Vergated clayshale clay								SPT 45.40, 45 N = 95																		
5.25	6.00	Vergated clayshale clay								DS																		
6.00	6.75	Vergated clayshale clay								UCS																		
6.75	7.50	Vergated clayshale clay								DS																		
7.50	8.25	Vergated clayshale clay								SPT 45, N = 100 10cm pen																		
8.25	9.00	Vergated clayshale clay								DS																		
9.00	9.75	Vergated clayshale clay								UCS/CS																		
9.75	10.50	Vergated clayshale clay								DS																		
10.50	11.25	Vergated clayshale clay								SPT 50, N = 100 8.0cm pen																		
11.25	12.00	Redish brown clay shale clay with kankers								DS																		
12.00	12.75	Redish brown clay shale clay with kankers								UCS																		
12.75	13.50	Redish brown clay shale clay with kankers								DS																		
13.50	14.25	Weathered silty shale of redish yellow colour								SPT N = 100																		
14.25	15.00	Dark brown coloured lime stone with stromatolite fossil								DS																		
15.00	15.75	Dark brown coloured lime stone with stromatolite fossil							2	CS CR - 21% RQD 20%						20	220											
15.75	16.50	Dark brown coloured lime stone with stromatolite fossil							1 2	CS CR - 26% RQD 17%						17	220											
16.50	17.25	Dark brown coloured lime stone with stromatolite fossil							1	CS CR - 25% RQD 13%						13	220											
17.25	18.00	Dark brown coloured lime stone with stromatolite fossil							1 - 1	CS CR - 28% RQD 17%						17	280											
18.00	18.75	Dark brown coloured lime stone with stromatolite fossil							1 - 1	CS CR - 30% RQD NIL						-	250											
18.75	19.50	Dark brown coloured lime stone with stromatolite fossil							2 2	CS CR - 32% RQD NIL						-	250											
19.50	20.25	Dark brown coloured lime stone with silty shale having carbonate vams							1 - 1	CS CR - 40% RQD NIL						-	250											
20.25	21.00	Yellowish silty shale with carbonate vams							3 1	CS CR - 35% RQD NIL						-	250											
21.00	21.75	Yellowish silty shale with carbonate vams							3	CS CR - 36% RQD NIL						-	250											
21.75	22.50	Yellowish silty shale with carbonate vams							1	CS CR - 38% RQD NIL						-	235											
22.50	23.25	Yellowish silty shale with carbonate vams							1	CS CR - 40% RQD NIL						-	240											
23.25	24.00	Yellowish silty shale with carbonate vams							2 3	CS CR - 34% RQD NIL						-	235											
24.00	24.75	Yellowish silty shale with carbonate vams							1 2	CS CR - 36% RQD NIL						-	235											
24.75	25.50	Yellowish silty shale with carbonate vams							1 - 2	CS CR - 38% RQD NIL						-	230											
25.50	26.25	Yellowish silty shale with carbonate vams							1 1 1	CS CR - 40% RQD NIL						-	230											
26.25	27.00	Dark brown colour lime stone with stromatolite fossil							2 - 4	CS CR - 37% RQD 16%						16	225											
27.00	27.75	Dark brown colour lime stone with stromatolite fossil							2 2	CS CR - 38% RQD 18%						18	230											
27.75	28.50	Dark brown colour lime stone with stromatolite fossil							3 - 2	CS CR - 42% RQD 22%						22	235											
28.50	29.25	Dark brown colour lime stone with stromatolite fossil							2 3 1	CS CR - 44% RQD 24%						24	225											
29.25	30.00	Dark brown colour lime stone with stromatolite fossil							1 2	CS CR - 52% RQD 16%						16	180											

THE ROCK IS
FRICTIONARY,
SOFT,
WEATHERED.
ALSO CORE
SAMPLE BREAKS
FROM THE
CARBONATE VEIN
PART OF A
SAMPLE. THERE
IS ALTERNATE
LAYER OF LIME
STONE AND
SHALE. WATER
LOSS IS
ENCOUNTERED
AT 20 MTR. TILL
END.

LOT-2 PROJECTS
FLUE GAS DESULPHURISATION (FGD)
SYSTEM PACKAGE

TECHNICAL SPECIFICATION
SECTION – VI, PART-A
BID DOC. NO.:CS-0011-109(2)-9

SUB-SECTION-II-A5
PROJECT INFORMATION
(BHILAI 2X250 MW)

PAGE 22 OF 30

CLAUSE NO.	PROJECT INFORMATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
	M.K.SOIL TESTING LABORATORY - CAMP : BHILAI PROFORMA FOR PRESENTING DRILLING INFORMATION <table border="1"> <tr> <td colspan="2">PROJECT : GEOTECHNICAL INVESTIGATION OF PP2</td> <td colspan="2">GEOLOGICAL LOG OF DRILL HOLE</td> <td colspan="2">FEATURE</td> </tr> <tr> <td colspan="2">HOLE NO : BH 30</td> <td colspan="2">LOCATION : MAIN PLANT AREA PP 2</td> <td colspan="2">TOTAL DEPTH : 30 MTR.</td> </tr> <tr> <td colspan="2">BEARING OF HOLE : -</td> <td colspan="2">CD ORIGINATES : X 1700 Y 9400</td> <td colspan="2">GROUND WATER TABLE : 1 MTR. SEEPAGE WATER</td> </tr> <tr> <td colspan="2">COLLAR ELEVATION : -</td> <td colspan="2">ANGLE WITH HORIZONTAL : VERTICAL</td> <td colspan="2">TYPE OF CORE BARREL USED : DOUBLE TUBE</td> </tr> <tr> <td colspan="2">TYPE OF USED (WITH DEPTH) : DIAMOND</td> <td colspan="2">GROUND RL : 289.744</td> <td colspan="2">DATE OF COMPLETION : 09.09.20</td> </tr> <tr> <td colspan="2">STARTED : 03.09.2002</td> <td colspan="4"></td> </tr> </table> <table border="1"> <thead> <tr> <th>MT</th> <th>FROM</th> <th>TO</th> <th>DATE</th> <th>DESCRIPTION</th> <th>LITHOLOGY</th> <th>PIECES WITH SIZES</th> <th>STRUCTURAL</th> <th>SAMPLING</th> <th>RECOVERY</th> <th>ROD (%)</th> <th>RATE</th> <th>WATER LOSS</th> <th>NO PARTIAL</th> <th>WATER LOSS</th> <th>REMARKS</th> <th>SPECIAL OBSERVATION AND</th> </tr> <tr> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th>LOG</th> <th>LOG</th> <th>ST-RUN</th> <th>20</th> <th>40</th> <th>60</th> <th>80</th> <th>100</th> <th>25</th> <th>50</th> <th>75</th> <th>100</th> </tr> </thead> <tbody> <tr> <td>0.00</td> <td>0.00</td> <td>3.9.03</td> <td></td> <td>Reddish brown clay with organic material with lankers and gravels (Red colour)</td> <td></td> <td></td> <td></td> <td>DS</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>0.00</td> <td>0.50</td> <td>3.9.03</td> <td></td> <td>Reddish brown clay with lankers and gravels</td> <td></td> <td></td> <td></td> <td>UGS/DS</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>0.50</td> <td>1.50</td> <td>3.9.03</td> <td></td> <td>Reddish brown clay with lankers and gravels</td> <td></td> <td></td> <td></td> <td>SPT 7, 12, 19 N=31</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>1.50</td> <td>2.25</td> <td>3.9.03</td> <td></td> <td>Reddish brown clay with lankers and gravels</td> <td></td> <td></td> <td></td> <td>DS</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>2.25</td> <td>3.00</td> <td>4.9.03</td> <td></td> <td>Reddish brown clay with lankers and gravels</td> <td></td> <td></td> <td></td> <td>UGS</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>3.00</td> <td>3.75</td> <td>4.9.03</td> <td></td> <td>Reddish brown clay with lankers and gravels</td> <td></td> <td></td> <td></td> <td>DS</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>3.75</td> <td>4.50</td> <td>4.9.03</td> <td></td> <td>Reddish brown clay with lankers and gravels</td> <td></td> <td></td> <td></td> <td>SPT 12, 18, 23 N=41</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>4.50</td> <td>5.25</td> <td>4.9.03</td> <td></td> <td>Reddish brown clay with lankers and gravels</td> <td></td> <td></td> <td></td> <td>DS</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>5.25</td> <td>6.00</td> <td>4.9.03</td> <td></td> <td>Yellowish green slaty shale with fossil impression and carbonate veins</td> <td></td> <td></td> <td></td> <td>DS</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>6.00</td> <td>6.75</td> <td>4.9.03</td> <td></td> <td>Yellowish green slaty shale with fossil impression and carbonate veins</td> <td></td> <td></td> <td></td> <td>DS</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>6.75</td> <td>7.50</td> <td>4.9.03</td> <td></td> <td>Yellowish green slaty shale with fossil impression and carbonate veins</td> <td></td> <td></td> <td></td> <td>DS</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>7.50</td> <td>9.00</td> <td>5.9.03</td> <td></td> <td>Yellowish green slaty shale with fossil impression and carbonate veins</td> <td></td> <td></td> <td></td> <td>CS CR - 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Length</td> <td></td> <td>2</td> <td>3</td> <td>-</td> <td>CS CR - 88 ROD 38%</td> <td></td> <td></td> <td>38</td> <td>220</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>28.50</td> <td>30.00</td> <td>9.9.03</td> <td></td> <td>Grayish slaty shale with carbonate veins</td> <td></td> <td>6</td> <td>4</td> <td>1</td> <td>CS CR - 90 ROD 34%</td> <td></td> <td></td> <td>34</td> <td>200</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> REMARKS: THE ROCK IS SEDIMENTARY SOFT AND WEATHERED. YELLOWISH GREEN SLATY SHALE IS FOUND IN THIS BORE WITH FOSSIL IMPRESSIONS AND CARBONATE VEINS. LIME STONE PATCH OF 55 CM. HAS BEEN ENCOUNTERED AT A DEPTH OF 16 METRS. WHICH IS A PECULIAR FEATURE OF THIS BORE HOLE. IN THIS BORE HOLE ROCK HAS BEEN ENCOUNTERED AT A DEPTH OF 7.50 METRS.				PROJECT : GEOTECHNICAL INVESTIGATION OF PP2		GEOLOGICAL LOG OF DRILL HOLE		FEATURE		HOLE NO : BH 30		LOCATION : MAIN PLANT AREA PP 2		TOTAL DEPTH : 30 MTR.		BEARING OF HOLE : -		CD ORIGINATES : X 1700 Y 9400		GROUND WATER TABLE : 1 MTR. SEEPAGE WATER		COLLAR ELEVATION : -		ANGLE WITH HORIZONTAL : VERTICAL		TYPE OF CORE BARREL USED : DOUBLE TUBE		TYPE OF USED (WITH DEPTH) : DIAMOND		GROUND RL : 289.744		DATE OF COMPLETION : 09.09.20		STARTED : 03.09.2002						MT	FROM	TO	DATE	DESCRIPTION	LITHOLOGY	PIECES WITH SIZES	STRUCTURAL	SAMPLING	RECOVERY	ROD (%)	RATE	WATER LOSS	NO PARTIAL	WATER LOSS	REMARKS	SPECIAL OBSERVATION AND							LOG	LOG	ST-RUN	20	40	60	80	100	25	50	75	100	0.00	0.00	3.9.03		Reddish brown clay with organic material with lankers and gravels (Red colour)				DS										0.00	0.50	3.9.03		Reddish brown clay with lankers and gravels				UGS/DS										0.50	1.50	3.9.03		Reddish brown clay with lankers and gravels				SPT 7, 12, 19 N=31										1.50	2.25	3.9.03		Reddish brown clay with lankers and gravels				DS										2.25	3.00	4.9.03		Reddish brown clay with lankers and gravels				UGS										3.00	3.75	4.9.03		Reddish brown clay with lankers and gravels				DS										3.75	4.50	4.9.03		Reddish brown clay with lankers and gravels				SPT 12, 18, 23 N=41										4.50	5.25	4.9.03		Reddish brown clay with lankers and gravels				DS										5.25	6.00	4.9.03		Yellowish green slaty shale with fossil impression and carbonate veins				DS										6.00	6.75	4.9.03		Yellowish green slaty shale with fossil impression and carbonate veins				DS										6.75	7.50	4.9.03		Yellowish green slaty shale with fossil impression and carbonate veins				DS										7.50	9.00	5.9.03		Yellowish green slaty shale with fossil impression and carbonate veins				CS CR - 40 ROD NIL				190						9.00	10.50	5.9.03		Yellowish green slaty shale with fossil impression and carbonate veins				CS CR - 37 ROD NIL				190						10.50	12.00	6.9.03		Yellowish green slaty shale with fossil impression and carbonate veins				CS CR - 36 ROD NIL				190						12.00	13.50	6.9.03		Yellowish green slaty shale with fossil impression and carbonate veins				CS CR - 42 ROD NIL				180						13.50	15.00	6.9.03		Yellowish green slaty shale with fossil impression and carbonate veins		3	1	-	CS CR - 60 ROD NIL			200						15.00	16.50	6.9.03		Dark brown colour lime stone with stromatolitic fossil impression along with grayish slaty shale having carbonate veins		5	8	2	CS CR - 60 ROD 26%			26	200					16.50	18.00	6.9.03		Grayish slaty shale with carbonate veins		6	6	3	CS CR - 90 ROD 15%			15	190					18.00	19.50	7.9.03		Grayish slaty shale with carbonate veins		5	4	3	CS CR - 91 ROD 28%			28	190					19.50	21.00	7.9.03		Grayish slaty shale with carbonate veins		4	3	1	CS CR - 76 ROD 14%			14	180					21.00	22.50	7.9.03		Grayish slaty shale with carbonate veins		3	1	6	CS CR - 92 ROD 34%			34	200					22.50	24.00	8.9.03		Grayish slaty shale with carbonate veins		3	-	5	CS CR - 93 ROD 45%			45	210					24.00	25.50	8.9.03		Grayish slaty shale with carbonate veins		2	2	7	CS CR - 90 ROD 50%			50	220					25.50	27.00	8.9.03		Grayish slaty shale with carbonate veins		2	2	-	CS CR - 98 ROD 62%			62	230					27.00	28.50	9.9.03		Grayish slaty shale with carbonate veins along with Dark brown colour lime stone with 55 cm. 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12.00	13.50	6.9.03		Yellowish green slaty shale with fossil impression and carbonate veins				CS CR - 42 ROD NIL				180																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
13.50	15.00	6.9.03		Yellowish green slaty shale with fossil impression and carbonate veins		3	1	-	CS CR - 60 ROD NIL			200																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
15.00	16.50	6.9.03		Dark brown colour lime stone with stromatolitic fossil impression along with grayish slaty shale having carbonate veins		5	8	2	CS CR - 60 ROD 26%			26	200																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
16.50	18.00	6.9.03		Grayish slaty shale with carbonate veins		6	6	3	CS CR - 90 ROD 15%			15	190																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
18.00	19.50	7.9.03		Grayish slaty shale with carbonate veins		5	4	3	CS CR - 91 ROD 28%			28	190																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
19.50	21.00	7.9.03		Grayish slaty shale with carbonate veins		4	3	1	CS CR - 76 ROD 14%			14	180																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
21.00	22.50	7.9.03		Grayish slaty shale with carbonate veins		3	1	6	CS CR - 92 ROD 34%			34	200																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
22.50	24.00	8.9.03		Grayish slaty shale with carbonate veins		3	-	5	CS CR - 93 ROD 45%			45	210																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
24.00	25.50	8.9.03		Grayish slaty shale with carbonate veins		2	2	7	CS CR - 90 ROD 50%			50	220																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
25.50	27.00	8.9.03		Grayish slaty shale with carbonate veins		2	2	-	CS CR - 98 ROD 62%			62	230																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
27.00	28.50	9.9.03		Grayish slaty shale with carbonate veins along with Dark brown colour lime stone with 55 cm. Length		2	3	-	CS CR - 88 ROD 38%			38	220																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
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LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-II-A5 PROJECT INFORMATION (BHILAI 2X250 MW)	PAGE 23 OF 30																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												

CLAUSE NO.

PROJECT INFORMATION

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NTPC

M.K.SOIL TESTING LABORATORY - CAMP : BHILAI																								
PROFORMA FOR PRESENTING DRILLING INFORMATION																								
PROJECT : GEOTECHNICAL INVESTIGATION OF PP2										GEOLOGICAL LOG OF DRILL HOLE										FEATURE				
HOLE NO BH 20										LOCATION MAIN PLANT AREA PP 2										TOTAL DEPTH : 50 MTR.				
BEARING OF HOLE -										CD ORDINATES X 1700 Y 9400										GROUND WATER TABLE: 1 MTR. SEEPAGE WATER				
COLLAR ELEVATION -										ANGLE WITH HORIZONTAL VERTICAL										TYPE OF CORE BARREL USED : DOUBLE TUBE				
TYPE OF USED (WITH DEPTH) DIAMOND										GROUND RL : 209.344										DATE OF COMPLETION 09.09.03				
STARTED 03.09.2003																								
FROM MT	TO MT	DATE	LITHOLOGY	LOG NO	PIECES WITH SIZES					STRUCTURAL LOG DESCRIPTION	SAMPLING-TE STRUN	RECOVERY				ROD (%)	RATE OF CUTTING	WATER LOSS				NO OF WATER DETER.	SPECIAL OBSERVATION AND REMARKS	
					10	5	2	1	0.5			20	40	60	80			25	50	75	100			
0.00	0.00	3.9.03	Reddish brown clay with organic materials with kankers and gravels (Red colour)								DS													
0.00	0.50	3.9.03	Reddish brown clay with kankers and gravels								UDS/DS													
0.50	1.50	3.9.03	Reddish brown clay with kankers and gravels								SPT 7, 12, 19 N=31													
1.50	2.25	3.9.03	Reddish brown clay with kankers and gravels								DS													
2.25	3.00	4.9.03	Reddish brown clay with kankers and gravels								UDS													
3.00	3.75	4.9.03	Reddish brown clay with kankers and gravels								DS													
3.75	4.50	4.9.03	Reddish brown clay with kankers and gravels								SPT 12, 18, 23 N=41													
4.50	5.25	4.9.03	Reddish brown clay with kankers and gravels								DS													
5.25	6.00	4.9.03	Yellowish green silty shale with fossilie impression and carbonate veins								DS													
6.00	6.75	4.9.03	Yellowish green silty shale with fossilie impression and carbonate veins								DS													
6.75	7.50	4.9.03	Yellowish green silty shale with fossilie impression and carbonate veins								DS													
7.50	9.00	5.9.03	Yellowish green silty shale with fossilie impression and carbonate veins								CS CR - 40 ROD NIL					-	190							
9.00	10.50	5.9.03	Yellowish green silty shale with fossilie impression and carbonate veins								CS CR - 37 ROD NIL					-	190							
10.50	12.00	6.9.03	Yellowish green silty shale with fossilie impression and carbonate veins								CS CR - 36 ROD NIL					-	190							
12.00	13.50	6.9.03	Yellowish green silty shale with fossilie impression and carbonate veins								CS CR - 42 ROD NIL					-	180							
13.50	15.00	6.9.03	Yellowish green silty shale with fossilie impression and carbonate veins			3	1	-	-		CS CR - 60 ROD NIL					-	200							
15.00	16.50	6.9.03	Dark brown colour lime stone with brown silty fossilie impression alongwith grayish silty shale having carbonate veins			5	8	2	-		CS CR - 80 ROD 26%					26	200							
16.50	18.00	6.9.03	Grayish silty shale with carbonate veins			6	6	3	-		CS CR - 90 ROD 15%					15	190							
18.00	19.50	7.9.03	Grayish silty shale with carbonate veins			5	4	3	-		CS CR - 91 ROD 28%					28	190							
19.50	21.00	7.9.03	Grayish silty shale with carbonate veins			4	3	1	-		CS CR - 96 ROD 14%					14	180							
21.00	22.50	7.9.03	Grayish silty shale with carbonate veins			3	1	6	1		CS CR - 92 ROD 34%					34	200							
22.50	24.00	8.9.03	Grayish silty shale with carbonate veins			3	-	5	2		CS CR - 93 ROD 45%					45	210							
24.00	25.50	8.9.03	Grayish silty shale with carbonate veins			2	2	7	2		CS CR - 90 ROD 56%					56	220							
25.50	27.00	8.9.03	Grayish silty shale with carbonate veins			2	2	-	2		CS CR - 96 ROD 62%					62	230							
27.00	28.50	9.9.03	Grayish silty shale with carbonate veins alongwith Dark brown colour lime stone with 55 cm. Length.			2	3	-	1		CS CR - 88 ROD 36%					36	220							
28.50	30.00	9.9.03	Grayish silty shale with carbonate veins			6	4	1	-		CS CR - 160 ROD 34%					34	200							

LOT-2 PROJECTS
FLUE GAS DESULPHURISATION (FGD)
SYSTEM PACKAGE

TECHNICAL SPECIFICATION
SECTION – VI, PART-A
BID DOC. NO.:CS-0011-109(2)-9

SUB-SECTION-II-A5
PROJECT INFORMATION
(BHILAI 2X250 MW)

PAGE 24 OF 30

CLAUSE NO.	PROJECT INFORMATION																																																																																																																																																																																								
	 Table-1 COAL AND ASH CHARACTERISTICS <table border="1"> <thead> <tr> <th>S.N.</th> <th>Description</th> <th>Symbol</th> <th>Design Coal</th> <th>Worst Coal</th> <th>Best Coal</th> </tr> </thead> <tbody> <tr> <td colspan="6">A: PROXIMATE ANALYSIS (As received basis)</td> </tr> <tr> <td>1</td> <td>Total Moisture</td> <td>%</td> <td>13</td> <td>16</td> <td>12</td> </tr> <tr> <td>2</td> <td>Ash</td> <td>%</td> <td>42</td> <td>46</td> <td>38</td> </tr> <tr> <td>3</td> <td>Volatile matter</td> <td>%</td> <td>21</td> <td>18</td> <td>24</td> </tr> <tr> <td>4</td> <td>Fixed carbon</td> <td>%</td> <td>24</td> <td>20</td> <td>27</td> </tr> <tr> <td colspan="6">B: ULTIMATE ANALYSIS (As received basis)</td> </tr> <tr> <td>1</td> <td>Carbon</td> <td>C%</td> <td>32.92</td> <td>27.97</td> <td>39.08</td> </tr> <tr> <td>2</td> <td>Hydrogen</td> <td>H2%</td> <td>3.2</td> <td>2.45</td> <td>3.4</td> </tr> <tr> <td>3</td> <td>Nitrogen</td> <td>N2%</td> <td>1.28</td> <td>1.08</td> <td>1.19</td> </tr> <tr> <td>4</td> <td>Oxygen (By difference)</td> <td>O2%</td> <td>7.2</td> <td>6.00</td> <td>6.97</td> </tr> <tr> <td>5</td> <td>Sulphur</td> <td>S%</td> <td>0.4</td> <td>0.50</td> <td>0.36</td> </tr> <tr> <td>6</td> <td>Total Moisture</td> <td>H2O%</td> <td>13.00</td> <td>16.00</td> <td>11.00</td> </tr> <tr> <td>7</td> <td>Ash</td> <td>%</td> <td>42.00</td> <td>46.00</td> <td>38.00</td> </tr> <tr> <td>8</td> <td>Gross Calorific Value</td> <td>KCal/Kg</td> <td>3400</td> <td>2800</td> <td>4000</td> </tr> <tr> <td>9</td> <td>Hard grove index</td> <td></td> <td>55</td> <td>50</td> <td>60</td> </tr> <tr> <td colspan="6">C: ASH ANALYSIS</td> </tr> <tr> <td>1</td> <td>Silica</td> <td>(SiO2)%</td> <td>58.78</td> <td>61.30</td> <td>55.70</td> </tr> <tr> <td>2</td> <td>Alumina</td> <td>(Al2O3)%</td> <td>28.20</td> <td>28.35</td> <td>27.20</td> </tr> <tr> <td>3</td> <td>Iron Oxide</td> <td>(Fe2O3)%</td> <td>7.5</td> <td>6.00</td> <td>10.00</td> </tr> <tr> <td>4</td> <td>Titania</td> <td>(TiO2)%</td> <td>1.50</td> <td>1.00</td> <td>2.00</td> </tr> <tr> <td>5</td> <td>Lime</td> <td>(CaO)%</td> <td>1.23</td> <td>1.05</td> <td>1.50</td> </tr> <tr> <td>6</td> <td>Magnesia</td> <td>(MgO)%</td> <td>1.55</td> <td>1.35</td> <td>2.05</td> </tr> <tr> <td>7</td> <td>Sodium Oxide(Na2O) & Potassium Oxide (K2O)</td> <td>% By Difference</td> <td>1.09</td> <td>0.80</td> <td>1.40</td> </tr> <tr> <td>8</td> <td>Phosphoric Anhydride</td> <td>(P2O5)%</td> <td>0.05</td> <td>0.05</td> <td>0.05</td> </tr> <tr> <td>10</td> <td>Sulphuric Anhydride</td> <td>(SO3)%</td> <td>0.10</td> <td>0.10</td> <td>0.10</td> </tr> <tr> <td colspan="6">D: ASH FUSION RANGE (Under reducing atmosphere)</td> </tr> <tr> <td>a)</td> <td>Initial Deformation Temperature (IDT)</td> <td>°C</td> <td>1150</td> <td>1200</td> <td>1100</td> </tr> <tr> <td>b)</td> <td>Hemispherical temperature</td> <td>°C</td> <td>1350</td> <td>1400</td> <td>1300</td> </tr> <tr> <td>c)</td> <td>Flow temperature</td> <td>°C</td> <td>1400</td> <td>1400</td> <td>1400</td> </tr> </tbody> </table>					S.N.	Description	Symbol	Design Coal	Worst Coal	Best Coal	A: PROXIMATE ANALYSIS (As received basis)						1	Total Moisture	%	13	16	12	2	Ash	%	42	46	38	3	Volatile matter	%	21	18	24	4	Fixed carbon	%	24	20	27	B: ULTIMATE ANALYSIS (As received basis)						1	Carbon	C%	32.92	27.97	39.08	2	Hydrogen	H2%	3.2	2.45	3.4	3	Nitrogen	N2%	1.28	1.08	1.19	4	Oxygen (By difference)	O2%	7.2	6.00	6.97	5	Sulphur	S%	0.4	0.50	0.36	6	Total Moisture	H2O%	13.00	16.00	11.00	7	Ash	%	42.00	46.00	38.00	8	Gross Calorific Value	KCal/Kg	3400	2800	4000	9	Hard grove index		55	50	60	C: ASH ANALYSIS						1	Silica	(SiO2)%	58.78	61.30	55.70	2	Alumina	(Al2O3)%	28.20	28.35	27.20	3	Iron Oxide	(Fe2O3)%	7.5	6.00	10.00	4	Titania	(TiO2)%	1.50	1.00	2.00	5	Lime	(CaO)%	1.23	1.05	1.50	6	Magnesia	(MgO)%	1.55	1.35	2.05	7	Sodium Oxide(Na2O) & Potassium Oxide (K2O)	% By Difference	1.09	0.80	1.40	8	Phosphoric Anhydride	(P2O5)%	0.05	0.05	0.05	10	Sulphuric Anhydride	(SO3)%	0.10	0.10	0.10	D: ASH FUSION RANGE (Under reducing atmosphere)						a)	Initial Deformation Temperature (IDT)	°C	1150	1200	1100	b)	Hemispherical temperature	°C	1350	1400	1300	c)	Flow temperature	°C	1400	1400	1400
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CLAUSE NO.	PROJECT INFORMATION																																						
	TABLE - 2 LIGHT DIESEL OIL CHARACTERISTICS AS PER IS 1460-2000 <table><tr><th colspan="2">Characteristics</th><th>LDO</th></tr><tr><td>1.</td><td>Pour Point (max)</td><td>21°C & 12°C for Summer and Winter respectively</td></tr><tr><td>2.</td><td>Kinematic viscosity in centistokes at 40 deg.C</td><td>2.5 to 15.7</td></tr><tr><td>3.</td><td>Sediment percent by mass (max)</td><td>0.10</td></tr><tr><td>4.</td><td>Total sulphur percent by mass (max)</td><td>1.8</td></tr><tr><td>5.</td><td>Ash percentage by mass (max)</td><td>0.02</td></tr><tr><td>6.</td><td>Carbon residue (Rans bottom) percent by pass (max.)</td><td>1.50</td></tr><tr><td>7.</td><td>Acidity in organic</td><td>Nil</td></tr><tr><td>8.</td><td>Flash point(Min.) - Pensky Martens</td><td>66 deg.C</td></tr><tr><td>9.</td><td>Copper strip corrosion for3 hours at 100°C</td><td>Not worse than No. 2</td></tr><tr><td>10.</td><td>Water content, % by volume(max)</td><td>0.25</td></tr><tr><td>11.</td><td>GCV (Kcal/kg)</td><td>10,000</td></tr></table>			Characteristics		LDO	1.	Pour Point (max)	21°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 for3 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-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-II-A5 PROJECT INFORMATION (BHILAI 2X250 MW)	PAGE 26 OF 30																																			

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PAGE 27 OF 30																																																																										

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	 Table-4 DESIGN CLARIFIED WATER ANALYSIS <table border="1"> <thead> <tr> <th>S.No</th> <th>Constituent</th> <th>As</th> <th>mg/l (except pH & turbidity)</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Calcium</td> <td>CaCO₃</td> <td>38</td> </tr> <tr> <td>2.</td> <td>Magnesium</td> <td>CaCO₃</td> <td>22</td> </tr> <tr> <td>3.</td> <td>Chloride</td> <td>CaCO₃</td> <td>20</td> </tr> <tr> <td>4.</td> <td>Sulphate</td> <td>CaCO₃</td> <td>17</td> </tr> <tr> <td>5.</td> <td>Alkalinity</td> <td>CaCO₃</td> <td>54</td> </tr> <tr> <td>6.</td> <td>Iron(total)</td> <td>Fe</td> <td>0.1</td> </tr> <tr> <td>7.</td> <td>Total Silica</td> <td>SiO₂</td> <td>07</td> </tr> <tr> <td>8.</td> <td>pH value</td> <td>---</td> <td>7.5</td> </tr> <tr> <td>9.</td> <td>Turbidity</td> <td>NTU</td> <td>02</td> </tr> </tbody> </table> Note: Clarified water is used for CW system as make up & the CW system is expected to operate at about 5.0 – 5.5 Cycles of Concentration (COC) with suitable chemical treatment program using acid, scale & corrosion inhibitor dosing. As CW blow down water is tapped from CW system, the water quality of CW blow down shall accordingly be arrived by the bidder. Table-5 ANALYSIS OF DM WATER <table border="1"> <thead> <tr> <th>S.N.</th> <th>Characteristics</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Silica (Max.)</td> <td>0.02 ppm as SiO₂</td> </tr> <tr> <td>2.</td> <td>Iron (Fe)</td> <td>Nil</td> </tr> <tr> <td>3.</td> <td>Total hardness</td> <td>Nil</td> </tr> <tr> <td>4.</td> <td>pH value</td> <td>6.8 to 7.2</td> </tr> <tr> <td>5.</td> <td>Conductivity</td> <td>Not more than 0.1 µs/cm</td> </tr> </tbody> </table>			S.No	Constituent	As	mg/l (except pH & turbidity)	1.	Calcium	CaCO ₃	38	2.	Magnesium	CaCO ₃	22	3.	Chloride	CaCO ₃	20	4.	Sulphate	CaCO ₃	17	5.	Alkalinity	CaCO ₃	54	6.	Iron(total)	Fe	0.1	7.	Total Silica	SiO ₂	07	8.	pH value	---	7.5	9.	Turbidity	NTU	02	S.N.	Characteristics	Value	1.	Silica (Max.)	0.02 ppm as SiO ₂	2.	Iron (Fe)	Nil	3.	Total hardness	Nil	4.	pH value	6.8 to 7.2	5.	Conductivity	Not more than 0.1 µs/cm
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CLAUSE NO.	PROJECT INFORMATION																																																					
	 Table-6 STEAM GENERATOR DATA <table border="1"> <tr><td>1.</td><td>Location</td><td>Outdoor</td></tr> <tr><td>2.</td><td>Operation</td><td>Base load</td></tr> <tr><td>3.</td><td>Type</td><td>Pulverized coal fired</td></tr> <tr><td>4.</td><td>Maximum Continuous Rating</td><td>790 Tonns/hr.</td></tr> <tr><td>5.</td><td>Steam pressure at SH outlet</td><td>155 Kg/cm²(a)</td></tr> <tr><td>6.</td><td>Steam temperature at SH outlet</td><td>540°C</td></tr> <tr><td>7.</td><td>Oil for startup and flame stabilization</td><td>LDO</td></tr> <tr><td>8.</td><td>Fuel oil system sizing</td><td>7.5% of Boiler MCR for start-up by LDO, 40% of Boiler MCR by HFO</td></tr> <tr><td>9.</td><td>Pulverised coal size and 99% thru 50 mesh</td><td>Minimum 70% through 200 Mesh</td></tr> <tr><td>10.</td><td>Type of pulveriser</td><td>Vertical spindle mills</td></tr> <tr><td>11.</td><td>Type of oil burners</td><td>Air atomized for LDO</td></tr> <tr><td>12.</td><td>No. of air heaters</td><td>One</td></tr> <tr><td>13.</td><td>No. of ID Fans</td><td>Two (both working)</td></tr> </table> ESP DATA <table border="1"> <tr><td>1.</td><td>Location:</td><td>Downstream side of Air preheaters</td></tr> <tr><td>2.</td><td>Operation:</td><td>Base load</td></tr> <tr><td>3.</td><td>Type:</td><td>Rigid Discharge frame</td></tr> <tr><td>4.</td><td>Rapping:</td><td>Intermittent</td></tr> </table>			1.	Location	Outdoor	2.	Operation	Base load	3.	Type	Pulverized coal fired	4.	Maximum Continuous Rating	790 Tonns/hr.	5.	Steam pressure at SH outlet	155 Kg/cm ² (a)	6.	Steam temperature at SH outlet	540°C	7.	Oil for startup and flame stabilization	LDO	8.	Fuel oil system sizing	7.5% of Boiler MCR for start-up by LDO, 40% of Boiler MCR by HFO	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	Air atomized for LDO	12.	No. of air heaters	One	13.	No. of ID Fans	Two (both working)	1.	Location:	Downstream side of Air preheaters	2.	Operation:	Base load	3.	Type:	Rigid Discharge frame	4.	Rapping:	Intermittent
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PAGE 29 OF 30																																																						



TITLE:

**2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
AGITATORS**

SPECIFICATION No: PE-TS-468-571-18000-A001

SECTION-I, SUB-SECTION-C1

REV. 00

DATE: April, 2020

SECTION-I, SUB-SECTION-C1

SPECIFIC TECHNICAL REQUIREMENT – MECHANICAL

	TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATIONS FOR AGITATORS	SPECIFICATION No: PE-TS-468-571-18000-A001	
		SECTION-C, SUB-SECTION-C1	
		REV. 00	
		Date: April, 2020	

1.0. APPLICABLE CODES & REGULATIONS

The design and materials shall conform to the requirements of applicable codes and regulations of the latest edition. The design, manufacture, installation and testing of the Agitator shall follow the latest applicable Indian/International (AISI / ASME/EN/Japanese) Standards.

Bidder shall supply the equipment in accordance with relevant regulations, codes and standards specified in the specification. If required by relevant regulations, codes and standards specified in the specification, Successful Bidder shall assist BHEL to obtain approval against the equipment, documents and drawings by Indian authorities.

2.0. PROVENNESS CRITERIA/Pre-QUALIFICATION REQUIREMENT

The Bidders are required to meet the Qualification Requirement (PQR) for Agitators as per Provenness Criteria & shall submit the credentials as called in the tender document. Only OEMs qualifying as per the Qualification requirement shall be considered for placement order.

3.0. MATERIAL OF CONSTRUCTION

Sl. No.	Material of construction	Horizontal agitators (side entry)	Vertical Agitators (Top entry)
i.	Impeller blade	Alloy 926 or better material	Alloy 926 or better material
ii.	Impeller Hub	Alloy 926 or better material	Alloy 926 or better material (or) Carbon steel with 6mm thick Bromo/Chloro Butyl Rubber Lining (as per Proven practice)
iii.	Shaft	Alloy 926 or better material	CS with Rubber Lining (min 6 mm thk Chloro/bromo butyl Rubber)
iv.	Fasteners in wetted parts	Alloy 926 or better material	Alloy 926 or better material
v.	Fasteners in Non Wetted	GI fastener (40 μ plated) / SS	GI fastener (40 μ plated) / SS
vi.	Mounting base	Alloy 926/SMO254 (Wetted parts)	Carbon Steel
vii.	Tank Nozzle (for inserting agitator) with Flange	Not applicable (in BHEL scope)	Not applicable (in BHEL scope)
viii.	Flush pipe for Start up with flange	Not applicable (in BHEL scope)	Not applicable (in BHEL scope)
ix.	Flush Pipe at the bottom of the mounting flange	Not applicable (in BHEL scope)	Not applicable (in BHEL scope)
x.	Lantern support with mounting flange and bolts	Carbon steel/MS	Carbon steel/MS
xi.	Tie rods	Bidder to select	Bidder to select
xii.	Seal type and shaft sleeve material	Bidder to select (as applicable)	Bidder to select (as applicable)

Castings used for any part of the agitator assembly ordered under the specification shall be of sound and free of shrink or blow holes, scale, blisters and other similar casting defects.

	TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATIONS FOR AGITATORS	SPECIFICATION No: PE-TS-468-571-18000-A001	
		SECTION-C, SUB-SECTION-C1	
		REV. 00	
		Date: April, 2020	

3.1. POWER SUPPLY DETAILS:

1.	POWER SUPPLY	
	The following voltage levels shall apply:	
	3 phase, 3.3 kV AC ,50 Hz	Voltage for motors equal to / bigger than 200KW and for power distribution within the plant.
	3 phase, 415 V, AC , 50 Hz	Standard voltage for power supplies to electric power consumers and motors Above 0.2 KW and upto 200 kW.
	240V AC / 3 phase 415 V AC, 50 Hz	Standard voltage for power supplies to electric power consumers and motors Upto 0.2 kW.
	- All equipments shall be suitable for rated frequency of 50 Hz with a variation of + 3% & -5%, and 10 % combined variation of voltage and frequency unless specifically brought out in the specification. - Bidder shall design and supply the equipment suitable for satisfactory operation under above mentioned power supply condition. - For further details, refer electrical specification under Section-I, Sub-Section-C2	

4.0. SCOPE OF SUPPLY & SERVICES

The bidder shall assume sole responsibility for the design, fabrication, testing, surface preparation & painting, packing, transportation and performance of the specified equipment with accessories, and shall ensure that the equipment with accessories are in conformance with this specification, as well as other documents which form part of the Purchase Order/Contract.

Various inspections by the BHEL/NTPC shall not relieve the Bidder in any way of his obligation to maintain an adequate test, inspection, and documentation program of his own, and shall not relieve the Bidder of any other obligation under this specification. Furthermore, any inadvertent overlook of deviations from some requirements of this specification by the buyer shall not constitute a waiver of these requirements, or of the Bidder's obligation to correct the condition when it is discovered, or of any other obligation under this specification.

This specification only states the lowest technical requirement, neither specifying all technical details, nor referring the pertaining code and standard fully. It is the Bidder's responsibility to ensure that the complete delivery complies with all relevant codes, standards and specifications.

The Bidder is obliged to supply relevant drawings and documentation to the buyer. All to be in English language and metric system, if not otherwise agreed in writing.

Scope for the bidders shall include Design, Manufacturing, Supply, and Supervision of Erection & Commissioning

Design: broadly includes basic engineering, detail engineering, preparation and submission of engineering drawings/calculations/datasheets/quality assurance documents/field quality plans, storage instructions, commissioning procedures, Erection & assembly Drawings, operation & maintenance manuals, performance guarantee test procedures and assisting BHEL in obtaining time bound approval from NTPC.

Supply: the scope includes the following:

- Includes manufacturing/fabrication, shop floor testing, stage inspections, final inspections, painting & packing.

	TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATIONS FOR AGITATORS	SPECIFICATION No: PE-TS-468-571-18000-A001	
		SECTION-C, SUB-SECTION-C1	
		REV. 00	
		Date: April, 2020	

- Mandatory spares as defined as Section-I, Sub-Section-D, Annexure-II.
- Recommended spare parts list to be furnished (is not part of scope of supply)
- Any special tools & tackles required for the entire equipment to disassemble, assemble or maintain the units.
- Start-up & Commissioning Spares
- First fill of consumables

Services: Services to be provided by the bidder:

- Detailed Erection and commissioning procedure shall be submitted by successful bidder for carrying out the erection and commissioning at site by BHEL.
- Supervision for Erection & Commissioning, trial run at site
- Performance guarantee tests at site & handover in flawless condition of the package to the customer
- Training of customer/ client O&M staff covering all aspects of the GDS- Operation & Maintenance, Trouble-shooting etc. at site
- Training of customer at manufacturer's works (3 persons for 2 days including lodging and boarding)
- Visits shall be planned by BHEL site team and prior intimation shall be sent to supplier for visit to site for supervision services. Bidder shall be informed at least 10 days in advance for the requirement of visit at site. Visiting team shall consist of one or two expert of bidder as deemed necessary by them.

The scope of supply for AGITATORS shall include but not limited to the following:

A) For Horizontal (Side Entry) Agitators:

Sl. No	Scope
1.	AGITATOR complete with
	i. AGITATOR Blades
	ii. AGITATOR Shafts
	iii. Coupling arrangement (Flexible)
	iv. Single Mechanical Seals
	v. Shaft Sleeve
	vi. Lanterns/ Stools (Bearing Housing), Safety Guard
	vii. Bearings
	viii. Agitator Mounting Flanges with gaskets and fasteners
	ix. Drive Motor(IE3) with gearbox arrangement
	x. Supporting arrangement including tie rods, gusset plates etc. of Side Entry Agitator on the tank Wall. Vessel Nozzle and mating flange for supporting on the tank wall , gaskets and fasteners.
	xi. Flushing system for startup consisting of : Pipe with Flange , Nozzle and mating flange, Blind flange for plugging.
	xii. Foundation plate with foundation bolts, vessel nozzle
	xiii. Painting and Rust Prevention during shipment and construction
	xiv. Packing and transportation
	xv. Supervision of Erection & commissioning at site
	xvi. Special tools & tackles as applicable
	xvii. Start-up spares, Spare parts for commissioning & erection, Mandatory Spares: As per



TITLE:
2 X 250 MW BHILAI FGD
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SECTION-C, SUB-SECTION-C1

REV. 00

Date: April, 2020

Sl. No	Scope
	Project Specific Requirement
xviii.	Installation, operation and maintenance manuals
xix.	Any other items required for completeness of the equipment except the items covered in the exclusions.

B) For Vertical (Top Entry) Agitators:

Sl. No	Scope
2.	AGITATOR complete with
	i. AGITATOR Blades
	ii. AGITATOR Shafts
	iii. Coupling arrangement (Flexible)
	iv. Gland Packing, Seals, O Rings, Glands
	v. Shaft Sleeve
	vi. Lanterns/ Stools (Bearing Housing), Safety Guard
	vii. Bearings
	viii. AGITATOR Mounting Flanges with gaskets and fasteners
	ix. Drive Motor(IE3) with gearbox arrangement
	x. Mating Flange for Supporting on Slurry Tank Roof
	xi. Shims
	xii. Painting and Rust Prevention during shipment and construction
	xiii. Packing and transportation
	xiv. Supervision of Erection & commissioning at site
	xv. Special tools & tackles as applicable
	xvi. Start-up spares, Spare parts for commissioning & erection, Mandatory Spares: As per Project Specific Requirement
	xvii. Installation, operation and maintenance manuals
	xviii. Any other items required for completeness of the equipment except the items covered in the exclusions.

The quantity, location of the agitators has been included in the agitator schedule (Section-II, Annexure-8)

		TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATIONS FOR AGITATORS		SPECIFICATION No: PE-TS-468-571-18000-A001	
				SECTION-I, SUB-SECTION-C1	
				REV. 00	
				Date: April, 2020	

4.1	TECHNICAL REQUIREMENTS
I	Agitators shall be supplied in tanks and vessels to prevent caking and settlement of particles out of the slurry, e.g. in the limestone slurry tank, Auxiliary Absorbent tank, and sumps etc.
II	All agitators shall be designed for continuous operation unless otherwise specified. The design of the agitators shall be of proven type.
III	Standard type agitators with suitable characteristics shall be used wherever practical. The agitators shall be complete with motor, gearbox, agitator shaft, coupling, safety guards, mechanical seal (for side entry agitators), impeller, support legs, agitator mounting flange including bolts nuts and gasket etc.
IV	All agitator parts and accessories in contact with the stirred fluid shall be constructed of materials specifically designed for the conditions and nature of the stirred fluid and be resistant to erosion and corrosion.
V	MOC of various agitator parts shall be as per Cl 3.0. This does not release the bidder of the responsibility for selecting the correct materials.
VI	Each agitator and its associated equipment shall be arranged in such a manner as to permit easy access for operation, maintenance and agitator removal without interrupting plant operation. It shall be possible to remove the sealing devices of the side mounted agitators without having to drain completely the slurry inside the tank.
VII	-VOID-
VIII	Lifting lugs and eyes and other special tackle shall be provided as necessary to permit easy handling of the agitators and their components.
IX	Static and dynamic (as far as applicable) balancing of all agitators shall be carried out after assembly.
X	All agitator parts and components shall be designed and calculated for fatigue life, considering maximum bending loads, induced by fluctuating hydraulic forces and torsional loads, based on the installed motor power. For side entry agitators the alternating bending moment resulting from impeller and shaft weight has to be considered additionally.
XI	All exposed moving parts shall be covered by guards.
XII	The shape of the impeller blades of side entry agitator's/top entry agitators shall be designed to avoid wear on the impellers which will affect the agitator performance as specified for a minimum period of 2 years of continuous operation under design conditions for the range of coal & limestone specified in the specification. In order to avoid excessive wear impeller tip speeds must not exceed 12 m/s.
XIII	Belt drives (if applied for side entry agitators) shall be properly designed to provide a minimum lifetime of 2 years under design conditions
XIV	It shall be noted that all Agitators are meant for keeping the solid particles in suspended mode in liquid with "Full off-Bottom Suspension" of solid particles to 98% of liquid column to virtually "Uniform Solid Concentration". No chemical reaction will takes place.
XV	Maintaining a uniform concentration over the 95% of liquid column. Absolute sweeping of solid particle from tank bottom is a must for all Agitators. If speed is required to be increased to guarantee the above requirements; the same can be increased by vendor. Bidder's machines that consume less power will be in an advantageous position.
XVI	It is to be noted that in continuous process any deposit at tank bottom is the loss of material which are not getting converted as per process. Hence, total loss of material by sedimentation is a loss to FGD Process & determines the "In efficiency of the Agitator".
XVII	Vendor should ensure nil settlement; utilization of solid material shall be a guaranteed parameter and will be assessed in percentage (%) term to net wet of solid mass of inflow or out flow. This is one of the guarantee parameter.

PEM-MAX		TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATIONS FOR AGITATORS		SPECIFICATION No: PE-TS-468-571-18000-A001	
		SECTION-I, SUB-SECTION-C1			
		REV. 00			
		Date: April, 2020			
XVIII	Agitator and its driver shall perform on the test stand at shop and on the Agitator's permanent location at site within vibration limit the vibration of combined unit will be the responsibility of Agitator manufacturer. Agitator manufacturer is to ensure that Site performance of vibration is one of the "Acceptance Criteria" of the equipment. Please note vibration at test stand can only be taken as for information.				
XIX	Every Tank will have a pump whose suction line shall be connected to tank. These pumps are to operate continuously at the lowest operating level which is decided by Process requirement. Hence, the minimum operating level of liquid in every tank for every Agitator is a must to assess the combined operation of Agitator as well as that of pump alone. The Tank water level is indicated as per "SECTION-II Annexure-8".				
XX	Agitator must have low-pitch propeller with low solidity ratio and Power Number of 0.3-0.35. The Maximum Input Power at motor terminal shall be considered as a guaranteed parameter under "Schedule of Guaranteed Parameters" in "SECTION-II Annexure-10-Schedule of Guarantees"- and the same shall be calculated for maximum liquid level in tank. A calculation of power specifying the hydraulic power of Agitator, Seal loss, Gear box and Motor internal loss must be submitted along with the offer. A characteristics curve showing power versus liquid level should be submitted from the lowest liquid level, required for Agitator to maximum liquid level in the tank. Motor should be selected based on the highest power demand with a 15% margin at maximum liquid level, taking into account frequency variation.				
XXI	The agitator shall be suitably designed for mounting and operation in purchaser's tank whose drawings is annexed with the enquiry specification (SECTION-I,SUB-SECTION-D, Annexure-III). The successful bidder shall review and comment on the BHEL's tank drawings for number and size of the baffles, sparger locations, mounting nozzle details etc.				
XXII	Unless otherwise specified, for small diameter impeller, it shall be possible to remove complete agitator assembly without dismantling through the opening provided on the tank/sump, and for large diameter impeller, the blade shall be of removable construction for ease of removal. Bidder shall also provide the headroom required for taking out the agitator as above.				
XXIII	Any instruments provided shall be Profibus Compatible.				
XXIV	Bidder shall provide the design and arrangement of baffle plates in circular tanks. Baffle plates are in BHEL scope.				
XXV	Bidder shall provide proper dowelling between motor and base plate, gear box and mounting tool/base plate, for ease of assembly of agitator unit. Tapered dowell shall be provided.				
XXVI	Successful bidder shall provide suitable arrangement for supporting the agitator shaft with impellers during removal of gear-box for maintenance and details of such arrangements shall be furnished during detail engineering.				
4.2	CONSTRUCTIONAL FEATURES				
A)	BLADE AND HUB OF PROPELLER				
I)	The Blade design of the Agitator to be of most efficient design in order to offer least power consumption. The Agitator power consumption is part of the guarantee parameters.				
II)	Although Agitator will have substantial low speed because of reduction Gear Box, hydraulic unbalance at impeller can cause severe vibration, hence it is mandatory that rotating assembly shall be dynamically balanced to its rated speed.				
III)	Impeller should be dynamically balanced to Gr: G16: ISO-1940 after rubber lining of shaft.				
B)	SEAL				
1	Horizontal / Side Entry Agitators:				
I.	Agitators should be provided with Single Stage mechanical seal. the mechanical seal should be as per ISO-21049 / API 682				
II.	The Mechanical Seals shall be so arranged that repacking or fitting of replacement seals can be carried out with the minimum of disruption to plant operation.				
III.	Design the mechanical seals chamber to have sufficient room to lubricate and get seal face cool with				

		TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATIONS FOR AGITATORS		SPECIFICATION No: PE-TS-468-571-18000-A001	
				SECTION-I, SUB-SECTION-C1	
				REV. 00	
				Date: April, 2020	
		its own slurry.			
IV.		Provide requirements for periodical flushing to rinse the seal face for leaked slurry.			
V.		All mechanical seals, regardless of type or arrangement, shall be of the cartridge design. Hook sleeve cartridge should not be used.			
VI.		Requirement of flushing water, its quantity, and pressure to be indicated in data sheet.			
VII.		Zero leakage is the intension of this specification. However, quantity of leakage, if it is unavoidable, it should have a provision of collecting / or discharging back to the tank.			
VIII.		Mechanical seals shall be fitted and installed in the Agitator before shipment and shall be clean. Mechanical seals shall be plugged with screw for shipping.			
IX.		Intention of the specification is not to specify Type of Seal, Seal design, Spring configuration, Seal configuration, Balanced or Unbalance type etc. Agitator manufacturer to decide the same along with seal manufacturer, the best seal that is suitable for the offered Agitator			
X		Seal life has to be guaranteed, taking into consideration all its components for 25000 hrs. If the seals fail before the completion of guaranteed period, the same should be replaced free of cost by the bidder.			
XI		The sub-vendor of the seal shall be approved by NTPC during contract execution.			
2		<u>Vertical Agitators for Other Slurry Tanks & Drain Pit Tanks</u>			
I		Agitator shall be supplied with stuffing box or any proven equivalent or superior sealing type. Mechanical and hydraulic conditions in the seal chamber, required to maintain a stable film at seal face, including temperature, pressure and flow, shall be jointly established by Agitator manufacturer and seal manufacturer, and shall be noted in data sheet submitted in tender. If mechanical seal is offered by bidder, the mechanical seal should be as per ISO-21049 / API 682.			
C)		SHAFT			
I.		Use of dissimilar material at flange joint shall be avoided to eliminate any crevice corrosion. Spacing of the shaft joint should not be more than 3.0 m for easy assembly if it is more than 40kg. If welding is used for joining two tubes, welding joint must be 100% radio graphed. If split shaft is proposed for larger tanks, shaft flange at the joining interface has to be rubber lined at manufacturer's works and necessary fasteners have to be provided.			
II.		Shaft shall be capable of transmitting full rated torque as mentioned in the driver's nameplate.			
III.		Shaft shall be capable for jamming conditions considering the impeller is jammed at a point 0.75 R from the center. Unless otherwise specified a safety factor of 1.5 shall be taken on the motor rating to work out pull out torque for calculating the stresses as per maximum shear strain energy theory. The maximum stress thus calculated shall be limited to yeild stress of shaft material at tank design temperature.			
IV.		Shaft runout shall be limited to a maximum value of 0.05mm at the face of the stuffing box/seal			
V.		In assembled condition the maximum shaft runout at free end shall be limited to 1.0mm/ meter of overhung length of the shaft (measured from the nearest bearing/ seal face end)			
VI.		There shall be a separation margin of minimum 20% between the critical speed and any operating speed.			
D)		BEARING & BEARING HOUSING IN GEAR BOX			
I		Bearing shall be of rolling type radial and thrust bearing (FAG/SKF/Timken make only) as required. Thrust bearing shall be sized for continuous operation under all specified condition.			
II		Thrust bearing shall provide full load capability if the Agitator's normal direction of rotation is reversed. Up-thrust and Down-thrust load must be taken into account in sizing bearing. Life of the every anti-friction bearing, used in the bearing housing as per manufacturer's design, should have L10 of 25000 hr (minimum).			
III		Bearing housing should be grease/oil lubricated. If bearing is oil lubricated, constant-level sight-feed oiler of 100cc size or bigger capacity is to be provided. Bearing housing should have oil drain, constant oil level indicator. A provision of one(1) numberG1/2" thread(ISO-228,Part-1)port is			

PEM-MAX 		TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATIONS FOR AGITATORS		SPECIFICATION No: PE-TS-468-571-18000-A001 SECTION-I, SUB-SECTION-C1 REV. 00 Date: April, 2020	
	required for remote control of temperature of bearing housing oil bath RTD.				
IV	If bearing housing requires cooling water, volume and pressure of cooling water is to be indicated in Technical Data Sheet.				
V	Lubricating oil will be the responsibility of Gear Box manufacturer. Hence, manufacturer has to make arrangement of first fill of oil at installation and at commissioning stage. Quantity of oil and its grade is to be indicated in Drawing and Operation Manual.				
E)	MATERIALS				
I	Agitator components designated as “Full Compliance Material” shall meet the requirements of the industry specification as listed for the material in the table as well as in the specification in the respective section.				
II	A detail quality plan is to be submitted along with offer for all items				
III	Final acceptance of the quality plan will be approved by ultimate user (hereafter called NTPC). Comments, if any, given by NTPC during detail engineering, shall be incorporated by bidders without any price implication. QAP should be as per the best practice followed internationally to avoid any conflict of interest.				
F)	DRIVER (MOTOR)				
I	Driver shall be sized to meet all specified operating conditions including bearing housing , seal, external gear box and coupling loss(if any).				
II	Motor shall be able to accelerate to speed at reduced voltage and frequency as specified in “Site Power Supply Condition” as per Clause: 3.1.				
III	It should meet the electrical specification (SECTION-C, SUBSECTION-C3).				
G)	GEAR BOX				
I.	Gear box should be vertical flange mounted solid shaft type (Vertical Agitators), reducing speed type, specially designed for the requirement of Slurry mixing and to be manufactured by the Agitator supplier. Complete up-thrust and down-thrust, developed by Agitator shall be taken by thrust bearing housing of Gear Box. An auxiliary slow drive provision shall be provided in the Gear Box so that slurry is always kept in dynamic condition to avoid settling of slurry at bottom, in the event of Agitator is not operating at its rated speed. Rating of at Gear box shall be at least 1.5 times the rated torque of Agitator.				
II.	The reduction unit shall be procured from a reputed manufacturer and shall confirm to BS:721 (latest edition)/AGMA/Equivalent specification. The sub-vendor of the gear-box shall be approved by NTPC during contract execution.				
III.	Gear drives shall have splash type oil lubrication. If oil pumps are used, they shall be removable for maintenance without disturbing the motor or drive housing.				
IV.	The gear reduction unit shall always be provided with an oil drain, a breather and oil level guage. The lubrication to be designed keeping in view that the temperature within the bearing should not exceed 85 Deg.C.				
V.	Drive housings shall be fabricated steel (fully stress relieved after welding) or of fine grain cast iron.				
VI.	The bidder shall provide an easily accessible oil level gauge and a dipstick that will indicate oil level under standstill and operating conditions.				
H)	COUPLING & COUPLING GUARD				
I.	Coupling and coupling guard should be supplied between driver and driven equipment.				
II.	Coupling should be designed taking into consideration adequate service factor.				
III.	Design rating of the coupling (excluding service factor) should be indicated in data sheet.				

PEM-MAX 		TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATIONS FOR AGITATORS		SPECIFICATION No: PE-TS-468-571-18000-A001 SECTION-I, SUB-SECTION-C1 REV. 00 Date: April, 2020	
IV.	Coupling must be having locking screw so that it does not slide over shaft in due course operation.				
V.	Vertical Agitators - Coupling between Motor and Gear Box shall be Spacer-type flexible coupling, made of Cast Iron. Spacer length shall be of sufficient length so than Motor and Gear Box shall be able to run independently at no-load condition by detaching the respective coupling.				
VI.	It is desirable that for servicing of seal, coupling half should not be removed. Coupling should be dynamically balanced to Gr: G6.3, ISO-1940.				
VII.	Removable coupling guard shall conform to the requirements of all applicable national, industrial or statutory regulations.				
I)	PLATE AND FASTENING BOLTS				
I.	Base plate shall be interpreted as the component of Agitator assembly through which the whole load will be transmitted to the Sole Plate/Nozzle over which the equipment will be mounted. The Base plate shall be fabricated with mild steel of structural quality (UTS=42N/sq mm minimum) with anti-corrosive paint of sufficient dry-film thickness.				
II.	Base plate must have provision of leveling on its intended mounting place. Nozzle is not in the scope of supply of Agitator manufacturer. It should be noted that Nozzle will be rubber lined to prevent any leakage of corrosive gases				
III.	Alignment between Gear Head Shaft and Agitator shaft shall be within the permissible limit of Gear Box. Similarly, misalignment between Motor shaft and Gear Box Shaft shall be within 0.050 micron (radial) and 2 degree (angular) or better as per requirement of Motor and Gear Box				
IV.	Sole plate with desired number of hole shall be provided by the bidder, will be machined on one side. Sole Plate shall be welded to the structure after leveling, as recommended by Agitator manufacturer and rubber lining is completed before placing the equipment in its desired location.				
J)	OTHER COMPONENTS				
I	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, thread remains unaffected. Raw material of fastener must undergo Inter-granular Corrosion test as per ISO-3651, Part-1 for Nitric Acid test.				
II	Wherever required, the bidder shall provide mounting stool for agitator unit. It shall house the shaft coupling, the bearing housing, the seal and the auxiliary coupling as applicable.				
III	The lantern stool shall be designed to provide adequate accessibilty for ease of erection and maintenance. The stool shall be either in standard ERW construction as per IS: 1978 or shall be fabricated from IS: 2062 Gr.B plate. Plugged holes shall be provided at proper locations to drain the oil which may get collected in the stool due to improper functioning of gear box, oil seal etc.				
IV	Mounting flange dimensions shall be as per ASME B16.5 upto 600 Nb, ASME B 16.47 for more than 600 NB.				
V	Rubber Lining (As Applicable) a) Rubber lined surfaces shall utilize 6 mm nominal thickness chlorobutyl rubber. b) Areas of high wear (e.g. leading edges on impeller blades) shall have an additional 6 mm of rubber for abrasion protection. c) No field-applied linings are permitted except for file patch kits.				
	GENERAL REQUIREMENT OF SIDE ENTRY AGITATORS:				
I.	All Agitators shall be designed for continuous operation.				
II.	The Material of Construction (MOC) of side entry Agitators shall be as per C1 3.0				
III.	It should be of Flange mounted type.				
IV.	Nozzle size, on which Agitator shall be mounted, shall have enough opening to Insert rotating assembly from side. Vendor to provide the nozzle and flange along with the agitator.				
v.	The Bidder to consider Gypsum Sedimentation during stoppage of Agitator.				

PEM-MAX 		TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATIONS FOR AGITATORS		SPECIFICATION No: PE-TS-468-571-18000-A001 SECTION-I, SUB-SECTION-C1 REV. 00 Date: April, 2020	
VI.		The following information to be provided along with the bid: a) Impeller Diameter b) Impeller Speed c) Agitator Pumping Capacity (m^3/min) d) Volume per Agitator:			
		GENERAL REQUIREMENT OF TOP ENTRY AGITATORS IN OTHER SLURRY TANKS & DRAIN PITS:			
I.		All Agitators shall be designed for continuous operation.			
II.		The Material of Construction (MOC) of Top Entry Agitators shall be as per Cl 3.0			
III.		It should be roof mounted.			
IV.		Agitators shall be vertical mounted type and shall be driven by motor with reducing speed gear box of rigid type, solid shaft coupling between gear box and agitator and flexible coupling of spacer type coupling between Motor and Gear Box. Both Gear Box and Motor should be vertically/horizontally flange mounted type with a common frame of the whole equipment. The entire thrust load of agitator should be transmitted to the thrust bearing of Gear box.			
V.		Nozzle size, on which Agitator shall be mounted, shall have enough opening to Insert rotating assembly from top.			
VI.		Cable entry to the Motor terminal box should preferably be from top when motor is vertically mounted at its position and it should be easily accessible.			
VII.		Impeller should be dynamically balanced to Gr: G16: ISO-1940 after rubber lining of shaft.			
5		GENERAL REQUIREMENTS			
1		Metric unit shall be used in the drawings and in the any displays on the equipment's. Special attention should be taken that the unit of pressure shall be in dual scales of kPa and kg/cm2G. For instance the pressure gauges should have dual unit's indication.			
2		Descriptions in the drawings, in the documents, and in the displays shall be in English			
3		All rotating parts such as coupling shall be covered with suitable protective guards. Guards shall be easily removable type.			
4		The equipment shall be designed to withstand the corrosive and moist environment in which these are proposed to operate.			
5		Noise level produced by any rotating equipment individually or collectively shall not exceed 85 dB measured at a distance of 1.0 meters from the source in any direction and 1.5m above operating floor.			
6		The overall vibration level shall be as per ISO 10816.			
7		Suitable drain connections shall be provided.			
8		The equipment shall be suitable for stable operation continuously.			
9		Corrosion allowance: Corrosion allowance for entire equipment shall be in accordance with latest applicable Indian / International standard.			
10		Unless otherwise specified , flanges shall be in accordance with ANSI B16.5 Class 150			
11		Name plate: All equipment shall be provided with nameplates indicating the item number and service name. Name plates shall be of 304 Stainless steel plate and placed at a readily visible location. Nameplate of main equipment shall have enough information, which will be confirmed during engineering phase. Stainless steel nameplates for all instruments and valves shall be provided.			
12		Rotation arrows shall be cast in or attached with stainless steel plate on each item of rotation equipment at a readily visible location.			

		TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATIONS FOR AGITATORS		SPECIFICATION No: PE-TS-468-571-18000-A001	
				SECTION-I, SUB-SECTION-C1	
				REV. 00	
				Date: April, 2020	
13	Unless otherwise specified, all equipment items where the weight exceeds 15 kg shall be provided with suitable lifting lugs, ears or ring bolts or tapped holes for lifting rings. Minimum shock factor for lifting lugs shall be minimum 2.0. The position of lifting lugs and reference dimension shall be shown on GA and/or outline drawings. NDT shall be conducted for lifting lugs. When any spreader bars are required for lifting and laydown, the bidder shall provide spreader bar with equipment.				
14	Skid Mount/Transportation: Equipment shall be fabricated as skid mount design as much as practical to minimize erection at the site.				
15	If the driver/driven equipment train is in the resonance condition or any vibration problems occur, the bidder shall solve the problems in a timely manner.				
16	Bidder shall provide the necessary gaskets.				
17	All the surfaces of the carbon steel should be rust prevented before shipment for the period of at least 12 months for storage and construction.				
18	Bidder to provide capacity of hoist required for material handling and the details of heaviest component to be handled. Bidder shall provide a typical arrangement/drawing of the handling arrangement.				
19	The list of all Bought out items with makes and country of origin to be mentioned along with offer to be submitted.				
20	Cost towards the participation in discussions/meetings, providing technical assistance during technical discussions/meetings with customer for approval of drawing/documents etc. TA/DA, boarding and lodging to attend these meetings shall be borne by the bidder and shall be inclusive in supply portion.				
21	Material of construction for all equipment/components shall be subject to NTPC/ BHEL approval during detail engineering. Accordingly bidder shall consider MOC for all equipment/component (complying tender specifications), as per best engineering practice, global standard and global references, in case no MOC is available in specs.				
22	Bidder to provide sub vendor list and Bidder shall strictly adhere to NTPC approved vendor list (reference list is included in SUB-SECTION-C1F). In case bidder proposes an additional vendor for an item or vendor approval is required for any new item, acceptance shall be subject to approval by NTPC/ BHEL before placing order and bidder shall submit relevant documents to take up with NTPC for approval.				
23	It shall be the complete responsibility of the successful bidder to obtain “Sub Vendor Approval” from BHEL / NTPC for all equipment’s & components. Any delay in sub vendor’s approval should not affect the project schedule. If any of the sub vendors does not have the approval of NTPC/ BHEL, the same may be replaced with another NTPC/BHEL approved sub-vendor only, without any price implications to BHEL.				
24	The modalities of inspection (Stage, Final, In-process) shall be finalized during detail engineering after submission of quality assurance plan (QAP). It shall be reviewed by the NTPC and BHEL. Bidder shall follow the procedures of inspection as per the approved QAP. Bidder has to submit the following documents along with inspection call and if any other documents required as per approved QAP. - Raw material inspection certificate - Internal test reports - Statutory certificates as required. - All inspection & testing shall be carried out based on the following documents: a. Relevant Standards b. Specifications c. Approved drawings d. Data Sheets e. Calibration certificate for all the measuring instruments				

		TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATIONS FOR AGITATORS		SPECIFICATION No: PE-TS-468-571-18000-A001	
				SECTION-I, SUB-SECTION-C1	
				REV. 00	
				Date: April, 2020	
25	During detail engineering, bidder to strictly adhere to BHEL/NTPC drawing formats, document numbering, quality plan & FQP formats				
26	The identification and numbering of equipment, systems, items, etc. of supply, as well as of all documents and drawings shall be in accordance with reference Designation System for Power Plants - KKS system.				
27	Complete detail engineering drawings, calculations, selection of components etc. shall be reviewed & subject to approval of BHEL/NTPC during detail engineering				
28	Bidder shall furnish necessary inputs & drawings of all equipment in editable Auto CAD/ MS-Word /Excel format.				
29	During detail engineering, successful bidder shall ensure flow of drawings/documents as per schedule. Any comments from BHEL/NTPC should be addressed timely by the bidder.				
30	Bidder to note above mentioned points not exhaustive and any work /items required for completing the smooth operation and ensuring satisfactory running of the machines till final hand over to the end user shall also be in the scope of the bidder.				
31	Bidder shall provide design support to assist the Purchaser in efficiently integrating the furnished equipment. Design support specifically includes: • Bidder shall verify/ validate the number and location of agitators to keep material in suspension. • Static and dynamic loading information and requirements for agitator support design (applicable for top & side type)				
6	PACKING AND FORWARDING				
1	Proper packing to be ensured. Indigenous Supply: Agitator & sub system assembly shall be wrapped in polythene bags & packed in a strong rigid wooden crate. Rain water should not enter into the Agitator internals during storage in the outer yard of power plant. Further the packing shall be done in line with requirements mentioned in point no. 2 to 20 of this section. Imported Supply: All imported supply should be packed as per Sea worthy packing standards as per Sub-Section C-1G. All imported items should have Sea worthy packing. Liberal packing materials and struts shall be provided to arrest rolling and to protect from transit damages.				
2	Equipment and process materials shall be packed and semi-knocked down, to the extent possible, to facilitate handling and storage and to protect bearings and other machine surfaces from oxidation. Each container, box, crate or bundle shall be reinforced with steel strapping in such a manner that breaking of one strap will not cause complete failure of packaging. The packing shall be of best standard to withstand rough handling and to provide suitable protection from tropical weather while in transit and while awaiting erection at the site.				
3	Equipment and materials in wooden cases or crates shall be properly cushioned to withstand the abuse of handling, transportation and storage. Packing shall include preservatives suitable to tropical conditions. All machine surfaces and bearings shall be coated with oxidation preventive compounds. All parts subject to damage when in contact with water shall be coated with suitable grease and wrapped in heavy asphalt or tar impregnated paper.				
4	Crates and packing material used for shipping will become the property of owner (NTPC).				
5	Packaging or shipping units shall be designed within the limitations of the unloading facilities of the receiving ports and the ship will be used. It shall be the bidder’s responsibility to investigate these limitations and to provide suitable packaging and shipping to permit transportation to site.				
6	Packing (tare) shall be part of the equipment cost and shall not be subject to return. The packing should ensure integrity and cohesiveness of each delivery batch of equipment during transportation. In case of equipment assemblies and unit’s delivery in the packing of glass, plastics or paper the				

		TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATIONS FOR AGITATORS		SPECIFICATION No: PE-TS-468-571-18000-A001	
				SECTION-I, SUB-SECTION-C1	
				REV. 00	
				Date: April, 2020	
		specification of packing with the material and weight characteristics are to be indicated.			
7		Each package should have the following inscriptions and signs stenciled with an indelible ink legibly and clearly: a. Destination b. Package Number c. Gross and Net Weight d. Dimensions e. Lifting places f. Handling marks and the following delivery marking			
8		Each package or shipping units shall be clearly marked or stenciled on at least two sides as per the dispatch instruction givens during the contract. In addition, each package or shipping unit shall have the symbol painted in red on at least two sides of the package, covering one fourth of the area of the side.			
9		Each part of the equipment which is to be shipped as a separate piece or smaller parts packed within the same case shall be legibly marked to show the unit of which it is part, and match marked to show its relative position in the unit, to facilitate assembly in the field. Unit marks and match marks shall be made with steel stamps and with paint.			
10		Each case shall contain a packing list showing the detailed contents of the package. When any technical documents are supplied together with the shipment of materials no single package shall contain more than one set of such documents. Shipping papers shall clearly indicate in which packages the technical documents are contained.			
11		The case number shall be written in the form of a fraction, the numerator of which is the serial number of the case and the denominator the total number of case in which a complete unit of equipment is packed.			
12		Wherever necessary besides usual inscriptions the cases shall bear special indication such as “Top”, “Do not turn over”, “Care” , “Keep Dry” etc. as well as indication of the center of gravity (with red vertical lines) and places for attaching slings (with chain marks)			
13		Marking for Safe handling: To ensure safe handling, packing case shall be marked to show the following: a. Upright position b. Sling position and center of Gravity position c. Storage category d. Fragile components (to be marked properly with a clear warning for safe handling)			
14		Each crate or package is to contain a packing list in a waterproof envelope. All items are to be clearly marked for easy identification against the packing List. All cases, packages etc. are to be clearly marked on the outside to indicate the total weight where the weight is bearing and the correct position of the slings are to bear an identification mark relating them to the appropriate shipping documents. All stencil marks on the outside of cases are either to be made in waterproof material or protected by shellac or varnish to prevent obliteration in transit.			
15		The packing slip shall contain the following information: - Customer name, Name of the equipment, Purchase Order number with Date, Address of the delivery site, Name and Address of the Sender, Serial Number of Agitator, BHEL item Code, Gross Weight and Net weight of Supplied items.			
16		Prior to transport from manufacturer’s work to destination, components of the unit shall be completely cleaned to remove any foreign particles. Flange faces and other machined surfaces shall be protected by an easily removable rust preventive coating followed by suitable wrapping.			
17		All necessary painting, corrosion protection & preservation measures shall be taken as specified in painting schedule. Supplier shall consider the coastal environment zone which is defined as “very			

		TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATIONS FOR AGITATORS		SPECIFICATION No: PE-TS-468-571-18000-A001	
				SECTION-I, SUB-SECTION-C1	
				REV. 00	
				Date: April, 2020	
		severe” during final finishing/shipping.			
18		Successful bidder shall furnish the detail packing /shipment box details with information like packing box size, type of packing, weight of each consignment, sequence no. of dispatch, no. of consignment for each deliverable item against each billing break up units/ billable blocks. Without these details the BBU shall not be approved during detail engineering.			
19		All items/equipment shall be dispatched in properly packed condition (i.e. no item shall be dispatched in loose condition such that it becomes difficult to store/identify its location at site at a later stage).			
20		Cases which cannot be marked as above shall have metal tags with the necessary markings on them. The metal tags shall be securely attached to the packages with strong steel binding wire. Each piece, Skid, Case or package shipped separately shall be labelled or tagged properly.			
8		SUPERVISION OF ERECTION, TESTING AND COMMISSIONING			
1		The erection of Agitators will be done by owner, based on Erection Manual and check List to be provided by the bidder during detail engineering. However, the bidder shall make visit as per enquiry/PO for the supervision of erection, pre-commissioning & post- commissioning check-up, start-up, testing and trial runs of all the items covered under the scope of supply & Services.			
2		The bidder will be informed well in advance for the visit.			
3		BHEL shall submit fabrication dwgs to successful bidder for review and approval. Successful bidder to furnish its observations on fabrication dwgs. within 7 days of dwgs submission. The cost for the same shall be included by bidder in its offer.			
4		Price comparison for evaluating the lowest bid will be considered all main supply, supervision of E&C charges and mandatory spares price all together.			
5		Scope of Supervision for Erection & commissioning: Tentatively following visits shall be planned by site team which shall be as follows: - • Three visits (for all agitators) of 20 days each for supervision for erection, pre-commissioning & post- commissioning check-up, start-up, testing and trial runs of all the items covered under the scope of supply & Services. • Two visits of 10 days each (for all agitators) for performance demonstrations and handing over of system. • Any additional visit as per requirement of BHEL site office during erection of equipment.			
6		Any other service required for making the installation complete in all respect within battery limits and for satisfactory erection & commissioning of the system shall be in bidders scope.			
9		EXCLUSION			
		The following work associated with the Agitators will be by others: a. Access, Walkways, platforms and ladders b. Handling equipment (hoist) along with the handling arrangement. However, bidder shall provide the details of the same to BHEL. c. Baffle plates d. Agitator mounts/supports except as specifically identified above e. Foundations f. Receiving, unloading, and storage at the project site g. Installation, however, supervision of erection and commissioning shall be in bidder’s scope h. Support steel structure for top entering agitators			
10		INSPECTION AND TESTING			
1		The General inspection requirements to be considered are as below:			
2		Bidder shall furnish written copies of shop production, fabrication and quality test procedures and drawings to be used on the Agitators for review by BHEL/NTPC prior to manufacture.			
3		The Bidder shall furnish performance test procedure along with standard. The test procedure will be reviewed and approved by the BHEL/NTPC.			

PEM-MAX 		TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATIONS FOR AGITATORS		SPECIFICATION No: PE-TS-468-571-18000-A001 SECTION-I, SUB-SECTION-C1 REV. 00 Date: April, 2020	
4	Since there is no standard for “Acceptance Test Procedure” for Agitator, Agitator manufacturer is to submit a test procedure and Quality Plan, clearly indicating that equipment will meet the desired parameter.				
5	Power consumption at motor terminal and vibration of equipment will be conducted at site. Vendor to indicate other material tests that are to be conducted as per their practice in their Quality plan.				
6	No liquid should enter the tube through any flange joint. “O”-ring used in the flange joint will deteriorate at a highly chlorinated and acidic environment of medium at a maximum operating temperature unless right quality of rubber is used. Hydrostatic testing of tube assembly is required at a pressure of twice that of maximum liquid column in any tank or 30m whichever is higher. The hydro test duration will be for a minimum of 1 hr to check sweating at any flange. Hydrostatic test is meant in part for a check of equipment joint at new condition only. It is cannot be considered as a guarantee of functional objective of rubber used.				
7	Mechanical Run Test (in air) Each Agitator unit shall be given a 4-hour mechanical run test in air at vendor's shop. Agitator unit shall be mounted in the same manner as it will operate in the field. During this test the record shall be made of: a) Shaft run out at free end. b) Dynamic shaft deflection adjacent to the mechanical seal/packing/vapour seal. c) Gearbox oil temperature and temperature of bearing housing in stool. The temperature of the gear box oil shall not exceed ambient plus 40 Deg.C and that of bearing housing shall not exceed from room temperature plus 20 Deg.C after temperatures have stabilized. d) Bearing Housing vibration checks shall be carried out. maximum acceptable vibration velocity shall be 6 mm/sec. e) Noise level shall be checked and shall be within the specified limits mentioned in the specification. f) Agitator shaft RPM and motor RPM. g) Check of satisfactory operation of shut off and retracting arrangement.				
8	As a part of the Quality Assurance Plan, bidder has to demonstrate the power consumption of each agitator at shop with the available fluid along with relevant calculation to establish the correlation with the slurry used for the project.				
9	Acceptance Test (at Site) After the agitator has been installed at site and is ready for test, vendor shall depute his representative to supervise the site acceptance test				
10	DYNAMICS				
10.1	CRITICAL SPEED				
10.1.1	Operation speed of the Agitator motor shall be at least 25% below the first critical speed				
10.1.2	Additional to the requirement of the critical speed of Agitator, as specified above. Agitator manufacturer is to analyze the torsional critical speed of combined system of Agitator, Gear Box and Motor to establish there is a separation margin of minimum 20% between the torsional critical speed (dry/wet) and any operating speed.				
10.2	VIBRATION SEVERITY				
10.2.1	During performance test, unfiltered vibration measurements shall be made with running of Agitator in Air. Measurement shall be taken on the Gear Box thrust bearing housings as well in motor top.				
10.2.2	Guaranteed Site vibration of the equipment on its own pedestal, at commissioning with normal level of liquid and with maximum liquid at respective tank, Vibration limit at site will be as per ISO-10816, and 1.5-2.3mm/sec even if Motor rating falls below 15kw.				
10.2.3	Vibration measurements of bearing housing shall be made in root mean square (RMS) velocity.				
10.2.4	Vibration levels measured on the non-rotating parts shall not exceed the zone limit “B” as defined in ISO 10816 at steady conditions and shall not exceed the zone limit “C” as defined in ISO 10816 at transient conditions.				

PEM-MAX		 TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATIONS FOR AGITATORS		SPECIFICATION No: PE-TS-468-571-18000-A001	
SECTION-I, SUB-SECTION-C1					
REV. 00					
Date: April, 2020					

11	For surfaces with rubber lining Welding shall be visually inspected to verify the absence of rough area and unacceptable transition between surfaces which prevent the adequate adherence of rubber. The acceptance criteria shall be as per latest standard.
12	For surfaces with rubber lining, degree of cleaning shall be visually checked before the application of the coating. There must be no area with oxidation, dirt or partially or generalized corrosion defects.
13	Test certificates shall be issued for each lot of raw material used in the coating, corresponding to specific weight and traction resistance.
14	For surfaces with rubber lining, adherence test shall be conducted on production samples. Adherence test shall be conducted on the actual surface through hammering. In order to verify the absence of air packets (or) surface without adherence.
15	For surfaces with rubber lining, Coating thickness shall be checked at 100%. A High voltage porosity test will be conducted on 100 % of the coated surface.
16	Out of all Agitators One Number of each type will be inspected at the Bidder's works before dispatch or where the test facilities are available.
17	The Bidder shall conduct performance test for the remaining Agitators and submit the reports.
18	Contract shaft mechanical seals shall be used during shop tests, unless the seal design is unsuitable for the shop-test condition, if applicable.
19	Agitators shall not be released for shipment, until shop tests data and performance tests curves have been approved by Owner.
20	Bidder should furnish performance guarantee as per applicable standard guarantee for the design, manufacture, material and safe operation of the equipment.
21	Bidder to arrange all calibrated gauges, Instruments during inspection.
22	Mechanical running and the performance test shall be carried out. Bidder to arrange Motor of same / higher rating for the shop test and inspection.
11	PAINTING
	Please refer painting specification (SECTION-C, SUB-SECTION-C2C)
12	SPARES,TOOLS & TACKLES
	Bidder shall supply a set of special tools and tackles required either for erection or operation or maintenance of the agitator units. A list of such tools shall be submitted by bidder along with the offer.
	Any special tools & tackles required for the entire equipment to disassemble, assemble or maintain the units, they shall be included in the quotation and furnished as part of the initial supply of the machine. List of special tools & tackles shall be decided by bidder as per his proven practice. When special tools are provided, they shall be packaged in separate, boxes with lugs and marked as "Special Tools for (tag / item number)."Each tool shall be stamped or tagged to indicate its intended usage. Levers and eye bolts for the removal of parts to be serviced shall be submitted with special tools (SECTION-II Annexure-7).
12.1	START UP & COMMISSIONING SPARES
	Start-up & Commissioning Spares shall be part of the main supply of the Agitators. Start-up & commissioning spares are those spares which may be required during the start- up and commissioning of the equipment/system. All spares required for successful operation till commissioning of Agitator shall come under this category. Bidder shall provide an adequate stock of such start up and commissioning spares to be brought by him to the site for the equipment erection and commissioning. The spares must be available at site before the equipment's are energized. The List of such spares to be provided during bidding stage (SECTION-II Annexure-9).
12.2	RECOMMENDED SPARES

	TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATIONS FOR AGITATORS	SPECIFICATION No: PE-TS-468-571-18000-A001	
		SECTION-I, SUB-SECTION-C1	
		REV. 00	
		Date: April, 2020	

	Bidders shall also furnish the recommended spares list along with the offer required for 3 years of normal operation of the plant and should be independent of the list of the mandatory spares. Prices of recommended spares will not be used for evaluation of the bids. The price of these spares will remain valid up to 6 months after placement of Notification of Award for the main equipment.
12.3	MANDATORY SPARES:
	Bidder to quote for the mandatory spares as per the Mandatory Spare list given for a specific project (SECTION-I, SUB-SECTION-D Annexure-II). Bidder shall quote for the “Mandatory Spares Part List”, and it will be considered for L1 evaluation. Mandatory spare parts items shall be handed over separately and shall not be mixed with the supply of the main equipment parts. Spares shall be sent in pre-decided lots in containers/secure boxes. All boxes/containers are to be distinctly marked in red color with boldly written “S” mark on each face of the containers. Spares shall not be dispatched before dispatch of corresponding main equipment’s. Each item shall be labelled in English and be packed against damage and sealed to prevent deterioration from corrosion. The protection shall be sufficient for a minimum of 10 years’ storage in a dry weatherproof building. All spares supplied under this contract shall be strictly inter-changeable with the parts for which they are intended for replacements. All the mandatory spares shall be manufactured along with the main equipment components as a continuous operation as per same specification and quality plan. Any special tools & tackles required for the entire equipment to disassemble, assemble or maintain the units, they shall be included in the quotation and furnished as part of the initial supply of the machine. List of special tools & tackles shall be decided by bidder as per his proven practice. When special tools are provided, they shall be packaged in separate, boxes with lugs and marked as “Special Tools for (tag / item number).” Each tool shall be stamped or tagged to indicate its intended usage. Levers and eye bolts for the removal of parts to be serviced shall be submitted with special tools.
12.4	FIRST FILL OF CONSUMABLES
I	Bidder’s scope shall include supply and filling of all chemicals, lubricants, grease, filters and consumable items for operation up to commissioning including top up requirements. All lubricants proposed for the plant operation shall be suitable for all operating and environmental conditions that will be met on site consistent with good maintenance procedures as instructed in the maintenance manuals.
II	Bidder shall also supply a quantity not less than 10% of the full charge of each variety of lubricants, servo fluids, gases, chemicals etc. (as applicable) used which is expected to be utilized during the first year of operation. This additional quantity shall be supplied in separate containers.
III	Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals including items qualities and quantities required per month of the plant operation for the NTPC/BHEL’s approval herein shall be furnished within 2 months of placement of Order. On completion of erection, complete list of bearings/equipment giving their location and identification marks shall be furnished to BHEL along with lubrication requirements. All types of chemicals, consumables, lubricants and grease shall be readily obtainable locally and the number of different types shall be kept to a minimum. For each type and grade of lubricant recommended, bidder shall list at least three equivalent lubricants manufactured by alternative companies.
14	PERFORMANCE GUARANTEE
	All performance tests for Agitators shall be carried out in accordance with any latest international codes/standards. Bidder shall furnish Performance guarantee for the design, manufacture, material, safe and trouble-free operation of the Agitators and its accessories. The Bidder shall ensure a design of the equipment to achieve an average target availability of 98% for 120 days and average target availability of 95% for 1 year. Noise level ≤85 dB (A) at 1m horizontal distance from equipment/enclosures and 1.5m above operating floor is to be guaranteed. Vibration levels measured on the non-rotating parts shall not exceed the zone limit “B” as defined in

	TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATIONS FOR AGITATORS	SPECIFICATION No: PE-TS-468-571-18000-A001	
		SECTION-I, SUB-SECTION-C1	
		REV. 00	
		Date: April, 2020	

	ISO 10816 at steady conditions and shall not exceed the zone limit “C” as defined in ISO 10816 at transient conditions. Acceptance tests to be carried out as per the procedure defined by the bidder which shall be submitted for BHEL/ NTPC approval. In the event that the performance test is unsuccessful, bidder shall take necessary remedial action at his cost and the performance test shall be repeated.
14	DOCUMENTATION
A	DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER
	The Bidder shall submit all documents, drawings, diagrams and all such information, which are necessary to fully understand the offer for techno – commercial Offer. Vendors are requested to comply with above in all respect. List of such documents have been indicated in (SECTION-II Annexure-1).
B	DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT
	The Successful bidder shall submit necessary data, documents and drawings for review, approval as specified in this specification. Drawings that are reviewed by the NTPC/ BHEL will be returned to bidder with a transmittal letter with any comments and / or questions marked on the drawings or noted in the letter. All comments and questions must be resolved before a resubmission of drawings / documents. If the design has not developed enough to resolve some of the comments or questions, bidder shall place a “hold” on those items or areas of design. NTPC/ BHEL reserves the right to return drawings unprocessed to bidder if there exists any evidence that bidder has not acknowledged all comments and questions. All necessary GA drawings, sections, sub-assembly drawings, specifications of main and sub components and necessary set of operation & maintenance manual as asked by NTPC must be furnished by bidder in soft and hard copy forms. For all documents softcopy format shall be searchable pdf, however in addition all drawings, diagrams shall be supplied in ACAD or other editable format and all lists in Excel format. Further break up of technical documents will be discussed during finalization of the purchase contract. All documents in hard and soft form are to be submitted in the English language. Electronic Copies shall be submitted in primary original data format (e.g. DOC, XLS, DWG) as well as in a printable non-proprietary document format (e.g. PDF). Especially P&IDs shall be submitted as DWG files and PDF files. Bidder to ensure submission of hard copies as per NTPC requirement for all engineering drg/doc and for all subsequent revisions along with a soft copy through email to concerned project team. The list of such drawing/documents have been indicated in (SECTION-I,SUB-SECTION-D Annexure-IV).
15	LIST OF REFERENCE DRAWINGS BY BHEL
I	The drawings specified in in Annexure-III, Sub-Section-D of Section-I are being provided along with the tender specification for estimation and calculation purpose of the bidder.
16	BID EVALUATION CRITERIA FOR POWER CONSUMPTION
I	Bidder is required to quote Guaranteed power consumption (GPC) in GPC format attached with the price schedule, declaring GPC value in KW. The power consumption values indicated by the bidders shall be used for bid evaluation. In case of any mis-match in the GPC values in the price and un-priced bids, the GPC figure in the un-priced bid shall be considered for evaluation.

5897/2020/PS-PEM-MAX



TITLE:

2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
AGITATORS

SPECIFICATION No: PE-TS-468-571-18000-A001

SECTION-I, SUB-SECTION-C2

REV. 00

Date: April, 2020

SECTION-I, SUB-SECTION-C2

CUSTOMER SPECIFICATION

5897/2020/PS-PEM-MAX



TITLE:

2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
AGITATORS

SPECIFICATION No: PE-TS-468-571-18000-A001

SECTION-I, SUB-SECTION-C2A

REV. 00

Date: April, 2020

SECTION-I, SUB-SECTION-C2A

CUSTOMER SPECIFICATION: TECHNICAL REQUIREMENT

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	respective clauses. The pump shall be capable of pumping of filtrate water with solid concentration upto 10% & particle lumps of 6-7mm. Sump pumps handling slurry shall be designed with a maximum concentration of 30% solid by weight.		
9.05.00	The material chosen for the pump components shall be suitable for the fluid handled and shall be proven in similar application.		
9.06.00	The pumps shall not be supported below the base plate level for easy withdrawal without entering the sump.		
10.00.00	SLURRY & PROCESS WATER TANKS		
10.01.00	All the slurry tanks (Slurry Tanks, Filtrate Tank, Secondary hydro cyclone feed tank, vacuum receiver tank, Waste water Tank, Lime Neutralization tanks etc.) shall be designed, fabricated, erected and tested in accordance with the IS:803, latest edition. Additional Corrosion allowance of 1.5 mm on the minimum tank shell thickness as calculated by IS:803, latest edition shall be provided by the Contractor. Tanks shall be made from IS:2062 quality mild steel plates of tested quality. The tanks shall be of welded construction. Interior surface of the tanks shall be lined with the following: Wastewater tank, Filtrate tank, Secondary hydro cyclone feed tank: Vinyl Ester based flake glass lining of minimum 3 mm thickness Slurry tanks: Replaceable Chlorobutyl/ Bromobutyl rubber lining of minimum 4 mm thickness The outside surface of the tanks shall be coated with paint as approved by the Employer. Coarse-screen(s) at suction-side of slurry recirculation pumps shall be provided.		
11.00.00	AGITATORS		
11.01.00	Agitators shall be supplied in tanks and vessels to prevent caking and settlement of particles out of the slurry, e.g. in the absorber vessel, limestone mill recycle tanks, limestone slurry tank, Auxiliary Absorbent tank, and sumps etc.		
11.02.00	All agitators shall be designed for continuous operation unless otherwise specified. Horizontal agitators shall be used for Absorber. Vertical agitators can also be used for Absorber, if it is only the standard & proven practice of the Contractor for the offered Absorber design. In other vessels and tanks vertical agitators are also acceptable if they are of proven make and the Bidders standard practice which can be proven by means of suitable references. The design of the agitators shall be of proven type.		
11.03.00	Standard type agitators with suitable characteristics shall be used wherever practical. The agitators shall be complete with motor, gearbox, agitator shaft, coupling, safety guards, mechanical seal (for side entry agitators), impeller, support legs, agitator mounting flange including bolts nuts and gasket etc.		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.:CS-0011-109(2)-9	PART-B SUB-SECTION-I-M1 (FGD)
			PAGE 32 OF 52

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
11.04.00	All agitator parts and accessories in contact with the stirred fluid shall be constructed of materials specifically designed for the conditions and nature of the stirred fluid and be resistant to erosion and corrosion.			
11.05.00	The material for the shaft (which is continuously in contact with slurry) and agitator blades of the Absorber Agitators shall be made with Alloy 926 or better material. For Agitators in other tanks, agitator blades shall be made with Alloy 926 or better material & shaft can be rubber lined. This does not release the Contractor of the responsibility for selecting the correct materials.			
11.06.00	Each agitator and its associated equipment shall be arranged in such a manner as to permit easy access for operation, maintenance and agitator removal without interrupting plant operation. It shall be possible to remove the sealing devices of the Agitators of the absorber vessel without having to drain completely the absorber.			
11.07.00	To prevent mechanical blocking load start-up after standstill of pumps, piping and agitators for slurries shall be applied with C-hose connection.			
11.08.00	Lifting lugs and eyes and other special tackle shall be provided as necessary to permit easy handling of the agitators and their components.			
11.09.00	Static and dynamic (as far as applicable) balancing of all agitators shall be carried out after assembly.			
11.10.00	All agitator parts and components shall be designed and calculated for fatigue life, considering maximum bending loads, induced by fluctuating hydraulic forces and torsional loads, based on the installed motor power. For side entry agitators the alternating bending moment resulting from impeller and shaft weight has to be considered additionally.			
11.11.00	All exposed moving parts shall be covered by guards.			
11.12.00	Side entry agitator shall be flange mounted.			
11.13.00	The shape of the impeller blades of side entry agitators shall be designed to avoid wear on the impellers which will affect the agitator performance as specified for a minimum period of 2 years of continuous operation under design conditions for the range of coal & limestone specified in the specification. In order to avoid excessive wear impeller tip speeds must not exceed 12 m/s.			
11.14.00	Belt drives (if applied) shall be properly designed to provide a minimum lifetime of 2 years under design conditions			
~~12.00.00~~	SLURRY LINES AND VALVES			
12.01.00	Slurry pipes shall be designed to keep the velocity above the settling velocity under all operating conditions. The contractor may provide a recirculation line with motorized isolation valve / restriction orifice made of erosion resistant material for the above purpose.			
12.02.00	All the pipes handling slurry shall be provided with replaceable rubber lining of proven quality. The Contractor can provide slurry pipes of size lower than 300 NB made up of FRP material (silicon carbide coating on slurry exposed surface) if it has previous experience of providing the same. Outer surface of the pipes should be fire			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-0011-109(2)-9	PART-B SUB-SECTION-I-M1 (FGD)	PAGE 33 OF 52



TITLE:

**2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
AGITATORS**

SPECIFICATION No: PE-TS-468-571-18000-A001

SECTION-I, SUB-SECTION-C2B

REV. 00

Date: April, 2020

**SECTION-I,
SUB-SECTION-C2B**

**CUSTOMER SPECIFICATION: PROJECT SPECIFIC
GENERAL REQUIREMENTS**



TITLE:

2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
AGITATORS

SPECIFICATION No: PE-TS-468-571-18000-A001

SECTION-I, SUB-SECTION-C2B

REV. 00

Date: April, 2020

**SECTION-I,
SUB-SECTION-C2B**

**CUSTOMER SPECIFICATION: GENERAL TECHNICAL
REQUIREMENTS**

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
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.		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS PAGE 1 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
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,		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS
			PAGE 2 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
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)		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 3 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
5.03.00 5.04.00 5.05.00 5.06.00 5.07.00 5.08.00	p) IEEE standard q) JEC standard 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. Not used. 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. 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. 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. 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.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 4 OF 83	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
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			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 5 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	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.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 6 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	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) Chapter 1 - Plant Description: To contain the following sections specific to the equipment/system supplied a) Description of operating principle of equipment / system with schematic drawing / layouts.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 10 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	(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.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 11 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	(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			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 12 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	longer intervals to ensure trouble free operation and quantity required for complete replacement. (j) Tolerance for fitment of various components. (k) Details of sub vendors with their part no. in case of bought out items. (l) List of spare parts with their Part No, total population, life expediency & their interchangeability with already supplied spares to NTPC. (m) List of mandatory and recommended spare list along with manufacturing drawings, material specification & quality plan for fast moving consumable spares. (n) Lead time required for ordering of spares from the equipment supplier, instructions for storage and preservation of spares. (o) General information on the equipment such as modification carried out in the equipment from its inception, equipment population in the country / foreign country and list of utilities where similar equipments have been supplied.			
8.03.03	After finalization and approval of the Employer, the O & M Manuals shall be submitted as indicated in Annexure-VI. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals have been supplied to the Employer.			
	If after the commissioning and initial operation of the plant, the instruction manuals (Erection and /or O &M manuals) require modifications/additions/ changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Employer for records and number of copies shall be as mentioned in Annexure-VI.			
8.03.03	PLANT HANDBOOK AND PROJECT COMPLETION REPORT			
8.03.03.01	PLANT HANDBOOK			
	The Contractor shall submit to the Employer a preliminary plant hand book preferably in A-4 size sheets which shall contain the design and performance data of various plants, equipments and systems covering the complete project including			
	i) Design and performance data. ii) Process & Instrumentation diagrams. iii) Single line diagrams.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 13 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
8.03.03.02	iv)	Sequence & Protection Interlock Schemes.		
	v)	Alarm and trip values.		
	vi)	Performance Curves.		
8.03.03.02	vii)	General layout plan and layout of main plant building and auxiliary buildings		
	viii)	Important Do's & Don't's		
	The plant handbook shall be submitted within twelve (12) months from the date of award of contract. After the incorporation of Employer's comments, the final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.			
8.03.03.02	PROJECT COMPLETION REPORT			
8.03.04	The Contractor shall submit a Project Completion Report at the time of handing over the plant.			
	DRAWINGS			
	a)	i)	~~All the FGD plant layouts shall be made in computerised 3D modelling system. The Employer reserves the right to review the 3D model at different stages during the progress of engineering. The layout drawings submitted for Employer's review shall be fully dimensioned and extracted from 3D model after interference check.~~	
8.03.04		ii)	All documents submitted by the Contractor for Employer's review shall be in electronic form (soft copies) along with the desired number of hard copies as per Annexure-VI of Part-C. The soft copies shall be uploaded by the vendors in C-folders, a Web-based system of NTPC ERP, for which a username and password will be allotted to the new vendor by NTPC.	
	Similarly, the vendor can download the drawings/documents, approved/ commented by NTPC, through above site.			
	The soft copies of identified drawings/documents shall be in pdf format, whereas the attachments/reply to the submitted document(s) can be in .doc, .xls, .pdf, .dwg or .std formats.			
8.03.04	iii)	Final copies of the approved drawings along with requisite number of hard copies shall be submitted as per Annexure-VI of Part-C.		
	iv)	Contractor shall prepare the model of all the facilities located in FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE (including all		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9		PART-C GENERAL TECHNICAL REQUIREMENTS
				PAGE 14 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	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.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 15 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	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.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 16 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
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			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 17 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	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 :			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 18 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	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,		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS PAGE 19 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	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			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 20 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	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.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 21 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
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			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 22 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
13.02.00	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. 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.		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS PAGE 23 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	
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: - Manufacturer's identification. - Nominal inlet and outlet sizes in mm. - Set pressure in Kg/cm² (abs). - Blowdown and accumulation as percentage of set pressure. - 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,	
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9
PART-C GENERAL TECHNICAL REQUIREMENTS		PAGE 24 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	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 performed 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		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS PAGE 25 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	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			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9		PART-C GENERAL TECHNICAL REQUIREMENTS PAGE 26 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	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.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 27 OF 83	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
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			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 28 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
22.08.00 22.09.00 22.10.00 22.11.00 22.12.00 22.13.00 22.14.00 22.15.00 22.16.00	Clearance Certificate (MDCC). 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 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. 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. 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. 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 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes. No welding shall be carried out on cast iron components for repair. Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only. 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.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 29 OF 83	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	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. With in 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			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 30 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	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.			
22.21.00	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.			
22.22.00	For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.			
22.23.00	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 ~~Environmental stress screening test process / procedure for eliminating infant mortile components for DDCMIS / PLC based system & for other systems having substantial electronics components (as determined by employer) like Electronic transmitter, CCTV components, PA systems etc. shall be necessarily furnished for any sub vendors proposed for vendor assessment and approval for this contract. For other approved sub vendors of above mentioned systems, contractor shall furnish the test procedure for eliminating infant mortile components in case, if it is asked for by the employer before these items are offered for inspection / dispatched to site.~~			
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.			
22.26.00	~~Software Reliability / Quality Certification~~ ~~Certification from OEM's authorized signatory that software offered with DDCMIS, PLC, CCTV, PA, Pyrometer, CEMS, AAQMS, EQMS, BHMS etc. declaring that the all the offered software(s) had gone through the established software quality test and offered software is not of β-version and offered software is also free from all known bugs as on date of approval of systems documents by NTPC as a part of quality documentation review and approval process during detail engineering.~~			
23.00.00	QUALITY ASSURANCE DOCUMENTS			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 31 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
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.			
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.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 32 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
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 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.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 33 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following: (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			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 34 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	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 (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			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 35 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	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.		
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.		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS PAGE 36 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
	b) Graphics. c) HSR d) Logs/Reports. e) Calculations (Basic & Performance Calculations).		
25.12.02	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.		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS PAGE 37 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
26.01.00	(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. (d) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period. (e) The check outs during the pre - commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over to Employer's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed commissioning documentation [SLs(standard check list)/TS(testing schedule)/CS(commissioning schedule)] approved by the employer. (f) The Contractor during initial operation and performance testing shall conduct vibration testing to determine the 'base line' of performance of all plant rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable. Contractor shall furnish the commissioning organization chart for review & acceptance of employer at least twelve months prior to the schedule date of commissioning of 1st unit. The chart should contain: (1.) Biodata including experience of the Commissioning Engineers. (2.) Role and responsibilities of the Commissioning Organisation members. (3.) Expected duration of posting of the above Commissioning Engineers at site.		
26.02.00	Initial Operation (a) On completion of all pre-commissioning activities/ tests and as a part of commissioning the complete facilities shall be put on 'Initial Operation' during which period all necessary adjustments shall be made while operating over the full load range enabling the facilities to be made ready for the Guarantee Tests. (b) The 'Initial Operation' of the complete facility as an integral unit shall be conducted for 720 continuous hours. During the period of initial operation of 720 hours, the FGD System shall operate continuously at full load for a period not less than 72 hours.		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS PAGE 38 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
26.03.00	The Initial Operation shall be considered successful, provided that each item/ part of the facility can operate continuously at the specified operating characteristics, for the period of Initial Operation with all operating parameters within the specified limits and at or near the predicted performance of the equipment/ facility. 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 operational interruption in the FGD System due to constraints attributable to the Employer shall be construed as Deemed to be in operation. (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 Engineer shall make the unit ready to conduct such test before start of initial operation. Such test shall be conducted along with the Initial Operations. 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.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 39 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	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. 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 with held 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 three (3) man months. 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.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 40 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
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 and 3 man months respectively for O&M and 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			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 41 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS								
	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 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 border="0"> <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 Wcd).</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 Wcd).
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LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9								
PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 42 OF 83								

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC
	5. Flow (Gas) - Tonnes/ hour 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.	
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS PAGE 43 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	
37.00.00	~~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.~~ 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	
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS PAGE 44 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	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 connection drawings etc as required to do the testing and maintenance of the electronic modules.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 45 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	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	
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 46 OF 83

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	
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9		PART-C GENERAL TECHNICAL REQUIREMENTS PAGE 47 OF 83

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 monocrystalline 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			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 48 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	IS:4540 IS:4671 IS:4736 IS:4894 IS:5456 IS:5749 IS:6392 IS:6524 Part-I IS:7098 IS:7373 IS:7938 ISO:1217 ASHRAE-33 and air heating coils. ASHRAE-52-76 particle matter.	Specification for monory- stallines rectifire assembly equipment Expanded polystyrene for thermal insulation purpose Hot dip zinc coating on steel tubes Centrifugal fans Code of practice for testing of positive displacement type air compressors and exhauster (For Test Tolerance Only) Forged ramshorn hooks Steel pipe flanges Code of practice for design of tower cranes Static and rail mounted Cross linked Polyethylene insulated PVC sheathed cables Specification for wrought aluminium and aluminium sheet and strips Air receivers for compressed air installation Displacement compressor-Acceptance test Methods of testing for rating of forced circulation air cooling Air cleaning device used in general ventilation for removing	Entwurf DIN 15402 Blett 1 Entwurf DIN 15402 BS 3017-1958 BS 4504 : 1969 BS 2799 : 1956 Standard No. 1 to IPCEA (USA) Pub. No. 5-66-524	
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9		PART-C GENERAL TECHNICAL REQUIREMENTS PAGE 49 OF 83

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 Fans (Part-1,2) 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-23-1958 Atmospheric Water Cooling Equipment 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.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 50 OF 83	

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.		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 51 OF 83

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.	
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS PAGE 52 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	IS: 457 IS: 516 IS: 650 IS: 1199 IS: 1791 IS: 1838 (Part-I) IS: 2204 IS: 2210 IS: 2438 IS: 2502 IS: 2505 IS: 2506 IS: 2514 IS: 2645 IS: 2722 IS: 2750 IS: 2751 IS: 3025 IS: 3366 IS: 3370	Code of practice for general construction of plain & reinforced concrete for dams & other massive structures. Method of test for strength of concrete. Specification for standard sand for testing of cement. Methods of sampling and analysis of concrete. General requirements for batch type concrete mixers. Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type). Code of practice for construction of reinforced concrete shell roof. Criteria for the design of reinforced concrete shell structures and folded plates. Specification for roller pan mixer. Code of practice for bending and fixing of bars for concrete reinforcement. General requirements for concrete vibrators, immersion type. General requirements for concrete vibrators, screed board type. Specification for concrete vibrating tables. Specification for Integral cement water proofing compounds. Specification for portable swing weigh batches for concrete. (single and double bucket type) Specification for Steel scaffolding. Code of practice for welding of mild steel plain and deformed bars for reinforced concrete construction. Methods of sampling and test waste water. Specification for Pan vibrators. Code of practice for concrete structures for the storage of	
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 53 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	(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-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS PAGE 54 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	IS: 9417 IS: 10262 IS: 11384 IS: 11504 IS: 12118 IS: 12200 IS: 13311 Part-1 Part-2 SP:23 SP: 24 SP: 34	Recommendations for welding cold worked steel bars for reinforced concrete construction. Recommended guidelines for concrete mix design. Code of practice for composite construction in structural steel and concrete. Criteria for structural design of reinforced concrete natural draught cooling towers. Specification for two-parts poly sulphide. Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams. Method of non-destructive testing of concrete. Ultrasonic pulse velocity. Rebound hammer. Handbook of concrete mixes Explanatory Handbook on IS: 456-1978 Handbook on concrete reinforcement and detailing.	
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS PAGE 55 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	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.		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 56 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	
	IS: 814 Specification for covered Electrodes for Metal Arc Welding for weld steel. IS: 1852 Specification for Rolling and Cutting Tolerances for Hot rolled steel products. IS: 3502 Specifications for chequered plate. IS: 6911 Specification for stainless steel plate, sheet and strip. IS: 3757 Specification for high strength structural bolts IS: 6623 Specification for high strength structural nuts. IS: 6649 High Tensile friction grip washers. IS: 800 Code of practice for use of structural steel in general building construction. IS: 816 Code of practice for use of Metal Arc Welding for General Construction. IS: 4000 Code of practice for assembly of structural joints using high tensile friction grip fasteners. IS: 9595 Code of procedure of Manual Metal Arc Welding of Mild Steel. IS: 817 Code of practice for Training and Testing of Metal Arc Welders. IS: 1811 Qualifying tests for Metal Arc Welders (engaged in welding structures other than pipes). IS: 9178 Criteria for Design of steel bins for storage of Bulk Materials. IS: 9006 Recommended Practice for Welding of Clad Steel. IS: 7215 Tolerances for fabrication steel structures. IS: 12843 Tolerance for erection of structural steel. IS: 4353 Recommendations for submerged arc welding of mild steel and low alloy steels. SP: 6 (Part 1 to 7) ISI Hand book for structural Engineers.	
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS PAGE 57 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	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-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS PAGE 58 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	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-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 59 OF 83	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	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 (Part-I & II)	Code of practice for installation of septic tanks.	
	IS : 2501	Copper tubes for general engineering purposes.	
	IS : 2548	Plastic seat and cover for water-closets.	
	IS : 2556 (Part 1 to 15)	Vitreous sanitary appliances (vitreous china).	
	IS : 2963	Non-ferrous waste fittings for wash basins and sinks.	
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 60 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	
	IS : 3114 Code of practice for laying of cast iron pipes. IS : 3311 Waste plug and its accessories for sinks and wash basins. IS : 3438 Silvered glass mirrors for general purposes. IS : 3486 Cast iron spigot and socket drain pipes. IS : 3589 Electrically welded steel pipes for water, gas and sewage (200mm to 2000mm nominal diameter). IS : 3989 Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories. IS : 4111 (Part I to IV) Code of practice for ancillary structure in sewerage system. IS : 4127 Code of practice for laying of glazed stone-ware pipes. IS : 4764 Tolerance limits for sewage effluents discharged into inland-surface waters. IS : 4827 Electro plated coating of nickel and chromium on copper and copper alloys. IS : 5329 Code of practice for sanitary pipe work above ground for buildings. IS : 5382 Rubber sealing rings for gas mains, water mains and sewers. IS : 5822 Code of practice for laying of welded steel pipes for water supply. IS : 5961 Cast iron grating for drainage purpose. IS : 7740 Code of practice for road gullies. IS : 8931 Cast copper alloy fancy bib taps and stop valves for water services. IS : 8934 Cast copper alloy fancy pillar taps for water services. IS : 9762 Polyethylene floats for ball valves. IS : 10446 Glossary of terms for water supply and sanitation.	
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS
		PAGE 61 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
		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-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS PAGE 62 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-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 63 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS		
	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-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 64 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	
	Part-II Schedules IS:2395 Code of practice for painting concrete, masonry and plaster surfaces. Part-I Operations and workmanship. Part-II Schedule. IS:2524 Code of practice for painting of nonferrous metals in buildings. Part-I Pretreatment. Part-II Painting. IS:2932 Specification of synthetic enamel paint, exterior, under-coating and finishing. IS:2933 Specification enamel paint, under coating and finishing. IS:4759 Code of practice for hot dip zinc coating on structural steel and other allied products. IS:5410 Specification for cement paint IS:5411 Specification for plastic emulsion paint-for exterior use (Part-I) IS:6278 Code of practices for white washing and colour washing. IS:10403 Glossary of terms relating to building finishes. Piling and Foundation IS:1080 Code of practice for design and construction of simple spread foundations. IS:1904 Code of practice for design and construction of foundations in Soils; General Requirements. IS:2911 Code of practice for designs and construction of Pile foundations (Relevant Parts). IS:2950 Code of practice for designs and construction of Raft (Part-I) foundation. IS:2974 Code of practice for design and construction of machine (Part-I TO V) foundations. IS:6403 Code of practice for determination of Allowable Bearing pressure on Shallow foundation.	
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS PAGE 65 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	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-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 66 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	IRC:SP:13 IRC - Publication IS:73 Loadings IS:875 (Pt. I to V) IS:1893 IS:4091 IRC:6 M.O.T. Safety IS:3696 (Part I & II) IS:3764 IS:4081 IS:4130 IS:5121 IS:5916 IS:7205 IS:7293 IS:7969 IS:11769 - Indian Explosives Act. 1940 as updated. Architectural design of buildings SP:7 SP:41	Guidelines for the design of small bridges & culverts. Ministry of Surface Transport (Roads Wing), Specifications for road and bridge works. Specification for paving bitumen Code of practice for design loads other than earthquake) for buildings and structures. Criteria for earthquake resistant design of structures. Code of Practice for design and construction of foundation for transmission line towers & poles. Standard specifications & code of practice for road bridges, Section-II Loads and stresses. Deptt. of railways Bridge Rules. Safety code for scaffolds and ladders. Safety code for excavation work. Safety code for blasting and related drilling operations. Safety code for demolition of buildings. Safety code for piling and other deep foundations. Safety code for construction involving use of hot bituminous materials. Safety code for erection on structural steelwork. Safety code for working with construction machinery. Safety code for handling and storage of building materials Guidelines for safe use of products containing asbestos.	
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 67 OF 83

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			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 68 OF 83	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	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 1. Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974). 2. Temperature measurement - Thermocouples ANSI MC 96.1 - 1982. 3. Temperature measurement by electrical Resistance thermometers - IS:2806. 4. Thermometer - element - Platinum resistance - IS:2848. Pressure Measurements 1. a) Instruments and apparatus for pressure measurement - ASME PTC 19.2 (1964). b) Electronic transmitters BS:6447. 2. Bourdon tube pressure and vacuum gauges - IS:3624 - 1966. 3. Process operated switch devices (Pr. Switch) BS-6134. 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 1. Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973): IS:9319. 2. Safety requirements for electrical and electronic measuring and controlling instrument - ANSI C 39.5 - 1974. 3. Compatibility of analog signals for electronic industrial process instruments - ISA - S 50.1 (1982) ANSI MC 12.1 - 1975.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 69 OF 83	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	4. Dynamic response testing of process control instrumentation ISA - S 26 (1968). 5. 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. 6. Printed circuit boards - IPC TM - 650, IEC 326 C. 7. General requirement and tests for printed wiring boards - IS 7405 (Part-I) 1973. 8. Edge socket connectors - IEC 130-11. 9. Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2. 10. Dimensions of attachment plugs & receptacles - ANSI C 73 - 1973 (Supplement ANSI C 73 a - 1980). 11. Direct acting electrical indicating instrument - IS:1248 - 1968 (R). 12. Standard Digital Interface for Programmable Instrumentation - IEEE-488.2 - 1990. 13. Information Processing Systems - Local Area Networks - Part 2 : Logical Link Control - IEEE-802.2 - 1989. 14. Standard for Local Area Networks : Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1985. 15. Supplements A, B, C and E to Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1988. 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.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 70 OF 83	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एनटीपीसी NTPC
	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.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 71 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	Sampling System 1. Stainless steel material of tubing and valves for sampling system - ASTMA 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.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 72 OF 83	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	UPS System - Practices and requirements for semi-conductor power rectifiers - ANSI C 34.2, 1973. - Relays and relays system associated with electrical power apparatus - ANSI C 3.90 - 1983. - Surge withstand capability test - ANSI C 37.90 1 -1989. - Performance testing of UPS - IEC 146. - Stationary cells & Batteries Lead Acid type (with tubular positive plates) specification IS-1651-1991. - Recommended practice for sizing large lead storage batteries for generating stations & sub-stations - IEEE-485-1985. - Printed Circuit Board - IPC TM 650, IEC 326C. - General Requirements & tests for printed wiring boards, IS:7405 (Part-I) 1973. Control Valves - Control valve sizing - Compressible & Incompressible fluids - ISA S 75.01-1985. - Face to face dimensions of control valves - ANSI B 16.00 - 1973. - ISA Hand Book of Control Valves - (ISBN : B: 1047-087664-234-2). - Codes for pressure piping - ANSI B 31.1 - Control Valve leak class - ISA RP 39.6 Process Connection & Piping - Codes for pressure piping "power piping" - ANSI B 31.1. - Seamless carbon steel pipe ASTM - A - 106. - Forged & Rolled Alloy steel pipe flanges, forged fittings and valves and parts - ASTM - A - 182. - Material for socket welded fittings - ASTM - A - 105. - Seamless ferritic alloy steep pipe - ASTM - A - 335.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 73 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS	एनटीपीसी NTPC	
	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. 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.		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 74 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			
	12. Swedish Chimney test - SEN - 4241475 (F3). 13. Teflon (FEP) insulation & sheath test - ASTM D - 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. Public Address System 1. Specifications for loud 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			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 75 OF 83	

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS 		
	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-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENTS	PAGE 76 OF 83

ANNEXURE-I

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

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-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENT	PAGE 76 OF 83

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

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

1/1

ENGG. DIV./QA&I

LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENT	PAGE 77 OF 83

ANNEXURE-III

	Project :	Stage :	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL					DOC. NO.:		
	Package :							REV. NO.:		
	Supplier :		SUB-SYSTEM :					DATE :		
	Contractor No. :							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-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-C GENERAL TECHNICAL REQUIREMENT	PAGE 78 OF 83

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

ANNEXURE-V

		Project :		Stage :		FIELD WELDING SCHEDULE							DOC. NO.:			
		Contractor :				(To be raised by the contractor)							REV. NO.:			
		Contractor No. :				Welding Code:							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

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS (Annexure-VI)			एनटीपीसी NTPC																																																																								
	<table><tr><th>S.No</th><th>Description of Drgs/Docs</th><th>No of Prints</th><th>No of ROMs/DVDs/Portable Hard Disk</th><th>CD</th></tr><tr><td rowspan="8">1</td><td>Drawings, Data sheets, Design calculations, Purchase specifications and other documents</td><td></td><td></td><td></td></tr><tr><td>First submission and submission with major changes</td><td></td><td></td><td></td></tr><tr><td>▪ Layout (A0&A1 sizes)</td><td>4</td><td>-</td><td></td></tr><tr><td>▪ Other Drawings/Documents (A0&A1 sizes)</td><td>2</td><td>-</td><td></td></tr><tr><td>▪ P&ID (All sizes)</td><td>4</td><td>-</td><td></td></tr><tr><td>a) Final drawings/documents (Directly to site)</td><td>6</td><td>2</td><td></td></tr><tr><td>b) “As Built” Drawing/Documents (Directly to site)</td><td>6</td><td>2</td><td></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><td></td></tr><tr><td>2</td><td>Erection Manual (Directly to site)</td><td>4 sets</td><td>2</td><td></td></tr><tr><td rowspan="2">3</td><td>Operation & Maintenance manual</td><td rowspan="2">1 set</td><td rowspan="2">--</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><td></td></tr><tr><td>4</td><td>Plant Hand Book</td><td rowspan="2">1</td><td rowspan="2">1</td><td rowspan="2"></td></tr><tr><td></td><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><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><td></td></tr></table>				S.No	Description of Drgs/Docs	No of Prints	No of ROMs/DVDs/Portable Hard Disk	CD	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 ROMs/DVDs/Portable Hard Disk	CD																																																																								
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	-																																																																									
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3	Operation & Maintenance manual	1 set	--																																																																									
	i) First Submission																																																																											
	ii) Final Submission (Directly to site)	4 sets	2																																																																									
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	i) First Submission																																																																											
5	Commissioning and Performance Test Procedure manual	1 set	--																																																																									
	i) First Submission																																																																											
	ii) Final Submission (Directly to site)	4 sets	2																																																																									
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9		PART-C GENERAL TECHNICAL REQUIREMENTS Annexure-VI																																																																								
PAGE 81 OF 83																																																																												

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS (Annexure-VI)				एनडीपीसी NTPC
S.No	Description of Drgs/Docs	No of Prints	No of ROMs/DVDs/Portable Hard Disk	CD	
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-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9		PART-C GENERAL TECHNICAL REQUIREMENTS Annexure-VI	PAGE 82 OF 83

5897/2020/PS-PEM-MAX



TITLE:

**2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
AGITATORS**

**SPECIFICATION No: PE-TS-468-571-18000-
A001**

SECTION-I, SUB-SECTION-C2B

REV. 00

Date: April, 2020

**SECTION-I,
SUB-SECTION-C2B
PROJECT SPECIFIC GENERAL REQUIREMENTS
INCLUDING: QUALITY ASSURANCE**

PS-PEM-MAX		QUALITY ASSURANCE		एनटीपीसी NTPC	
CLAUSE NO.					
~~1.08.00~~		~~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$\geq$ 32mm. ii) For plates of 25mm$\leq$thickness$<$32mm-10% RT and 100% MPI. iii) For plates of thickness $<$25mm-10% MPI/LPI.			
1.08.04		Edge for shop and field weld shall be examined by MPI for plate thickness $\geq$ 32mm.			
1.09.00		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.			
1.10.00		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.~~			
1.11.00		AGITATORS:			
1.11.01		Rubber lining shall be tested for hardness and spark test			
1.11.02		Impellers shall be tested for dimensional and balancing check			
1.11.03		Gear Boxes shall be tested for run test as per standard practice			
~~1.12.00~~		~~FANS:~~			
1.12.01		Rotor components shall be subjected to ultrasonic test at mill and magnetic particle inspection / liquid penetrant examination after rough machining.			
1.12.02		Butt welds in rotor components shall be subjected to 100% RT and all welds shall be magnetic particle/dye penetrant tested after stress relieving.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9		PART-B SUB-SECTION-V-QM1 FGD SYSTEM	
				Page 3 of 4	

PS-PEM-MAX			
CLAUSE NO.	QUALITY ASSURANCE	एनटीपीसी NTPC	
1.12.03	All rotating components and assemblies of fan shall be balanced dynamically		
1.12.04	Performance test shall be carried out on fans as per Technical specification/ Relevant standard		
1.12.05	Test for Natural Frequency and hardness of Fans blades shall be carried out as per Technical specification/ Relevant standard		
1.13.00	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 confirming to ASTM B-209-1060 temper H14 from reputed manufacturer meeting the requirements of NTPC data sheet.		
1.14.00	OTHER CRITICAL EQUIPMENTS:		
1.14.01	Checks/ NDTs shall be done as per relevant Indian Standards or equivalent International Standards.		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9	PART-B SUB-SECTION-V-QM1 FGD SYSTEM
			Page 4 of 4

CLAUSE NO.	QUALITY ASSURANCE			
	(b.) Longitudinal butt weld on bellow shall be subjected to suitable NDT examination before forming, and after forming MPE / DP test shall be carried out. (c.) All welds shall be subjected to 100% magnetic particle/dye pentrant check and butt welds shall be subjected to 100% radiographic testing. (d.) All the bellows subjected to vacuum service shall be subjected to vacuum test. (e.) The bellows shall be subjected to movement test to establish suitability to perform satisfactorily in site conditions. During this test spring rate shall also be measured. (f.) The testing of MEJ shall be as per Expansion joint Manufacturer Association (EJMA) standard.			

QUALITY ASSURANCE

10. Atmospheric Storage Tanks/ Pressure Vessels											
Tests/Check	Y ^a	Y	Y ^b	Y	Y	Y ⁸	Y		Y ^c	Y ^f	
Items / Components	Material Test	WPS/PQR/Welder Qualification	DPT/MPI	Assembly Fit up	Dimension	RT	Hydraulic / Water Fill	Performance Test	Test as per relevant Std/ Appd. Data Sheets	Other Tests	Remarks
11. Rubber lining	Y ^a				Y				Y	Y ⁹	Y ^f Heat Treatment of the Tank/Vessel shall be done per fabrication code requirement. Welded dished ends shall be stress relieved. Dished ends manufactured by cold working shall also be stress relieved as per the requirement of code. Y ⁸ RT as per fabrication code requirements. However, dished ends welds, if manufactured by using welded plates shall be subjected to 100% RT. Y ⁹ Rubber Lining Mix shall be subjected to Bleed Resistance Test on mould sample. Adhesion Test, Spark Test and Hardness Test for the Rubber lined jobs shall also be conducted. Y ¹⁰ Gear Boxes shall be checked for smooth No Load Operation at shop to verify noise and vibration levels. Gear Ratio and Kerosene Leak Test shall also be conducted. Y ¹¹ One Fan of each type & size shall be routine performance tested as per corresponding code for air flow, static pressure, total pressure, speed, efficiency, power consumption, noise & temperature rise. Also all Fans shall be subjected to run test of 4 hours during which noise, vibration, temperature rise and current drawn shall be measured. Y ¹² Dry cycle test on valve spring for 1, 00,000 cycles shall be carried out as type test, if not carried out earlier, for the similar MOC, size and type of spring.
12. Butterfly valves(HP)	Y ^a			Y	Y		Y	Y			
13. Ball valves(HP)	Y ^a			Y	Y		Y	Y			
12. Resins / Activated Carbon Filter	Y ^a	Y	Y ^b	Y	Y				Y	Y ¹⁰	
13. Hoists & Cranes	Y ^a	Y	Y ^b	Y	Y	Y ⁸		Y	Y		
14. Agitators /Flash Mixer/ Flocculator	Y ^a	Y	Y ^b	Y	Y			Y		Y ¹⁰	
15. Pipes (Fabricated)	Y ^a	Y	Y	Y	Y	Y	Y		Y		
16. Ventilation/Exhaust Fan	Y ^a		Y ^b	Y	Y			Y ¹¹	Y	Y ^{dc}	
After erection, the complete Piping system along with valves & fittings shall be hydraulically tested at 1.5 times design pressure or 2 times working pressure whichever is higher.											

		MANUFACTURING QUALITY PLAN												
		ITEM: AGITATOR												
		Page 1 of 2												
SL. NO.	COMPONENT OPERATION &	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N				M	C	N		
1	2	3	4	5	6		7	8	9	D*	10			11

1.0	Raw Material Inspection													
1.1	All materials including casting & forgings	Chem. & Mech. Dimensions Surface Defects	MA MA MA	Review of MTC Measurement Visual	1/Heat 100% 100%	1/H eat -	As per Spec. & Appd. Dwg.	TC IR IR	√	P P P	V - -	V - -		
2.0	Motor: Review of Manufacture Test Certificate													
3.0	In Process Inspection													
3.1	Welding Qualifications	WPS & PQR	MA	WPS, PQR & WPQ	100%		ASME Sec IX	IR	√	P	V	V	Recent qualified WPS,PQR and WPQ shall be submitted for review during inspection.	
3.2	Marking, Cutting, Edge Preparation Tacking	Dimensions	MA	Measurement	100%	-	Appd. Dwg.	IR		P	-	-		
3.3	Welds	Dimensions & Surface Quality	MA	Measurement & Visual	100%		Appd. Dwg. & ASME Sec VIII	IR	√	P	W	V		
3.4	Machining of Components	Dimensions Surface Defects	MA	Measurement Visual	100% 100%	-	Appd. Dwg.	IR		P P	- -	- -		
3.5	Impeller	Static balance test	MA	Measurement	100%		As per Specs.	TR	√	P	V	V		
3.6	Rubber Lining	Hardness test & Spark test	MA	Measurement	100%		As per Specs./ Appd. Drg.	TR	√	P	W	V		
3.7	Assembly	Dimensions Completeness	MA	Measurement Visual	100% 100%		Appd.Drg.	IR	√	P P	V V	V V		
4.0	Final Inspection													
4.1	Final Assembly	Overall Dimensions & Completeness	MA MA	Measurement Visual	100% 10%	*	Ar	Certification signature by Rakesh Sharma <Rakesh_sharma@ntpcceoc> Unknown Digitally signed by Rakesh Sharma Date: 2018.12.21 16:26:59 IST Reason: CAT IP Location: NTPCEOC						
4.2	Free Air Run Test of complete assembly	Measurement Current, RPM, Noise &	MA	Measurement	100%	10%	Vendor S Drawing / Data Sheet	* 10% of each type (Vertical/horizontal)						

		MANUFACTURING QUALITY PLAN												
							ITEM: AGITATOR							
							Page 2 of 2							
SL. NO.	COMPONENT OPERATION &	CHARATERISTICS	CLASS	TYPE OF CHECK	QUATUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N					M	C	N	
1	2	3	4	5	6		7	8	9	D*	10			11

4.3	Review of QA Documents	Vibration Verification of QA Documents	MA	Verification	100%	100%	As per Appd.MQP	IR		P	V	V	
5.0	Painting & Preservation												
5.1		Painting material	MI	Review of MTC	100%		Appd. "Painting Procedure" / Approved Painting Schedule	IR	√	P	V	-	
5.2		Surface treatment and inspection	MI	Visual	100%	-	-do-	IR	√	P	-	-	
5.3		DFT Check	MI	Measurement	10%		-do-	IR	√	P	V	-	
5.4		Painting Surface Quality	MI	Visual	100%		-do-	IR	√	P	V	-	
6.0	Inspection before Delivery												
6.1	Packing	Size, appearance & firmness	MI	Measurement & Visual	100%		As per "Packing Procedure"	IR	√	P	V	-	
6.2	Deliver Documents	Markings, Packing List & Detail Packing List, etc. Check	MI	Verification	100%		As per "Packing Procedure"	IR	√	P	V	-	

NOTES: 1. For Agitator Motor rating is 45KW and motor make NTPC/BHEL Approved source.

2. Routine test report duly witnessed by main contractor as per applicable standard shall be reviewed during inspection (more than 30KW Rating).

3. Bidder to consider these test as minimum, NTPC comments on this QAP for addition of any new test and / or witness of any test shall have no price implication on BHEL.

CLAUSE NO.		QUALITY ASSURANCE																		
MOTOR																				
TESTS/CHECKS TEMS/COMPONENTS		Visual	Dimensional	Make/Type/Rating Physical Inspection	Mech/Chem. Properties	NDT /DP/MPI/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	Routine & Acceptance tests as per IS-325/IS-4722 /IS- 9283/IS 2148/IEC60034\IEC 60079-I/ IS-12615	Vibration	Over speed	Tan delta, shaft voltage & polarization index test	Paint shade, thickness & adhesion
Plates for stator frame, end shield, spider etc.		Y	Y	Y	Y	Y				Y										
Shaft		Y	Y	Y	Y	Y	Y			Y										
Magnetic Material		Y	Y	Y	Y			Y			Y		Y							
Rotor Copper/Aluminium		Y	Y	Y	Y			Y		Y										
Stator copper		Y	Y	Y	Y			Y		Y			Y							
SC Ring		Y	Y	Y	Y	Y		Y	Y	Y										
Insulating Material		Y		Y	Y			Y					Y							
Tubes, for Cooler		Y	Y	Y	Y	Y				Y		Y								
Sleeve Bearing		Y	Y	Y	Y	Y				Y		Y								
Stator/Rotor, Exciter Coils		Y	Y	Y				Y	Y											
Castings, stator frame, terminal box and bearing housing etc.		Y	Y	Y	Y	Y			Y											
Fabrication & machining of stator, rotor, terminal box		Y	Y			Y			Y	Y										
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9						PART-B SUB-SECTION-V-QE1 MOTORS				PAGE 1 OF 2				

CLAUSE NO.	QUALITY ASSURANCE																		एन टी पी सी NTPC	
Wound stator	Y	Y					Y	Y												
Wound Exciter	Y	Y					Y	Y												
Rotor complete	Y	Y					Y						Y	Y						
Exciter, Stator, Rotor, Terminal Box assembly	Y	Y					Y													
Accessories, RTD, BTD,CT, Space heater, antifriction bearing, gaskets etc.	Y	Y	Y																	
Complete Motor	Y	Y	Y												Y	Y	Y	Y1	Y	
Note: 1. This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed along with relevant supporting documents during QP finalization. However, No QP for LT motor upto 50KW. 2. Additional routine tests for Flame proof motors shall be applicable as per relevant standard 3. Makes of major bought out items for HT motors will be subject to NTPC approval. 4. Y1 = for HT Motor / Machines only.																				
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE							TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:CS-0011-109(2)-9							PART-B SUB-SECTION-V-QE1 MOTORS				PAGE 2 OF 2		

5897/2020/PS-PEM-MAX



TITLE:

2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
AGITATORS

SPECIFICATION No: PE-TS-468-571-18000-A001

SECTION-C, SUB-SECTION-C1D

REV. 00

Date: April, 2020

**SECTION-C,
SUB-SECTION-C1D**

**CUSTOMER SPECIFICATION: FUNCTIONAL
GUARANTEES**

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
	FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES FOR SHORTFALL IN PERFORMANCE AND PERFORMANCE GUARANTEE TESTS			
1.00.00	GENERAL			
	The term “Performance Guarantees” wherever appears in the Technical Specifications shall have the same meaning and shall be synonymous to “Functional Guarantees”. Similarly the term “Performance Tests” wherever appears in the Technical Specifications shall have the same meaning and shall be synonymous to “Guarantee Test(s)”.			
2.00.00	PERFORMANCE GUARANTEES / PERFORMANCE TESTS			
2.01.00	General Requirements			
2.01.01	The Contractor shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in these specifications.			
2.01.02	The guaranteed performance parameters furnished by the Bidder in his offer, shall be without any tolerance values whatsoever. All margins required for instrument inaccuracies and other uncertainties shall be deemed to have been included in the guaranteed figures. No tolerance or allowance on the test result will be permitted for instrument errors or inaccuracy, the method of testing or any other causes.			
2.01.03	The Contractor shall conduct performance test and demonstrate all the guarantees covered herein. The various tests which are to be carried out during performance guarantee tests are listed in this Sub-section. The guarantee tests shall be conducted by the Contractor at site in presence of Employer on each unit individually.			
2.01.04	All costs associated with the tests including cost associated with the supply, calibration, installation and removal of the test instrumentation shall be included in the contract price.			
2.01.05	The performance tests shall be performed using only the normal number of Employer supplied operating staff. Contractor, vendor or other subcontractor personnel shall be used only for instructional purposes or data collection. At all times during the Performance Tests the emissions and effluents from the Plant shall not exceed the Guaranteed Emission and Effluent Limits.			
2.01.06	It shall be responsibility of the Contractor to make the plant ready for the performance guarantee tests.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.: CS-0011-109(2)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 1 OF 27

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
2.02.00	Test Instrumentation, Flow Measurement and their Calibration			
2.02.01	All instruments required for performance testing shall be of the type and accuracy required by the code and prior to the test, the Contractor shall get these instruments calibrated in an independent test Institute approved by the Employer and submit the same to Employer prior to commencement of test. All test instrumentation required for performance tests shall be supplied by the Contractor and shall be retained by him upon satisfactory completion of all such tests at site. All calibration procedures and standards shall be subject to the approval of the Employer prior to commencement of test. The protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes. Tools and tackles, thermowells (both screwed and welded) instruments/devices including flow devices, matching flanges, impulse piping & valves etc. and any special equipment, required for the successful completion of the tests, shall be provided by the Contractor free of cost. The Performance test shall be carried out as per the agreed procedure. The detailed PG test procedure shall be submitted within 90 days of the date of Notification of Award and finalization of the PG test procedure shall be done within 180 days from the date of Notification of Award.			
2.02.02	The P&G test procedures shall be submitted for equipments/system & subsystem under Contractor's scope for all Guarantees as mentioned below, as per latest International codes / standard including correction curves, meeting the specification requirements along with sample calculations & detailed activity plan of preparation (including test instrumentation), conductance and evaluation of Guarantees.			
2.02.03	The Contractor shall submit for Employer's approval the detailed Performance Test procedure containing the following: (a) Object of the test. (b) Various guaranteed parameters & tests as per contract. (c) Method of conductance of test and test code. (d) Duration of test, frequency of readings & number of test runs. (e) Method of calculation. (f) Correction calculations & curves. (g) Instrument list consisting of range, accuracy, least count, and location of instruments.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.: CS-0011-109(2)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 2 OF 27

Page 157 of 364

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	एनटीपीसी NTPC		
3.00.00	Accept the equipment /system/ plant after levying Liquidated Damages. The liquidated damages for shortfall in performance indicated in clause 3.00.00 of this sub-section shall be levied separately for each unit. The rates indicated in clause 3.00.00 of this sub-section are on per unit basis. The liquidated damages shall be pro-rated for the fractional parts of the deficiencies. (ii) For Category-II Guarantees In case during performance guarantee test(s) it is found that the equipment/system has failed to meet the guarantees, the Contractor shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements at no extra cost to the Employer and re-conduct the performance guarantee test(s) with Employer's consent. In case the specified performance guarantee(s) are still not met even after the above modifications/replacements within ninety (90) days or a reasonable period allowed by the Employer, after the tests have been completed, the Employer will have the right to either of the following: Reject the equipment /system / plant and recover from the Contractor the payments already made. OR Accept the equipment/system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by the Employer. Such damages shall, however be limited to the cost of replacement of the equipment(s)/system(s), replacement of which shall remove the deficiency so as to achieve the guaranteed performance. These parameters/capacities shall be termed as "Category-II" Guarantees. AMOUNT OF LIQUIDATED DAMAGES (LD) APPLICABLE FOR GUARANTEES FOR EACH PROJECT The rate of liquidated damages and acceptable shortfall limits for different guarantees shall be as under and such liquidated damages shall be deducted from the Contract Price of the project.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 4 OF 27	

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			एनटीपीसी NTPC																
	<u>BHILAI (2X250 MW)</u>																			
	<table><tr><th>Sl.No</th><th>Guarantee</th><th>Rate of Liquidated Damage (LD)</th><th>Acceptable Shortfall Limit with LD</th></tr><tr><td>i)</td><td>SO₂ Removal Efficiency For shortfall in guaranteed SO₂ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.</td><td>INR 2,153,738/- (INR Two Million One Hundred Fifty Three Thousand Seven Hundred Thirty Eight only) for every 0.1% point shortfall in SO₂ removal efficiency from the guaranteed value.</td><td>(-)0.25% point from the guaranteed SO₂ removal efficiency.</td></tr><tr><td>ii)</td><td>Limestone Consumption For increase in the limestone consumption of FGD system in Kg/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.</td><td>INR 30,872,327/- (INR Thirty Million Eight Hundred Seventy Two Thousand Three Hundred Twenty Seven only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.</td><td>(+)10% of the guaranteed limestone consumption.</td></tr><tr><td>iii)</td><td>Auxiliary Power Consumption For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.</td><td>INR 136,930/- (INR One Hundred Thirty Six Thousand Nine Hundred Thirty only) for every KW increase in Auxiliary power consumption from the guaranteed value.</td><td>(+)5% of the guaranteed auxiliary power consumption</td></tr></table>	Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD	i)	SO₂ Removal Efficiency For shortfall in guaranteed SO ₂ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	INR 2,153,738/- (INR Two Million One Hundred Fifty Three Thousand Seven Hundred Thirty Eight only) for every 0.1% point shortfall in SO ₂ removal efficiency from the guaranteed value.	(-)0.25% point from the guaranteed SO ₂ removal efficiency.	ii)	Limestone Consumption For increase in the limestone consumption of FGD system in Kg/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	INR 30,872,327/- (INR Thirty Million Eight Hundred Seventy Two Thousand Three Hundred Twenty Seven only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.	(+)10% of the guaranteed limestone consumption.	iii)	Auxiliary Power Consumption For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.	INR 136,930/- (INR One Hundred Thirty Six Thousand Nine Hundred Thirty only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)5% of the guaranteed auxiliary power consumption			
Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD																	
i)	SO₂ Removal Efficiency For shortfall in guaranteed SO ₂ removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	INR 2,153,738/- (INR Two Million One Hundred Fifty Three Thousand Seven Hundred Thirty Eight only) for every 0.1% point shortfall in SO ₂ removal efficiency from the guaranteed value.	(-)0.25% point from the guaranteed SO ₂ removal efficiency.																	
ii)	Limestone Consumption For increase in the limestone consumption of FGD system in Kg/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	INR 30,872,327/- (INR Thirty Million Eight Hundred Seventy Two Thousand Three Hundred Twenty Seven only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.	(+)10% of the guaranteed limestone consumption.																	
iii)	Auxiliary Power Consumption For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.	INR 136,930/- (INR One Hundred Thirty Six Thousand Nine Hundred Thirty only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)5% of the guaranteed auxiliary power consumption																	
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.: CS-0011-109(2)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 9 OF 27																

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	
	NOTES APPLICABLE FOR EACH PROJECT: i) Each of the liquidated damages specified above shall be independent and these liquidated damages shall be levied concurrently as applicable. ii) All these liquidated damages for short fall in performance shall be deducted from the contract price as detailed in accompanying General Conditions of Contract (GCC)/ Special Conditions of Contract (SCC) iii) Contractor's aggregate liability to pay Liquidated Damages (LD) for failure to attain the functional guarantee shall not exceed twenty five percent (25%) of the Contract Price. iv) The LD values are applicable on per unit basis. 4.00.00 GUARANTEES PARAMETERS 4.01.00 Guarantees Under Category-I The Performance Guarantees which attract Liquidated Damages (LD) are as follows: The following shall be guaranteed by the Bidder under guarantee point condition of Sub- Section-V, Part-A of section- VI: (i) SO₂ removal Efficiency The Contractor shall guarantee that SO₂ removal efficiency shall not be less than the value specified under guarantee point conditions (as specified in Clause 1.00.00/2.00.00/3.00.00 Sub-section-V, Part-A of Section-VI applicable for respective project). (To be conducted as per the stipulation of Cl. no. 6.00.00 of this sub-section.) (ii) Limestone Consumption The Contractor shall guarantee that limestone consumption of FGD system in kg/hr shall not be more than the value specified under guarantee point conditions (as specified in Clause 1.00.00/2.00.00/3.00.00 Sub-section-V, Part-A of Section-VI applicable for respective project). (iii) Auxiliary Power Consumption The Contractor shall guarantee that total auxiliary power consumption for the unit in normal operation shall not be more than the value specified under guarantee point conditions (as specified in Clause 1.00.00/2.00.00/3.00.00 Sub-section-V, Part-A of Section-VI applicable for complete scope of work for the respective project), inline with the requirements stipulated in clause 5.00.00 of this Sub-Section.	
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES PAGE 12 OF 27

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	एनटीपीसी NTPC		
4.02.00	Guarantees Under Category-II The parameters/capabilities shall be demonstrated for various systems/equipments shall include but not limited to the following:- (i) Wet ball Mill capacity at rated fineness The contractor shall demonstrate the guaranteed capacity of each limestone pulverizer under the following conditions: i) Limestone Output fineness : 90% or higher (as per the requirement of the absorber) through 325 mesh (for spray tower process) (OR) 90% or higher (as per the requirement of the absorber) through 200 mesh (for bubbling process) ii) Limestone Quality : All available quality from the specified range. (ii) Wet ball Mill wear parts guarantee Contractor shall demonstrate the life of wet ball Mill wear parts in line with requirements stipulated in Part B of the Technical Specification. The establishment of the above guarantee shall be based on the operating records available at the Power station and will be computed for each pulverizer based on actual total hours of operation. (iii) Wet ball Mill ball consumption Contractor shall guarantee ball consumption per ton of limestone throughput in line with requirements stipulated in Part B of the Technical Specification. Contractor shall furnish the minimum ball diameter below which the balls shall be replaced. (iv) Vacuum Belt Filter Capacity Contractor shall demonstrate the Designed Capacity of the Vacuum Belt Filters to dewater the quantity of gypsum with the specified purity and moisture content as specified in Part B of the Technical Specification. (v) Gypsum Purity The contractor shall demonstrate that the purity of the gypsum produced shall not be less than 90%, chloride content shall not be more than 100ppm			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.: CS-0011-109(2)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 13 OF 27

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	एनटीपीसी NTPC		
	~~and the moisture content shall not be more than 10% for guarantee point condition.~~ (vi) NOT USED (vii) Performance characteristics of fans (capacity, head developed, etc.). (viii) Margins on fans in case Booster Fan is provided by the Contractor. Booster Fans - As specified in Part B of Technical Specifications (ix) Passenger cum Goods Elevator for FGD absorber & Limestone Grinding Building: Over load tests, travel and hoist speed checks. (x) Noise All the plant, equipment and systems covered under this specification shall perform continuously without exceeding the noise level over the entire range of output and operating frequency specified in Part-C of Section-VI of the technical specifications. Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirement of IEC 651 or BS 5969 or is 9779. Sound pressure shall be measured all around the equipment at a distance of 1.0 m horizontally from the nearest surface of any equipment/ machine and at a height of 1.5 m above the floor level in elevation. A minimum of 6 points around each equipment shall be covered for measurement. additional measurement points shall be considered based on the applicable standards and the size of the equipment. the measurement shall be done with slow response on the a - weighting scale. the average of a-weighted sound pressure level measurements expressed in decibels to a reference of 0.0002 micro bar shall not exceed the guaranteed value. corrections for background noise shall be considered in line with the applicable standards. all the necessary data for determining these corrections, in line with the applicable standards, shall be collected during the tests. (xi) Mist Outlet Droplet Content The mist eliminator outlet droplet content shall be guaranteed to be ≤ 20			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 14 OF 27

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	एनटीपीसी NTPC		
5.00.00	ix) The pumps shall be guaranteed to operate satisfactorily without cavitation, pitting, excessive vibration or noise in single pump operation (one pump running) and/or in parallel operation with other pumps or and when starting or shutting down a pump while other pump(s) is/are in operation. x) Current, Voltage, Motor input Power, Frequency, Speed, Bearing / Motor winding Temperature, Vibration and noise level of pumps, blowers and their drives and parallel operation of pumps & blowers shall be demonstrated at site as a part of Performance & Guarantee test. Please also refer the attached Annexure –I to this sub-section for performance guarantee test (xix) Limestone Handling System and Gypsum Handling System a) Limestone Handling Plant (i) The Bidder shall demonstrate the unloading at truck tippler, crushing and conveying to storage shed/silo and then reclaim from storage shed/silos and conveying to mill bunker at the guaranteed capacity including all intermediate equipment & conveyors. (ii) Bidder shall also demonstrate the guaranteed tipping rate of truck tipplers. b) Gypsum Handling Plant The Bidder shall demonstrate the guaranteed conveying from belt filter to storage shed/silo including all intermediate equipment & conveyors. AUXILIARY POWER CONSUMPTION (PA) FOR EACH PROJECT The unit auxiliary power consumption shall be calculated using the following relationship. $P_a = (P_{a1} + P_{a2} + \dots + P_{an})/n$ $P_{an} = P_{un} + T_{Ln}$ P_a = Guaranteed Auxiliary Power Consumption P_{an} = Auxiliary Power Consumption for unit # n (Where "n" is the unit number e.g. 1, 2, ...) P_{un} = Power consumed by the auxiliaries of the unit under test			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 19 OF 27	

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	एनटीपीसी NTPC		
	T_{Ln} = Losses of the transformers supplied by bidder based on works test reports While guaranteeing the auxiliary power consumption of each project the bidder shall necessarily include all continuously operating auxiliaries under this package. The auxiliaries to be considered shall include but not be limited to the following: ~~i. Absorber Recirculation Pump(s)/Gas Cooling Pumps~~ ~~ii. Absorber Oxidation Air Blower(s)~~ iii. Absorber Oxidation Tank Agitators ~~iv. Gypsum Bleed Pumps~~ v. Limestone Gravimetric feeder, Wet ball mill and their integral Auxiliaries divided by the number of units in the project vi. Limestone Slurry Pump(s) vii. Vacuum Belt Filter, Vacuum Pump and its integral auxiliaries divided by the number of units in the project ~~viii. Power consumption of all working Booster water pumps (if provided) to ACW pumps after PHE divided by the number of units in the project~~ ~~ix. Power consumption of Clarified water pumps (if provided) and Clarified booster water pumps (if provided) divided by the number of units in the project~~ ~~x. Power consumption of Process water pump(s) divided by the number of units in the project~~ ~~xi. Mist Eliminator Wash Water pump(s)~~ ~~xii. Power consumption of Belt Filter Wash Water Pump divided by the number of units in the project~~ ~~xiii. Power consumption of total number of DM Cooling (working) Water pump to supply cooling water on the primary (DM) side of the plate type heat exchangers in the closed loop Equipment cooling water system divided by the number of units (working) in the project~~ ~~xiv. Power consumption of total number of Auxiliary Cooling (working) water pump/Permeate water pump to supply cooling water on the secondary side of the plate type heat exchangers in the closed loop Equipment cooling (unit auxiliary) water system divided by the number of units (working) in the project~~			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.: CS-0011-109(2)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 20 OF 27	

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	एनटीपीसी NTPC		
	xv. ~~Booster Fans~~ xvi. Power consumption of Limestone Slurry Tank Agitator(s) divided by the number of units in the project xvii. ~~Power consumption of Filtrate Pump(s) divided by the number of units in the project~~ xviii. ~~Power consumption of Cloth Wash Water Pump divided by the number of units in the project~~ xix. ~~Power consumption of Hydro-cyclone and Waste Water Pump divided by the number of units in the project~~ xx. Power consumption of all other continuous running Agitators divided by the number of units in the project xxi. Air Conditioning System (*) Total Power consumption at motor input terminals of working units (i.e. excluding stand-by) at its rated duty point of compressor and condenser fans of air cooled condensing unit, Air handling unit (AHU) fans for the Air conditioning system of FGD Control Room Building divided by total nos. of units in respective project xxii Total power consumption at motor input terminal at rated duty of fan of UAF divided by total nos. of units in respective project. (*) ((*) Above guaranteed power consumption values shall be at 20 deg C for centrifugal fans of AHUs and at 30 deg C for centrifugal fans of UAF units and at an elevation of RL (referring to GLP of respective projects) for both AHUs and UAF centrifugal fans.) xxiii Total power consumption at motor input terminal at rated duty of Air compressor, Air drying plant (Heater and blower, as applicable) divided by total nos. of units in respective project. xxiv "Total power consumption at motor input terminal at rated capacity of all working High Pressure Feed Pumps (SWRO)(1st Stage) (with its Energy Recovery Unit) to achieve the rated output of the SWRO plant", divided by the number of units in the project for Vallur TPP. xxv "Total power consumption at motor input terminal at rated capacity of all working PX Booster Pumps (if applicable) to achieve the rated output of the SWRO(1st Stage) plant " divided by the number of units in the project for Vallur TPP. xxvi. "Total power consumption at motor input terminal at rated capacity of all working High Pressure Feed Pumps RO (2st Stage) (with its Energy Recovery Unit) to achieve the rated output of the RO plant", divided by the			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 21 OF 27	

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	एनटीपीसी NTPC		
NOTE:	number of units in the project for Vallur TPP. xxvii. "Total power consumption at motor input terminal at rated capacity of all working PX Booster Pumps (if applicable) to achieve the rated output of the RO(2st Stage) plant " divided by the number of units in the project for Vallur TPP. xxviii. "Total power consumption at motor input terminal at rated capacity of all working UF Feed Pumps to achieve the rated output of the SWRO plant" divided by the number of units in the project for Vallur TPP. xxix. "Total power consumption at motor input terminal at rated capacity of all working UF permeate transfer pumps to achieve the rated output of the SWRO plant" divided by the number of units in the project for Vallur TPP. xxx. "Total power consumption at motor input terminal at rated capacity of all working Filter feed pumps to achieve the rated output of the SWRO plant" divided by the number of units in the project for Vallur TPP. xxxi. "Total power consumption at motor input terminal at rated capacity of all working Permeate transfer pumps to achieve the rated output" divided by the number of units in the project for Vallur TPP. xxxii. Power consumption of working Brine/Waste water Pumps at rated capacity and head divided by the no of units of the project for Vallur TPP. xxxiii. Power consumption of Raw Water Pump at rated capacity and head divided by the no of units of the project for Simhadri STPP-I & II (2X500MW) & (2X500MW). 1. Power Consumption for High Pressure Feed Pumps of SWRO (1st Stage) plant (Point No-xxiv) and RO(2nd stage) plant(point no-xxvi) operating with its Energy Recovery Unit and PX Booster Pump (if applicable) (Point No-xxv and Point No-xxvii) at its motor input terminals shall be measured at site while the pumps shall be operated at its design flow rate & rated Head. However, for UF feed pumps (point No-xxviii), UF permeate transfer pumps (point no-xxix), Filter feed pumps (point no-xxx), Permeate water transfer pumps(Point no-xxxi), Brine/Waste water Pumps(Point No-xxxii) power consumption figures obtained during shop test results (with their respective job motor(s)) shall be considered for computation of "<u>Total Power Consumption</u>". Guaranteed power consumption in KW as measured at motor terminal for High Pressure Pumps for SWRO & RO at rated capacity & rated head shall be at 20^o C. 2. The equipment's listed above for calculating auxiliary power consumption are indicative. Any other equipment required for continuous operation of the system shall also be considered for calculation of auxiliary power consumption. Power consumption of all equipments provided on unitized			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 22 OF 27

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES			
	basis shall be included in the unit auxiliary power consumption. For common station auxiliaries, the power consumption shall be assigned to each unit based on unit load for the purpose of calculating the unit auxiliary power consumption. 3. The bidder shall furnish a list of equipments to be covered under auxiliary power consumption, which shall be subject to Employer's approval. 4. Transformer losses (TL) shall be considered as per following (as applicable)- Aux/LT Outdoor/ LT Indoor Transformer: 100 % No load loss and 25 % of Copper Losses. 5. Auxiliary power shall be measured without SCR (De-NOx) system. 6. Auxiliary power shall be measured at the switchgear of the drives.			
6.00.00	METHOD OF COMPUTING TEST EFFICIENCY OF FGD The performance tests shall be carried out in accordance with ASME PTC 40 (1991) code. No tolerance or allowance on the test result will be permitted for instrument errors or inaccuracy, the method of testing or any other causes. The details of the test shall, however be mutually agreed upon between the employer and the contractor.			
7.00.00	METHOD OF COMPUTING AVAILABILITY The Contractor shall guarantee 98 % availability of FGD plant for a continuous period of 120 days. An availability guarantee test shall be conducted to assure this level of availability for a period of 240 days as per the procedure indicated below. Availability 'A' in %: $A = \frac{T_c \times 100\%}{T_k}$ T_c – recorded time of FGD operation, expressed in hours, T_k – recorded time of boiler operation, expressed in hours, However, it is required that: (i) In order to calculate the FGD availability, operation hours will be counted except boiler start-ups when the operation hours counting will start on the moment of shut down of all oil burners, (ii) FGD will be regarded as a FGD in operation, when by-pass damper is closed and total flow of flue gas from boiler goes via FGD, and SO₂			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.: CS-0011-109(2)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 23 OF 27

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES	एनटीपीसी NTPC		
	content is as below in cleaned flue gas for the range of specified coals & loads: (a) 200 mg/Nm³ (6% O₂ dry) for units having capacity of 500 MW & above (b) 100 mg/Nm³ (6% O₂ dry) for Rourkela (1x250 MW) & MTPS (2x195 MW) (c) 600 mg/Nm³ (6% O₂ dry) for Bhilai (2x250 MW) (iii) If FGD is out of operation during the boiler operation time as a result of the Employer's decision, this time will not be counted as boiler operation time for calculating the FGD availability, (iv) Boiler operation hours will be counted based on the recorded boiler operation hours and the recorded data will be made available to the Contractor by the Employer. Mandatory spares have been identified in the Employer. Contractor can use the mandatory spares supplied under the contract during this period in agreement with the Employer. However, if other additional spares are required for demonstration of availability demonstration guarantee, Bidder to should clearly indicate along with their offer. If the calculated availability after 120 days availability test is lower than the guaranteed value, the Contractor will undertake actions as per clause 2.04.00 (ii) of this Sub-Section to achieve the guaranteed availability.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-VI FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES	PAGE 24 OF 27	

CLAUSE NO.	GUARANTEE TEST PROCEDURE 											
	ANNEXURE – IIA FORMAT FOR SUBMISSION OF GUARANTEE TEST PROCEDURE <table border="1" data-bbox="425 451 1330 1587"> <thead> <tr> <th data-bbox="425 451 672 638">Clause No. as per LOA/ Tech. Specs.</th> <th data-bbox="672 451 888 638">Provision of LOA / Tech. Specs.</th> <th data-bbox="888 451 1112 638">Name and Methodology of Test proposed by Vendor</th> <th data-bbox="1112 451 1330 638">NTPC comments on the tests proposed by vendor</th> </tr> </thead> <tbody> <tr> <td data-bbox="425 638 672 1587"></td> <td data-bbox="672 638 888 1587"></td> <td data-bbox="888 638 1112 1587"></td> <td data-bbox="1112 638 1330 1587"></td> </tr> </tbody> </table>				Clause No. as per LOA/ Tech. Specs.	Provision of LOA / Tech. Specs.	Name and Methodology of Test proposed by Vendor	NTPC comments on the tests proposed by vendor				
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CLAUSE NO.	GUARANTEE TEST PROCEDURE 																											
	APPENDIX-IV GUARANTEE TEST PROFORMA POWER MEASUREMENT Project : Package : Date : 1. Equipment/Stream Composition : 2. Motor Description : 3. Sr. No. of meters used : 4. Date of Calibration of instrument and name of test house : 5. Multiplying factor (M.F.) of the wattmeter : 6. Wattmeter Readings (to be taken at 1 minute intervals) : <table border="1"> <thead> <tr> <th rowspan="2">Sl. No.</th> <th rowspan="2">Measurement Terminal Location</th> <th rowspan="2">Time</th> <th rowspan="2">Voltage (Volts)</th> <th rowspan="2">Current (amps)</th> <th colspan="2">kw Reading M.F.</th> <th rowspan="2">Total (W1+W2) MF kw</th> <th rowspan="2">Remarks</th> </tr> <tr> <th>W1</th> <th>W2</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>								Sl. No.	Measurement Terminal Location	Time	Voltage (Volts)	Current (amps)	kw Reading M.F.		Total (W1+W2) MF kw	Remarks	W1	W2									
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					W1	W2																						

CLAUSE NO.	GUARANTEE TEST PROCEDURE							
	APPENDIX-IV							
	7. Energymeter Readings							
	Sl.	Equip- Ment	Time Duration		Energymeter Readings kwHr		Equipmen t kw (R2- R1)/ (t2-t1)	Remarks
			Initial	Final	Initial	Final		
	*Reason and duration for system trip/stop may be recorded in remarks column.							
	NTPC				Contractor			

CLAUSE NO.	GUARANTEE TEST PROCEDURE																				
	APPENDIX-V																				
	GUARANTEE TEST PROFORMA VIBRATION LEVEL MEASUREMENTS Project : Package : Date : Time : Details of vibration Level Meter 1. Make 2. Model & Sl.No. 3. Date of calibration with name of Test House																				
	<table border="1"> <thead> <tr> <th rowspan="2">Sl.No.</th> <th rowspan="2">Equipment</th> <th rowspan="2">Pick *Point</th> <th colspan="3">Vibration level Amplitude/Velocity</th> </tr> <tr> <th>Horizontal Micron/ mm/ sec.</th> <th>Vertical micron/ mm/sec.</th> <th>Axial Micron / mm/sec.</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>					Sl.No.	Equipment	Pick *Point	Vibration level Amplitude/Velocity			Horizontal Micron/ mm/ sec.	Vertical micron/ mm/sec.	Axial Micron / mm/sec.							
Sl.No.	Equipment	Pick *Point	Vibration level Amplitude/Velocity																		
			Horizontal Micron/ mm/ sec.	Vertical micron/ mm/sec.	Axial Micron / mm/sec.																
	* Reading shall be taken at all the bearings of motor, gear box and driven equipment. In case of conveyor galleries, vibrations shall be measured at min. three locations, at midpoint of stringer between two short supports.																				
	NTPC		Contractor																		

CLAUSE NO.	GUARANTEE TEST PROCEDURE 																
	APPENDIX-VI GUARANTEE TEST PROFORMA NOISE LEVEL MEASUREMENT Project: Package : Date : Details of Sound Level Meter 1. Make 2. Model 3. Date of calibration with name of Test House <table border="1" data-bbox="435 877 1377 1388"> <thead> <tr> <th data-bbox="435 877 527 1031">Sl.No</th> <th data-bbox="527 877 693 1031">Equipment with location</th> <th data-bbox="693 877 888 1031">Equipment load/capacity</th> <th data-bbox="888 877 1094 1031">Measurement* point no.</th> <th data-bbox="1094 877 1245 1031">Sound level dBA.</th> <th data-bbox="1245 877 1377 1031">Remarks</th> </tr> </thead> <tbody> <tr> <td data-bbox="435 1031 527 1388"></td> <td data-bbox="527 1031 693 1388"></td> <td data-bbox="693 1031 888 1388"></td> <td data-bbox="888 1031 1094 1388"></td> <td data-bbox="1094 1031 1245 1388"></td> <td data-bbox="1245 1031 1377 1388"></td> </tr> </tbody> </table> NTPC Contractor * For each equipment location, a Projected Plan Diagram shall be made and the location of measurement points shall be identified.					Sl.No	Equipment with location	Equipment load/capacity	Measurement* point no.	Sound level dBA.	Remarks						
Sl.No	Equipment with location	Equipment load/capacity	Measurement* point no.	Sound level dBA.	Remarks												

5897/2020/PS-PEM-MAX



TITLE:

2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
AGITATORS

SPECIFICATION No: PE-TS-468-571-18000-A001

SECTION-I, SUB-SECTION-C2C

REV. 00

Date: April, 2020

SECTION-I, SUB-SECTION-C2C

CUSTOMER SPECIFICATION: PAINTING SPECIFICATION

S-PEM-MAX			
CLAUSE NO.	TECHNICAL REQUIREMENTS		
1.00.00	SPECIFICATION OF SURFACE PREPARATION & PAINTING		
1.01.00	Surface preparation methods and paint/primer materials shall be of the type specified herein. If the contractor desires to use any paint/primer materials other than that specified, specific approval shall be obtained by the contractor in writing from the employer for using the substitute material.		
1.02.00	All paints shall be delivered to job site in manufacturers sealed containers. Each container shall be labelled by the manufacturer with the manufacturer's name, type of paint, batch number and colour.		
1.03.00	Unless specified otherwise, paint shall not be applied to surfaces of insulation, surfaces of stainless steel/nickel/ copper/brass/ monel/ aluminum/ hastelloy/lead/ galvanized steel items, valve stem, pump rods, shafts, gauges, bearing and contact surfaces, lined or clad surfaces.		
1.04.00	All pipelines shall be Colour coded for identification as per the NTPC Colour-coding scheme, which will be furnished to the contractor during detailed engineering.		
1.05.00	SURFACE PREPARATION		
1.05.01	All surfaces to be painted shall be thoroughly cleaned of oil. Grease and other foreign material. Surfaces shall be free of moisture and contamination from chemicals and solvents.		
1.05.02	The following surface preparation schemes are envisaged here. Depending upon requirement any one or a combination of these schemes may be used for surface preparation before application of primer. SP1 Solvent cleaning SP2 Application of rust converter (Ruskil or equivalent grade) SP3 Power tool cleaning SP4 Shot blasting (shot blasting shall be used as surface preparation method for hot worked pipes prior to application of primer) SP4* Shot blast cleaning/ abrasive blast cleaning to SA21/2 (near white metal) 35-50 microns SP5 Shot blasting/ abrasive blasting. SP6 Emery sheet cleaning/Manual wire brush cleaning.		
1.06.00	APPLICATION OF PRIMER/PAINT		
1.06.01	The paint/primer manufacturer's instructions covering thinning, mixing, method of application, handling and drying time shall be strictly followed and considered as part of this specification. The Dry film thickness (DFT) of primer/paint shall be as specified herein.		
1.06.02	Surfaces prepared as per the surface preparation scheme indicated herein shall be applied with primer paint within 6 hours after preparation of surfaces.		
1.06.03	Where primer coat has been applied in the shop, the primer coat shall be carefully examined, cleaned and spot primed with one coat of the primer before applying intermediate and finish coats. When the primer coat has not been applied in the shop, primer coat shall be applied by brushing, rolling or spraying on the same day		

CLAUSE NO.	एनटीपीसी NTPC TECHNICAL REQUIREMENTS
1.06.04 1.06.05 1.06.06 1.06.07 1.06.08 1.06.09	as the surface is prepared. Primer coat shall be applied prior to intermediate and finish coats. Steel surfaces that will be concealed by building walls shall be primed and finish painted before the floor is erected. Tops of structural steel members that will be covered by grating shall be primed and finish painted before the grating is permanently secured. Following are the Primer/painting schemes envisaged herein: PS3 - Zinc Chrome Primer (Alkyd base) by brush/Spray to IS104. PS3* - Zinc Chrome primer (Alkyd base) by dip coat. PS4 - Synthetic Enamel (long oil alkyd) to IS2932. PS5 - Red Oxide Zinc Phosphate primer (Alkyd base) to IS 12744 PS9 - Aluminium paint to IS 2339. PS9* - Heat resistant Aluminium paint to IS-13183 Gr.-1 PS13 - Rust preventive fluid by spray, dip or brush. PS14 - weldable primer-Deoxaluminate or equivalent. PS16 - High Build Epoxy CDC mastic '15' . PS17 - Aliphatic Acrylic Polyurethane CDE134 ,%V=40.0(min.) PS18 - Epoxy based TiO2 pigmented coat PS19 - Epoxy Zinc rich primer (92% zinc in dry film (min.), %VS=40.0(min.) PS-20 - Epoxy based finish paint All weld edge preparation for site welding shall be applied with one coat of weldable primer. For internal protection of pipes/tubes, VCI pellets shall be used at both ends after sponge testing and ends capped. VCI pellets shall not be used for SS components and composite assemblies. SG membrane walls and other Flue gas swept pressure part surfaces shall be applied with appropriate primer for protection of surfaces during transit, storage and erection. a) All un-insulated equipments, pipes, valves etc covered in sub-section A-08 (Steam Turbine & Auxiliary system) shall be painted with paint not inferior to Epoxy resin based paints with minimum DFT of 150 micron. The paint shall be applied in three stages i.e. primer, intermediate and finish coats in following manner: ▪ Primer coat – Epoxy based zinc phosphate ▪ Intermediate - Epoxy based TiO2 pigmented coat ▪ Finish coat - Epoxy based finish coat b) Equipment, pipes etc. with high temperature shall be painted with heat resistant aluminum paint (to be selected based on the service condition of component as per IS-13183). Two coats of paint shall be applied with total DFT 40 micron. c) Surface preparation before painting shall be carried out according to requirement indicated in this sub-section and international standard
	Page 176 of 364

CLAUSE NO.	TECHNICAL REQUIREMENTS 
1.06.10	A) Specification for the application of Epoxy coating for internal protection of DM tank & other vessels/tanks (as applicable) shall be as follows: Primer : One coat of unmodified epoxy resin along with polyimide hardener. Paint : Two (2) coats unmodified epoxy resin along with Aromatic adduct hardener. Total thickness of primer and paint should not be less than 400 microns. B) Specification for application of chlorinated Rubber paint for external protection vessel, tanks, piping, valves & other equipments shall be as follows: i) For Indoor vessel, tanks, piping, valves & other equipments: (a) Surface preparation shall be done either manually or by any other approved method. (b) Primer coat shall consist of one coat of chlorinated rubber based zinc phosphate primer having minimum DFT of 50 microns. (c) Intermediate coat (or under coat) shall consist of one coat of chlorinated rubber based paint pigmented with Titanium dioxide with minimum DFT of 50 microns. (d) Top coat shall consist of one coat of chlorinated rubber paint of approved shade and colour with glossy finish and DFT of 50 microns. Total DFT of paint system shall not be less than 150 microns. ii) For Outdoor vessel, tanks, piping, valves & other equipments: (a) Surface preparation shall be blast cleared using non-siliceous abrasive after usual wire brushing, which shall conform to Sa 2-1/2 Swiss Standard. (b) Primer coat shall consist of one coat of epoxy resin based zinc phosphate primer having minimum DFT of 100 microns. (c) Intermediate coat (or under coat) shall consist of epoxy resin based paint pigmented with Titanium dioxide with minimum DFT of 100 microns. (d) Top coat shall consist of one coat of epoxy paint suitable pigmented of approved shade and colour with glossy finish and DFT of 75 microns. Additionally finishing coat of polyurethane of minimum DFT of 25 microns shall be provided. The paint may be applied in one coat, in case high built paint is used, otherwise two coats shall be applied. Total DFT shall not be less than 300 microns.



- ii) Painting specification for inside surfaces (such as inner surfaces of ducts/ tanks/ mills/ dampers/ ESP etc.) that are not covered specifically in above clauses, shall be provided with 2 coats of suitable primer i.e. PS5/ PS9 (Total DFT 60/40 micron) based on the temperature.

F) FGD System

- (i) Surface preparation shall be blast cleaned conforming to Sa 2-1/2 Swiss Standard.
- (ii) Primer coat shall consist of epoxy resin based zinc phosphate primer having minimum DFT of 100 microns.
- (iii) Intermediate coat (or under coat) shall consist of epoxy resin based paint pigmented with Titanium dioxide with minimum DFT of 100 microns.
- (iv) Top coat shall consist of one coat of epoxy paint suitable pigmented of approved shade and colour with glossy finish and DFT of 75 microns. Additionally finishing coat of polyurethane of minimum DFT of 25 microns shall be provided.

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

1. FGD SYSTEM

1	Slurry recirculation pump System (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)	FW 212	Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm	Primer: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ 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: Light Blue, RAL 5012	75 25	300
2	Absorber System Internals – Structural items (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)	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 (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)	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

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
6	Absorber system casing bottom (Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03) Inside surfaces of Absorber casing top& bottom is lined with C-276 material, hence no paint is envisaged.	FW 221	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer 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 = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 Intermediate Coat: One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min)	75 100	Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE) DFT = 35 µm per coat, Shade: Grey white RAL9002	70	245
7	Absorber system casing top, Duct supports & Structures for RC pump house (Tec. Spec. Sec.VI, Part-B, Subsection- D-01, cl. 6.04.03)	FW 222 FW 232 FW 234 FW 236	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 = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 Intermediate Coat: One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min)	75 100	Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE) DFT = 35 µm per coat, Shade: Grey white RAL9002	70	245
8	Absorber system accessories (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)	FW 223	Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm	Primer: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ Intermediate: One coat of Two component epoxy based	100 100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ	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.)	

				intermediate paint pigmented with MIO/Tio2 DFT- 100µ		Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL 9002		
9	Emergency Quench water tank- Outside surfaces (Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)	FW 226	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 = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 Intermediate Coat: One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min)	75 100	Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE) DFT = 35 µm per coat, Shade: Grey white RAL9002	70	245
10	Emergency Quench water tank- Inside surfaces	FW 226	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm	Primer Coat: 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) DFT = 30 µm per coat; Total DFT- 60µ				

SI No	SURFACE LOCATION		PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
					PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
11	Emergency quench system Handling Equipment RC pump (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)		FW 227 FW 249	Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm	Primer: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ 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, RAL 9002	75 25	300
12	Air oxidation system (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)		FW 230	Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm	Primer: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ 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, RAL 9002	75 25	300
13	Oxidation Air distribution system& Slurry distribution system, Absorber W/D interface and W/D wash system (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)		FW 228 FW 229 FW 243 FW 244	Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm	Primer: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ 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: Sky blue, Shade no.101 of IS:5	75 25	300
14	Expansion joint between bypass	Flue gas swept surface (Inside)	FW 251	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (two coats)	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.)		
	(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 6, 9 of 9) Temp>60°C	Insulated surfaces		Power Tool Cleaning to St3 (SSPC-SP3)	HR Aluminium paint to IS 13183 Gr.I (upto 600 deg C)	20	HR Aluminium paint to IS 13183 Gr.I (upto 600 deg C)	20	40
15	Expansion joint between scrubbers (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 6, 9 of 9) Temp>60°C	Flue gas swept surface (Inside)	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.I (upto 600 deg C)	20	HR Aluminium paint to IS 13183 Gr.I (upto 600 deg C)	20	40
16	Ducts between bypass duct inlet& Absorber (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 6, 9 of 9) Temp-150°C	Flue gas swept surface (Inside)	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.I (upto 600 deg C)	20	HR Aluminium paint to IS 13183 Gr.I (upto 600 deg C)	20	40

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)	
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)		
17	Ducts between Absorber& Stack (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 6, 9 of 9) Temp-60°C	Flue gas swept surface (Inside)	FW 257	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	NIL	--	60
				Power Tool Cleaning to St3 (SSPC-SP3)	HR Aluminium paint to IS 13183 Gr.I (upto 600 deg C)	20	HR Aluminium paint to IS 13183 Gr.I (upto 600 deg C)	20	40
18	Duct structure between by pass duct & Absorber (Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)		FW 260	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 = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 Intermediate Coat: One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min)	75 100	Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE) DFT = 35 µm per coat, Shade: Grey white RAL9002	70	245

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN ($\mu\text{m min.}$)
				PAINT	DFT ($\mu\text{m min.}$)	PAINT	DFT ($\mu\text{m min.}$)	
20	Foundation material for duct structures, Absorber, RC shed,tanks, pipe racks& Silo Structure	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- 20 μ 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.					
21	Structures for Elevator& Supporting structures for Emergency Quench Water Tank (Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)	FW 285 FW 292	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60 μm 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 = 75 μm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 Intermediate Coat: One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 μm per coat (min)	75 100	Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE) DFT = 35 μm per coat, Shade: Grey white RAL9002	70	245
22	Elevator and accessories (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)	FW 293 FW 716	Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 μm	Primer: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100 μ Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100 μ	100 100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75 μ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25 μ Shade: Grey white, Shade no. RAL 9002	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.)	

23	Galleries and railings for Stairs, Absorber, Dampers, Ducts, Tanks (Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.08, 6.04.09)	FW 237 FW 610 FW 612 FW 613 FW 722	Gratings- Blast cleaning to Sa 2½	Hand rails, Gratings- Hot dip galvanizing to 610gms/sq.m (minimum) and to a coating thickness of 87µm (minimum)				
24	Galleries and railings for Stairs, Absorber, Dampers, Ducts, Tanks – Structures other than the above (Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)	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 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 = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 Intermediate Coat: One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min)	75 100	Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE) DFT = 35 µm per coat, Shade: Grey white RAL9002	70	245
25	Slurry pumps & accessories (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)	FW 701	Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm	Primer: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ Intermediate: One coat of Two component epoxy based	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	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.)	
				intermediate paint pigmented with MIO/Tio2 DFT- 100µ		Shade: Light Blue, RAL 5012		
26	Water pumps & accessories (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)	FW 702	Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm	Primer: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ 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: Light Blue, RAL 5012	75 25	300
27	Monorail for hoist & cranes (Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)	FW 710	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 = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 Intermediate Coat: One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min)	75 100	Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE) DFT = 35 µm per coat, Shade: Grey white RAL9002	70	245
28	Handling Equipment in FGD (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)	FW 713 FW 714	Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm	Primer: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ 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, RAL 9002	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.)	
29	Man hole door & Viewing ports (Tec. Spec Sec VI, Part B, Subsection A-12 Page 6 of 9)	FW 239 FW 717	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
30	Agitator support, Air cannon silo, Bag filter and fan assy silo and Nozzles and Flanges (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)	FW 721 FW 723 FW 724 FW 725	Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm	Primer: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ	100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ	75	300
				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, RAL 9002	25	
31	Limestone silo structures (Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)	FW 730	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 = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 Intermediate Coat: One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min)	75 100	Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE) DFT = 35 µm per coat, Shade: Grey white RAL9002	70	245

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[illegible]

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
39	Gypsum belt filter and accessories Structural items (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)	FW 738	Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm	Primer: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ 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, RAL 9002	75 25	300
40	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 Outside surfaces (Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)	FW 742 FW 743 FW 744 FW 745 FW 747 FW 748 FW 785 FW 786 FW 802	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 = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 Intermediate Coat: One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min)	75 100	Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE) DFT = 35 µm per coat, Shade: Grey white RAL9002	70	245
41	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 Inside surfaces	FW 742 FW 743 FW 744 FW 745 FW 747 FW 748 FW 749 FW 785 FW 786 FW 802	Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50µm	Primer: Two coats of Red Oxide Zinc phosphate primer to IS: 12744 (Lining is inside the tanks, hence primer is only envisaged for protection till erection)	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.)	
42	Process water pipe accessories, Cooling water pipe accessories (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 7 of 9)	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 undercoat to IS: 2932	50 30	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- DFT- 35µ/ coat Identification Tag: Sea Green Shade no: 217 as per IS 5	70	150
43	Slurry pipe accessories (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 7 of 9)	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 undercoat to IS: 2932	50 30	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- DFT- 35µ/ coat Identification Tag: Sea Green Shade no: 217 as per IS 5	70	150
44	Service Air pipe accessories (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 7 of 9)	FW 754	Power Tool Cleaning to St3 (SSPC-SP3)	Primer: Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) Intermediate: One coat of Synthetic Enamel undercoat to IS: 2932	50 30	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- DFT- 35µ/ coat Identification Tag: Sky blue Shade no: 101 as per IS 5	70	150
45	Instrument air pipe accessories (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 7 of 9)	FW 755	Power Tool Cleaning to St3 (SSPC-SP3)	Primer: Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) Intermediate: One coat of Synthetic Enamel undercoat to IS: 2932	50 30	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- DFT- 35µ/ coat Identification Tag: Sky blue Shade no: 101 as per IS 5	70	150
46	All Valves and fittings (Temp <95 deg C) (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 7 of 9)	FW 815 to FW 851	Power Tool Cleaning to St3 (SSPC-SP3)	Primer: Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) Intermediate: One coat of Synthetic Enamel undercoat to IS: 2932	50 30	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- DFT- 35µ/ coat	70	150

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
47	Structure for Pipe racks Trestle for pipe racks & Structures inside Gypsum dewatering building and Ball mill building (Tec. Spec. Sec.- VI, Part-B, Sub section D-01, cl. 6.04.03)	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 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 = 75 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00 Intermediate Coat: One coat of two component polyamide cured Epoxy based MIO pigmented Intermediate coat (solid by volume- 80% (min), containing lamellar MIO min.30% on pigment)) DFT = 100 µm per coat (min)	75 100	Two coats of Two Pack Aliphatic Isocyanate cured acrylic finish Paint to IS 13213 (solid by volume- 55% (min) with gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min.1000 hours of exposure. Gloss loss less than 30 and color change less than 2.0ΔE) DFT = 35 µm per coat, Shade: Grey white RAL9002	70	245
48	Supports for Cable trays, Tools, Air receivers, commissioning spares (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 9 of 9)	FW 779 FW 798 FW 988 FW 996 FW 997	Blast Cleaning to SA 2 ½ (Near white metal) with surface profile 40 – 60 µm	Primer: One coat of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 100µ 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, RAL 9002	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-GATES & DAMPERS

01	Gates & Dampers > 95° C Insulated Surfaces& Uninsulated surfaces (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 6 of 9)	57 560 57 570 57 580 57 583	Power Tool Cleaning to St3 (SSPC-SP3)	One coat of HR Aluminium paint to IS 13183 Gr. I	20	One coat of HR Aluminium paint to IS 13183 Gr. I	20	40
02	Seal air piping (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 7 of 9)	57 141	Power Tool Cleaning to St3 (SSPC-SP3)	Primer: Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) Intermediate: One coat of Synthetic Enamel undercoat to IS: 2932	50 30	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- DFT- 35µ/ coat Identification Tag: Sky blue Shade no: 101 as per IS 5	70	150
03	Blower with Motor Knife Gate valve (Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 6 of 9) & (Clause 20.03.00 of Part- C Section VI)	57 491 57 497	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) Motor paint Shade: RAL 5012	40	100
04	Ladder, Cage for Ladder Toe Guard Plate Floor Grill, Hand Rails, Hand Rail Post (Tec. Spec. Sec.- VI, Part-B, Sub section D- 01, cl. 6.04.08, 6.04.09)	57 466	Gratings- Blast cleaning to Sa 2½	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. 4 of above& Mounting bracket	57 209 57 466	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.)	
	(Tec. Spec. Sec.- VI, Part-B, Sub section A-12 Page 6 of 9)							

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

3. 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 FGD SI no.01,02,03,04,05,06, 07,08,09,11,12,13,18 19,21,22,24,25,26,27,28,30,31,32,34,36, 37,39,40,47& 48 of FGD.	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 SI nos of FGD & Gates & Dampers	Power Tool Cleaning to Bare metal	Primer and Finish : As given in respective scheme

GENERAL NOTES

- No painting is required for Galvanized, non-ferrous & stainless steel items, except as indicated above.
- Machined items are to be applied with coat of temporary rust preventive oil
- PGMAs covered in sub-supplier (ie., Purchased) items viz., Agitator 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.
- In sub-assy, wherever plates / sheets of thickness less than or equal to 5mm and rods are used - Power Tool or Hand Tool Cleaning to SSPC - SP 3 / SP 2 shall be followed and painting shall be as per SI no:05 of GAD.
- Ground shade/colour of finish paints and identification tag/band for equipments, fans, piping, pipe services, supporting structures and other components is followed as per NTPC doc no: QS-01-DIV-W-4 at site.
- All components covered under different PGMAs are to be painted. In case any component is left out, the same shall deemed to be included under the relevant section.
- 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.
- Painting requirement for all electrical equipment shall be as per the details identified in specification for the respective equipment.
- 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.
- Finish coat to be applied after an interval of min 10 hrs and within 6 months (after completion of intermediate coat).
- Bottom of base plate including below zero level portion marked in Supporting Columns of structures which will be embedded in concrete, those surfaces shall be prepared by manual cleaning to ST3 and provided with primer coat of chlorinated rubber based zinc phosphate primer of min. 50 µm 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	24	Grey
03	Epoxy High solid-Polyamide cured Epoxy based MIO pigmented intermediate coat	--	2	80	Airless Spray only	16	Brown
04	Epoxy based finish paint	IS 14209	2	62	Airless Spray only	16	Corresponding shade no
05	Aliphatic isocyanate acrylic polyurethane paint	IS 13213	2	55	Spray	16	Corresponding shade no
06	Heat resistant aluminium paint	IS 13183 Grade II	1	--	Brush/ Spray	24	--
07	Synthetic Enamel undercoat	IS 2932	1	40	Brush/ Spray	12	--
08	Long oil alkyd Synthetic enamel finish paint	IS 2932	1	35	Brush/ Spray	12	Corresponding shade no
09	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

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
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:

**2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
AGITATORS**

SPECIFICATION No: PE-TS-468-571-18000-A001

SECTION-I, SUB-SECTION-C3

REV. 00

Date: April, 2020

**SECTION-I,
SUB-SECTION-C3
TECHNICAL SPECIFICATION OF AGITATORS
(ELECTRICAL PORTION)**

VOLUME NO. :	II-B
SECTION :	
REV NO. 00 :	DATE : 24.03.2020
SHEET :	1 OF 3

Page 206 of 364



TITLE :
ELECTRICAL EQUIPMENT SPECIFICATION
FOR AGITATOR
2X250 MW NSPCL BHILAI EXPANSION
POWER PROJECT

SPECIFICATION NO.
VOLUME NO. : II-B
SECTION :
REV NO. 00 : DATE : 24.03.2020
SHEET : 2 OF 3

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

- a) Services and equipment as per “Electrical Scope between BHEL and Vendor”.
- b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.
- c) Supply of mandatory spares as specified in the specifications of mechanical equipments.
- d) Electrical load requirement for **AGITATOR**.
- e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL.
- g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
- h) Motor shall meet minimum requirement of motor specification.
- i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
- j) Cable BOQ worked out based on routing of cable listing provided by the vendor for “ both end equipment in vendor’s scope”shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer “Electrical Scope between BHEL and Vendor”.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- 3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of



TITLE :
ELECTRICAL EQUIPMENT SPECIFICATION FOR
AGITATOR
2X250 MW NSPCL BHILAI EXPANSION
POWER PROJECT

SPECIFICATION NO.
VOLUME NO. : II-B
SECTION :
REV NO. 00 : DATE : 24.03.2020
SHEET : 3 OF 3

compliance certificate/No deviation certificate.

- 3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0 List of enclosures :

- a) Electrical scope between BHEL & vendor
- b) Customer (NTPC) specification for Motors
- c) Customer (NTPC) specification for cable lugs and glands
- d) Quality plan for motors & NTPC quality assurance
- e) Datasheet A & C (Annexure- I)
- f) Electrical Load data format (Annexure –II)
- g) BHEL cable listing format (Annexure –III)

REV: 0 DATE: 24.03.2020

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR
PACKAGE: AGITATOR (Supply Package)

PROJECT: 2X250 MW BHILAI EXPANSION POWER PROJECT

<u>S.NO</u>	<u>DETAILS</u>	<u>SCOPE SUPPLY</u>	<u>SCOPE E&C</u>	<u>REMARKS</u>
1	415 V MCC	BHEL	BHEL	415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motors.
3	Power cables, control cables and screened control cables	BHEL	BHEL	Incoming cable from BHEL supplied MCC will be informed by BHEL. Vendor shall provide lugs & glands accordingly.
4	Cable trays, accessories & cable trays supporting system	BHEL	BHEL	
5	Cable glands and lugs for equipments supplied by Vendor	Vendor	BHEL	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power and control cables.
6	Conduit and conduit accessories for cabling between equipments supplied by vendor	BHEL	BHEL	
7	Equipment grounding & lightning protection	BHEL	BHEL	
8	Below grade grounding	BHEL	BHEL	
9	LT Motors with base plate and foundation hardware	Vendor	BHEL	Makes shall be subject to BHEL approval at contract stage.
10	Mandatory spares	Vendor	-	Vendor to quote as per specification.
11	Recommended O & M spares	Vendor	-	As per specification
12	Any other equipment/material/service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the system).	Vendor	BHEL	
13	Electrical equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipments/items supplied shall be reputed make & shall be subject to approval of BHEL after award of contract.
2. All QPs shall be subject to approval of BHEL after award of contract without any commercial implication.

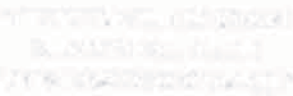


SUB-SECTION-II-E2

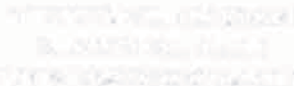
MOTORS

PS-REM-MAX		TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
CLAUSE NO.					
		MOTORS			
1.00.00	GENERAL REQUIREMENTS				
1.01.00	For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment.				
1.02.00	All equipment's shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.				
1.03.00	Contactor shall provide fully compatible electrical system, equipment's, accessories and services.				
1.04.00	All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.				
1.05.00	Paint shade shall be as per RAL 5012 (Blue) for indoor and outdoor equipment.				
1.06.00	The responsibility of coordination with electrical agencies and obtaining all necessary clearances for Contactors equipment and systems shall be under the Contactor scope.				
1.07.00	Degree of Protection				
	Degree of protection for various enclosures as per IEC60034-05 shall be as follows :-				
	i)	Indoor motors	-	IP 54	
	ii)	Outdoor motors	-	IP 55	
	iii)	Cable box-indoor area	-	IP 54	
	iv)	Cable box-Outdoor area	-	IP 55	
2.00.00	CODES AND STANDARDS				
	1)	Three phase induction motors	:	IS/IEC:60034	
	2)	Single phase AC motors	:	IS/ IEC:60034	
	3)	Crane duty motors	:	IS:3177, IS/IEC:60034	
	4)	DC motors/generators	:	IS:4722, IS/IEC:60034	
	5)	Energy Efficient motors	:	IS 12615, IEC:60034-30	
				PAGE 1 OF 9	

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC
3.00.00	TYPE	
3.01.00	AC Motors: - Squirrel cage induction motor suitable for direct-on-line starting. - Continuous duty LT motors upto 200 KW Output rating (at 50 deg.C ambient temperature), shall be Premium Efficiency class-IE3, conforming to IS 12615, or IEC:60034-30. - Crane duty motors shall be slip ring/ squirrel cage Induction motor as per the requirement. - Motor operating through variable frequency drives shall be suitable for inverter duty. Also these motors shall comply the requirements stipulated in IEC: 60034-18-41 and IEC: 60034-18-42 as applicable.	
3.02.00	DC Motors Shunt wound.	
4.00.00	RATING - Continuously rated (S1). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor. - Whenever the basis for motor or driven equipment ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.	
5.00.00	TEMPERATURE RISE Air cooled motors 70 deg. C by resistance method for both thermal class 130(B) & 155(F) insulation. Water cooled 80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method for both thermal class 130(B) & 155(F) insulation.	
6.00.00	OPERATIONAL REQUIREMENTS	
6.01.00	Starting Time	
6.01.01	For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.	
6.01.02	For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time.	
		PAGE 2 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS		
6.01.03	For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.		
6.01.04	Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.		
6.02.00	Torque Requirements		
6.02.01	Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.		
6.02.02	Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.		
6.03.00	Starting voltage requirement (a) Up to 85% of rated voltage for ratings below 110 KW (b) Up to 80% of rated voltage for ratings from 110 KW to 200 KW (c) Up to 85% of rated voltage for ratings from 201 KW to 1000 KW (d) Up to 80% of rated voltage for ratings from 1001 KW to 4000 KW (e) Up to 75 % of rated voltage for ratings above 4000KW		
7.00.00	DESIGN AND CONSTRUCTIONAL FEATURES		
7.01.00	Suitable single phase space heaters shall be provided on motors rated 30KW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided. However for flame proof motors, space heater terminals inside the main terminal box may be acceptable.		
7.02.00	All motors shall be either Totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). The method of movement of primary and secondary coolant shall be self-circulated by fan or pump directly mounted on the rotor of the main motor as per IEC 60034-6. However VFD driven motors can be offered with forced cooling type with machine mounted fan or pump driven by separate electric motor. Motors and EPB located in hazardous areas shall have flame proof enclosures conforming to IS:2148 as detailed below (a) Fuel oil area : Group – IIB (b) Hydrogen generation : Group - IIC or (Group-I, Div-II as per plant area NEC) or (Class-1, Group-B, Div-II as per NEMA /IEC60034)		
			PAGE 3 OF 9

CLAU SE NO.	TECHNICAL REQUIREMENTS	
7.03.00	Winding and Insulation (a) Type : Non-hygroscopic, oil resistant, flame resistant (b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature. (c) 11kV & 3.3 kV AC motors : Thermal class 155 (F) insulation. The winding insulation process shall be total Vacuum Presure Impregnated i.e resin poor method. The lightning Impulse & interturn insulation surge withstand level shall be as per IEC-60034 part-15. (d) 240VAC, 415V AC & 220V DC motors : Thermal Class (B) or better	
7.04.00	Motors rated above 1000KW shall have insulated bearings to prevent flow of shaft currents.	
7.05.00	Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.	
7.06.00	Noise level for all the motors shall be limited to 85 dB(A) except for BFP motor for which the maximum limit shall be 90dB(A). Vibration shall be limited within the limits prescribed in IS:12075 / IEC 60034-14 . Motors shall withstand vibrations produced by driven equipment. HT motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads.	
7.07.00	In HT motors, at least four numbers simplex / two numbers duplex platinum resistance type temperature detectors shall be provided in each phase stator winding. Each bearing of HT motor shall be provided with dial type thermometer with adjustable alarm contact and preferably 2 numbers duplex platinum resistance type temperature detectors.	
7.08.00	Motor body shall have two earthing points on opposite sides.	
7.09.00	11 KV motors shall be offered with Separable Insulated Connector (SIC) as per IEEE 386. The offered SIC terminations shall be provided with protective cover and trifurcating sleeves. SIC termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.	
7.10.00	3.3 KV motors shall be offered with dust tight phase separated double walled (metallic as well as insulated barrier) Terminal box. Employer shall provide termination kit for the offered Terminal box. The offered Terminal Box shall be suitable for fault level of 250 MVA for 0.12 sec. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided.	
		PAGE 4 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS	
7.11.00	The spacing between gland plate & centre of terminal stud shall be as per Table-I.	
7.12.00	All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.	
7.13.00	The motors shall be suitable for bus transfer schemes provided on the 11kV, 3.3 kV /415V systems without any injurious effect on its life.	
7.14.00	For motors rated 2000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.	
7.15.00	The size and number of cables (for HT motors) to be intimated to the successful Contactor during detailed engineering and the Contactor shall provide terminal box suitable for the same.	
8.00.00	The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance): (a) From 50KW & upto 110KW : 11.0 (b) From 110 KW & upto 200 KW : 9.0 (c) Above 200 KW & upto 1000KW : 10.0 (d) From 1001KW & upto 4000KW : 9.0 (e) Above 4000KW : 6 to 6.5	
10.00.00	TYPE TEST	
10.01.00	HT MOTORS	
10.01.01	The Contactor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The Contactor shall indicate the charges for each of these type tests separately in the relevant schedule of Section - VII- (BPS) and the same shall be considered for the evaluation of the bids. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the Employer's engineer.	
10.01.02	The type tests shall be carried out in presence of the Employer's representative, for which minimum 15 days notice shall be given by the Contactor. The Contactor shall obtain the Employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.	
10.01.03	In case the Contactor has conducted such specified type test(s) within last ten years as on the date of bid opening, he may submit during detailed engineering	
		PAGE 5 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS एनटीपीसी NTPC
10.01.04	the type test reports to the Employer for waiver of conductance of such test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The Employer reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the Contactor. Further the Contactor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED" and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However if the Contactor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the Contactor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/Employers representative and submit the reports for approval.
10.01.05	LIST OF TYPE TESTS TO BE CONDUCTED The following type tests shall be conducted on each type and rating of HT motor (a) No load saturation and loss curves upto approximately 115% of rated voltage (b) Measurement of noise at no load. (c) Momentary excess torque test (subject to test bed constraint). (d) Full load test(subject to test bed constraint) (e) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., coolant flow and its temp. shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.
10.01.06	LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED The following type test reports shall be submitted for each type and rating of HT motor (a) Degree of protection test for the enclosure followed by IR, HV and no load run test.

CLAUSE NO.	TECHNICAL REQUIREMENTS
	एनडीपीसी NTPC (b) Terminal box-fault level withstand test for each type of terminal box of HT motors only. (c) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15 (d) Surge-withstand test on inter-turn insulation shall be as per clause no. 4.2 of IEC 60034, part-15
10.02.00	LT Motors
10.02.01	LT Motors supplied shall be of type tested design. During detailed engineering, the Contactor shall submit for Employer's approval the reports of all the type tests as listed in this specification and carried out within last ~~ten~~ years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.
10.02.02	However if the Contactor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the Contactor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/Employers representative and submit the reports for approval.
10.02.03	LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED The following type test reports shall be submitted for each type and rating of LT motor of above 50 KW only - Measurement of resistance of windings of stator and wound rotor. - No load test at rated voltage to determine input current power and speed - Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors) - Full load test to determine efficiency power factor and slip - Temperature rise test - Momentary excess torque test. - High voltage test - Test for vibration severity of motor. - Test for noise levels of motor(Shall be limited as per clause no 7.06.00 of this section)
एनडीपीसी NTPC	Page 217 of 364 PAGE 7 OF 9

CLAUSE NO.	TECHNICAL REQUIREMENTS
10.03.00 10.04.00	10. Test for degree of protection and 11. Overspeed test. 12. Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1 All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price. The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.
परीक्षण और परीक्षण परिष्कार और परीक्षण परिष्कार और परीक्षण	परीक्षण और परीक्षण परिष्कार और परीक्षण परिष्कार और परीक्षण PAGE 8 OF 9

TABLE - I

DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS

Motor MCR in KW of	Minimum distance between centre stud and gland plate in mm As per manufacturer's practice.

UP to 3 KW

Above 3 KW - upto 7 KW	85

Above 7 KW - upto 13 KW	115

Above 13 KW - upto 24 KW	167

Above 24 KW - upto 37 KW	196

Above 37 KW - upto 55 KW	249

Above 55 KW - upto 90 KW	277

Above 90 KW - upto 125 KW	331

Above 125 KW-upto 200 KW	203

For HT motors the distance between gland plate and the terminal studs shall not be less than 500 mm.

PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:

NOTE: Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:

Motor MCR in KW	Clearance
UP to 110 KW	10mm
Above 110 KW and upto 150 KW	12.5mm
Above 150 KW	19mm

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC
3.06.00 3.06.01 3.07.00 3.07.01	Cable glands Cable shall be terminated using double compression type cable glands. Testing requirements of Cable glands shall conform to BS:6121 and gland shall be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating. Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected. Cable lugs/ferrules Cable lugs/ferrules for power cables shall be tinned copper solderless crimping type suitable for aluminium compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipments. Cable lugs and ferrule shall conform to IS/DIN standards.	
3.08.00 3.08.01 3.09.00 3.09.01 3.10.00 3.10.01 3.11.00	Trefoil clamps Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength, when installed at 1 mtr intervals, to withstand the forces generated by the peak value of maximum system short circuit current. Cable Clamps & Ties The cable clamps/ties required to clamp multicore cables shall be of SS-316 material, 12mm wide, polyester coated ladder lock type. The clamps/ties shall have self locking arrangement & shall have sufficient strength. The cable clamps/ties shall be supplied in finished individual pieces of suitable length to meet the site requirements. Receptacles Receptacles boxes shall be fabricated out of MS sheet of 2mm thickness and hot dipped gavanised or of die-cast aluminium alloy of thickness not less than 2.5 mm. The boxes shall be provided with two nos. earthing terminals, gasket to achieve IP55 degree of protection, terminal blocks for loop-in loop-out for cable of specified sizes, mounting brackets suitable for surface mounting on wall/column/structure, gland plate etc. The ON-OFF switch shall be rotary type heavy duty, double break, AC23 category, suitable for AC supply. Plug and Socket shall be shrouded Die-cast aluminium. Socket shall be provided with lid safety cover. Robust mechanical interlock shall be provided such that the switch can be put ON only when the plug is fully engaged and plug can be withdrawn only when the switch is in OFF position. Also cover can be opened only when the switch is in OFF position. Wiring shall be carried out with 1100 V grade PVC insulated stranded aluminium/copper wire of adequate size. The Terminal blocks shall be of 1100 V grade. The Terminal blocks shall be of 1100 V grade made up of unbreakable polyimide 6.6 grade with adequate current rating and size. The welding receptacles shall be provided with inbuilt ELCB rated for suitable mA sensitivity ranging from 30-300 mA . Cable Drum Lifting Jack The jack for cable drum lifting shall be of screw type with 10 ton capacity. The cable drum jacks shall be manufactured from fabricated steel. The spindles supplied with the cable drum jack shall be manufactured using BSEN-24 grade steel bar with locking collars. Jack nests shall be of SG cast steel. Cable drum jack supplied shall have undergone load testing and reports for the same shall be submitted. At least Two Nos. of jacks shall be supplied for	
		Page 7 of 69

5897/2020/PS-PEM-MAX



TITLE :

GENERAL TECHNICAL REQUIREMENTs

FOR

LV MOTORS

SPECIFICATION NO.
PE-SS-999-506-E101

VOLUME NO. : II-B

SECTION : D

REV NO. : 00 DATE : 29/08/2005

SHEET : 1 OF 1

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 1 OF 4

1.0 INTENT OF SPECIFICATION

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer's work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.

2.0 CODES AND STANDARDS

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

IS:325	Three phase Induction motors
IS : 900	Code of practice for installation and maintenance of induction motors
IS: 996	Single phase small AC and universal motors
IS: 4722	Rotating Electrical machines
IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines
IS: 4728	Terminal marking and direction of rotation rotating electrical machines
IS: 1231	Dimensions of three phase foot mounted induction motors
IS: 8789	Values of performance characteristics for three phase induction motors
IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment
IS: 2148	Flame proof enclosures for electrical appliance
IS: 5571	Guide for selection of electrical equipment for hazardous areas
IS: 12824	Type of duty and classes of rating assigned
IS: 12802	Temperature rise measurement for rotating electrical machines
IS: 12065	Permissible limits of noise level for rotating electrical machines
IS: 12075	Mechanical vibration of rotating electrical machines

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0 DESIGN REQUIREMENTS

3.1 Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A

3.2 Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information
Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.

3.3 Starting Requirements

3.3.1 Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.3.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 2 OF 4

The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.

3.3.3 The following frequency of starts shall apply

- i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.
- ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)
- iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for minimum 20,000 starts during the life time of the motor

3.4 Running Requirements

3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.

3.5 Stress During bus Transfer

3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

4.0 CONSTRUCTIONAL FEATURES

4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy

4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.

Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled

4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 3 OF 4
4.4.	Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.	
4.5	Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.	
4.6	In case Class ‘F’ insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class ‘B’ insulation. In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.	
4.7	Terminals and Terminal Boxes	
4.7.1	Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A. Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet “A”.	
4.7.2	unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.	
4.7.3	Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.	
4.7.4	Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.	
4.7.5	Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.	
4.7.6	Degree of protection for terminal boxes shall be IP 55 as per IS 4691.	
4.7.7	Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.	
4.7.8.	Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.	
4.7.9	Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.	
4.8	Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.	
4.9	General	

Page 224 of 364

SP-PEM-MAX 	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 4 OF 4
4.9.1 Motors provided for similar drives shall be interchangeable. 4.9.2 Suitable foundation bolts are to be supplied alongwith the motors. 4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above. 4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956. 4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz. 4.9.6 Name plate with all particulars as per IS: 325 shall be provided 4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions. 5.0 INSPECTION AND TESTING 5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied. 5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser. 5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan. 5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A. 6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT a) OGA drawing showing the position of terminal boxes, earthing connections etc. b) Arrangement drawing of terminal boxes. c) Characteristic curves: (To be given for motor above 55 kW unless otherwise specified in Data Sheet). i) Current vs. time at rated voltage and minimum starting voltage. ii) Speed vs. time at rated voltage and minimum starting voltage. iii) Torque vs. speed at rated voltage and minimum voltage. For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling. iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.		

Page 225 of 264

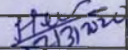
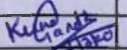
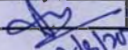


SUB-SECTION-V-QE1

MOTORS

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :		DATE:27.02.2020
		CUSTOMER :		QP NO.: PED-506-00-Q-006, REV-02		
		PROJECT:		PO NO.:		
		ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 OF 2	

SI No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY		
1	2	3	4	5	6		7	8	9	*	**		
					M	C/N				D	M	C	N
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	-	MFG. SPEC.	MFG. SPEC.	-DO-		P	-	-
		2.DIMENSIONS	MA	-DO-	-DO-	-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-		P	-	-
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	-	MFG.SPEC./	MFG.SPEC.	-DO-		P	-	-
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	-	MFG. SPEC/ APPROVED DATASHEET	SAME AS COL.7	LOG BOOK		P	-	-
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST	MA	-DO-	100%	100%	IS-325 / IS-12615/ APPROVED DATA SHEET	SAME AS COL.7	TEST/ INSPN. REPORT		P	W	W
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET	TEST/ INSPN. REPORT		P	W	W

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		Hema K.	Checked by:		KUNAL GANDHI
Reviewed by:		P. Dutta	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :		DATE: 27.02.2020
		CUSTOMER :		QP NO.: PED-506-00-Q-006, REV-02		
		PROJECT:		PO NO.:		
		ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))		SYSTEM:	SECTION: II	

SI No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY		
1	2	3	4	5	6		7	8	9	*	**		
					M	C/N				D	M	C	N
4.0	PACKING	3.NAMEPLATE DETAILS SURFACE FINISH & COMPLETENESS	MA MA	VISUAL VISUAL	100% 100%	100% 100%	IS-325 / IS-12615 / APPROVED DATA SHEET AS PER MFG. STANDARD / APPROVED PACKING DRAWING. (#)	SAME AS COL.7 AS PER MFG. STANDARD / APPROVED PACKING DRAWING. (#).	TEST/ INSPN. REPORT INSPC. REPORT		P P	W W	W -

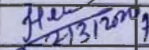
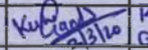
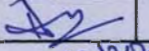
(#) APPLICABLE FOR EXPORT JOBS

NOTES:

- 1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL/CUSTOMER SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON
- 2 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.
- 3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.
- 4 BHEL RESERVES THE RIGHT TO PERFORM REPEAT TEST, IF REQUIRED.
- 5 AFTER PACKING AND PRIOR TO ISSUE MDCC, PHOTOGRAPHS OF ITEMS TO BE DESPATCHED SHALL BE SENT TO BHEL FOR REVIEW.
- 6 IN CASE , ANY CHANGES IN QP COMMENTED BY CUSTOMER AT CONTRACT STAGE SHALL BE CARRIED OUT BY BIDDER WITHOUT ANY IMPLICATION TO BHEL/ CUSTOMER.

LEGENDS:

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

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		Hema K.	Checked by:		KUNAL GANDHI
Reviewed by:		P. Dutt	Reviewed by:		

02/3/2020

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO.:		DATE: 27.02.2020
		CUSTOMER :		QP NO.: PED-506-00-Q-007, REV-04		
		PROJECT:		PO NO.:		
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 OF 9	

SI No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY		
1	2	3	4	5	6		7	8	9	-	-		
					M	C/N				D	M	C	N
1.0	RAW MATERIAL & BOUGHT OUT CONTROL												
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK		P	-	-
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	-DO-		P	-	-
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-	-DO-	-DO-	TEST REPORT		P/V	-	-
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%	-	-	FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-		P	-	-
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	SUPPLIERS TC & LOG		P/V	-	-
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%	-	-	FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK		P/V	-	-
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	SUPPLIER'S TC		P/V	-	-
		3.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG.	MANUFACTURER'S DRG.	LOG BOOK		P/V	-	-
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	LOG BOOK		P/V	-	-

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ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	<i>[Signature]</i>	Hema K.	Checked by:	<i>[Signature]</i>	KUNAL GANDHI
Reviewed by:	<i>[Signature]</i>	P. Datta	Reviewed by:		

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Seal	

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	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO.:		DATE: 27.02.2020
		CUSTOMER :		QP NO.: PED-508-00-Q-007, REV-04		
		PROJECT:		PO NO.:		
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 OF 9	

SI No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	.	..			
					M	C/N				D	M	C	N	
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	-DO-		P	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	-	MANUFACTURER'S DRG / SPEC.	MANUFACTURER'S DRG / STD.	SUPPLIER'S TC		PV	-	-	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-	-DO-	MANUFACTURER'S DRG.	LOG BOOK		PV	-	-	
		4. INTERNAL FLAWS	CR	ULTRASONIC TEST	100%	100%	ASTM-A388	MANUFACTURER'S STD.	-DO-	✓	PW	V	-	FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	-	MANUFACTURER'S DRG./STD.	MANUFACTURER'S DRG./STD.	-DO-		PV	-	-	
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-		PV	-	-	
		3. DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG. / STD	MANUFACTURER'S DRG. / STD.	-DO-		PV	-	-	
		4. PERFORMANCE/ CALIBRATION	MA	TEST	100%	-	-DO-	-DO-	TEST REPORT		PV	-	-	

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ENGINEERING			QUALITY		
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Reviewed by:			Reviewed by:		

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Seal	

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		PROJECT:		PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	

SI No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY		
1	2	3	4	5	6		7	8	9	.	..		
					M	C/N				D	M	C	N
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS	TEST REPORT		P/V	-	-
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK AND OR SUPPLIER'S TC		P/V	-	-
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK		P	-	-
		2. DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG.	MANUFACTURER'S DRG.	-DO-		P/V	-	-
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	-	MANUFACTURER'S DRG./ STD.	MANUFACTURER'S DRG./ STD.	SUPPLIER'S TC		P/V	-	-
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		*P/V	-	-
		2. ELECT. PROP. & MECH. PROP	MA	ELECT. & MECH TEST	SAMPLES	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S / SPEC.	SUPPLIERS TC & VENDOR'S TEST REPORTS		P/V	-	-

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ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	<i>[Signature]</i>	Hema K.	Checked by:	<i>[Signature]</i>	KUNAL GANDHI
Reviewed by:	<i>[Signature]</i>	P. Dutta	Reviewed by:		

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		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 4 OF 9	

SI No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY		
1	2	3	4	5	6		7	8	9				
					M	C/N				D	M	C	N
1.10	BEARINGS	3.DIMENSIONS	MA	MEASUREMENT	-DO-	-	-DO-	-DO-	Log Book		P/V	-	-
		1.MAKE & TYPE	MA	VISUAL	100%	-	MANUFACTURER'S DRG / APPROVED DATASHEET	MANUFACTURER'S DRG / APPROVED DATASHEET	-DO-		P/V	-	-
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	APPROVED DATASHEET	APPROVED DATASHEET / BEARING MANUF'S CATALOGUES	-DO-		P/V	-	-
		3.SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	-DO-		P/V	-	-
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-	-DO-	-DO-		P	-	-
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	-DO-		P	-	-
		3.TEMP WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	-	MANUFACTURER'S STD / APPROVED DATASHEET	MANUFACTURER'S STD / APPROVED DATASHEET	-DO-		P/V	-	-
		4.HWIR	MA	-DO-	100%	-	-DO-	-DO-	-DO-		P/V	-	-
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	-	MANUFACTURER'S DRG/SPECS	MANUFACTURER'S DRG / SPECS.	-DO-		P	-	-
		2.SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	-DO-		P	-	-
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	-DO-		P	-	-

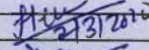
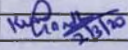
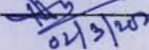
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ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	<i>[Signature]</i>	Hema K.	Checked by:	<i>[Signature]</i>	Rajesh
Reviewed by:	<i>[Signature]</i>	P. Dutta	Reviewed by:	<i>[Signature]</i>	

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Seal	

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1	2	3	4	5	6		7	8	9	.	..			
					M	C/N				D	M	C	N	
2.0	IN PROCESS													
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNES	MA	VISUAL	100%	-	-DO-	GOOD FINISH	LOG BOOK		P/W	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	-DO-		P	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-	-DO-	GOOD FINISH	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	-DO-		P	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	100%	100%	MANUFACTURER'S STD./ ASTM-E165	MANUFACTURER'S STD./ APPROVED DATASHEET.	-DO-	✓	P	V	-	
2.3	PAINING	1.SURFACE PREPARATION	MA	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	SAME AS COL.7	LOG BOOK		P	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-	-DO-	-DO-	-DO-		P	-	-	
		3.SHADE	MA	VISUAL	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	

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ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
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Reviewed by:		P. Dutta	Reviewed by:		

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Seal	

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		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 6 OF 9	

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	•	••			
					M	C/N				D	M	C	N	
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK		P	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-	-DO-	-DO-	LOG BOOK		P	-	-	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	100%	100%	IS-325/IS-12615/IEC-60034 PART-1	IS-325/IS-12615/IEC-60034 PART-1	LOG BOOK	✓	P	V	-	
		4.RESISTANCE	CR	-DO-	100%	100%	IS-325/IS-12615/IEC-60034 PART-1	IS-325/IS-12615/IEC-60034 PART-1	LOG BOOK	✓	P	V	-	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	
2.6	IMPREGNATION	1.VISCOSITY	MA	PHY. TEST	AT STARTING	-	MANUFACTURER'S STANDARD	MANUFRR'S STANDARD	LOG BOOK		P	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		3.NO. OF DIPS	MA	-DO-	CONTINUOUS	CONTINUOUS	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK	✓	P	V	-	THREE DIPS TO BE GIVEN

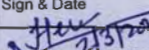
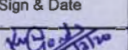
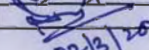
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ENGINEERING			QUALITY		
Sign & Date	Name		Sign & Date	Name	
Prepared by: <i>Hemant K. P. Dutt</i>	<i>Hemant K. P. Dutt</i>		Checked by: <i>Kunal Gandhi</i>	<i>Kunal Gandhi</i>	
Reviewed by: <i>02/3/2020 P. Dutt</i>			Reviewed by:		

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Sign & Date	
Seal	

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SI No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	-	--			
					M	C/N				D	M	C	N	
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION	MA	-DO-	CONTINUOUS	CONTINUOUS	-DO-	-DO-	LOG BOOK	✓	P	V	-	
		1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-	-DO-	-DO-	LOG BOOK		P	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	100%	100%	-DO-	-DO-	LOG BOOK	✓	P	V	-	
		3.HV	MA	ELECT. TEST	100%	100%	-DO-	-DO-	LOG BOOK	✓	P	V	-	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	-	MANUFACTURER'S SPEC./ ISO 1940	MANUFACTURER'S DWG.	LOG BOOK		P	-	-	
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	100%	100%	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✓	P	V	-	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	
		3.AXIAL PLAY	MA	MEAS.	100%	100%	-DO-	-DO-	LOG BOOK	✓	P	V	-	
		4.DIMENSIONS	MA	-DO-	-DO-	-	MANUFACTURER'S DRG./ MANUFACTURER'S SPEC.	MANUFACTURER'S DRG/ RELEVANT IS	LOG BOOK		P	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		6. RTD, 8TD & SPACE	MA	VISUAL	100%	100%	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✓	P	V	-	
		HEATER MOUNTING.												

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		Hema K.	Checked by:		KUNAL GANDHI
Reviewed by:		P. Dutt	Reviewed by:		

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Sign & Date	
Seal	

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1	2	3	4	5	6		7	8	9	10			
					M	C/N				D	M	C	N
3.0	TESTS	1. TYPE TESTS INCLUDING SPECIAL TESTS	MA	ELECT. TEST	1/TYPE/SIZE	1/TYPE/SIZE	IS-325//IS-12615/APPROVED DATASHEET	IS-325//IS-12615/APPROVED DATASHEET	TEST REPORT		P	W*	W*
		2. ROUTINE TESTS INCLUDING SPECIAL TEST	MA	-DO-	100%	100%	-DO-	-DO-	-DO-		P	V/W*	V/W*
		3. VIBRATION & NOISE LEVEL	MA	-DO-	100%	100%	IS: 12075 / IEC 60034-14 & IS-12065	IS: 12075 / IEC 60034-14 & IS-12065	-DO-		P	V/W*	V/W*
		4. OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET &	TEST/INSPC. REPORT		P	W	-
		5. DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	1/TYPE/ SIZE	IEC 60034-5/IS-12615	APPROVED DATASHEET	TC	✓	P	V	V
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	100%	IS-325//IS-12615/IEC-60034 PART-1/IS: 12802	IS-325//IS-12615/IEC-60034 PART-1/IS: 12802	-DO-		P	V/W*	V/W*
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	100%	IS-325//IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	-DO-		P	V/W*	V/W*
		8. NAME PLATE DETAILS	MA	VISUAL	100%	100%	IS-325//IS-12615& DATA SHEET	IS-325//IS-12615 & DATA SHEET	TEST/INSPC. REPORT		P	V/W*	V/W*
		9. EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	1/TYPE	IS 2148 / IEC 60079-1	IS 2148 / IEC 60079-1	TC	✓	P	V	V
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	SAMPLE	APPROVED DATASHEET	APPROVED DATASHEET	TC		P	WS	WS

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	<i>[Signature]</i>	<i>Hema R.</i>	Checked by:	<i>[Signature]</i>	<i>K. N. K.</i>
Reviewed by:	<i>[Signature]</i>	<i>P. D. D.</i>	Reviewed by:		

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Sign & Date	
Seal	

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Reviewed by:			
Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO.		DATE: 27.02.2020
		CUSTOMER :		QP NO.: PED-506-00-Q-007, REV-04		
		PROJECT:		PO NO.:		
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 9 OF 9	

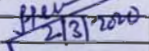
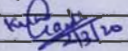
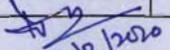
SI No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY		
1	2	3	4	5	6		7	8	9	.	..		
					M	C/N				D	M	C	N
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MANUFACT. STANDARD / APPROVED CROSS SECTION DRAWING.	AS PER MANUFACT. STANDARD / APPROVED CROSS SECTION DRAWING.	INSPC. REPORT		P	W	

NOTES:

- 1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.
- 2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL/CUSTOMER SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.
- 3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.
- 4 BHEL RESERVES THE RIGHT TO PERFORM REPEAT TEST, IF REQUIRED.
- 5 AFTER PACKING AND PRIOR TO ISSUE MDCC, PHOTOGRAPHS OF ITEMS TO BE DESPATCHED SHALL BE SENT TO BHEL PURCHASE GROUP FOR REVIEW.
- 6 IN CASE , ANY CHANGES IN QP COMMENTED BY CUSTOMER AT CONTRACT STAGE SHALL BE CARRIED OUT BY BIDDER WITHOUT ANY IMPLICATION TO BHEL/ CUSTOMER.

LEGENDS:

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

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		Hemma K.	Checked by:		KUNAL
Reviewed by:		P. Dutt	Reviewed by:		GRANDHI

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

CLAUSE NO.		QUALITY ASSURANCE																		
MOTOR																				
TESTS/CHECKS TEMS/COMPONENTS		Visual	Dimensional	Make/Type/Rating Physical Inspection	Mech/Chem. Properties	NDT /DP/MPI/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	Routine & Acceptance tests as per IS-325/IS-4722 /IS- 9283/IS 2148/IEC60034/IEC 60079-1/ IS-12615	Vibration	Over speed	Tan delta, shaft voltage & polarization index test	Paint shade, thickness & adhesion
Plates for stator frame, end shield, spider etc.		Y	Y	Y	Y	Y				Y										
Shaft		Y	Y	Y	Y	Y	Y			Y										
Magnetic Material		Y	Y	Y	Y			Y			Y		Y							
Rotor Copper/Aluminium		Y	Y	Y	Y			Y		Y										
Stator copper		Y	Y	Y	Y			Y		Y			Y							
SC Ring		Y	Y	Y	Y	Y		Y	Y											
Insulating Material		Y		Y	Y			Y					Y							
Tubes, for Cooler		Y	Y	Y	Y	Y				Y		Y								
Sleeve Bearing		Y	Y	Y	Y	Y				Y		Y								
Stator/Rotor, Exciter Coils		Y	Y	Y				Y	Y											
Castings, stator frame, terminal box and bearing housing etc.		Y	Y	Y	Y	Y			Y											
Fabrication & machining of stator, rotor, terminal box		Y	Y			Y			Y	Y										

PAGE 1 OF 2

PAGE 2 OF 2

5897/2020/PS-PEM-MAX



TITLE

LV MOTORS**DATA SHEET-A**

**2X250 MW NSPCL BHILAI EXPANSION
POWER PROJECT**

SPECIFICATION NO.

VOLUME II B

SECTION

D

REV NO.

DATE: 24.03.2020

SHEET 1 OF 2

ANNEXURE-I

- 1.0 Design ambient temperature : 50 °C
- 2.0 Maximum acceptable kW rating of LV motor : 200KW *
- 3.0 Installation (Indoors/ Outdoors) : As required
- 4.0 Details of supply system
- a) Rated voltage (with variation) : 415V $\pm$ 10%
 - b) Rated frequency (with variation) : 50 Hz + 3 % to - 5%
 - c) Combined voltage & freq. variation : 10% (sum of absolute values)
 - d) System fault level at rated voltage : 50 kA for 1 sec
 - e) Short time rating for terminal boxes
 - o 110 kW and above (Breaker : 50 KA for 0.25 sec. Controlled)
 - o Below 110 kW (Contactor : 50 KA protected by HRC fuse Controlled)
 - f) LV System grounding : Solidly
- 5.0 Winding & Insulation : Class F with temp rise limited to class B
- 6.0 Minimum voltage for starting : 85% for motor ratings below 110kW
(As percentage of rated voltage) 80% for motor ratings from 110kW to 200kW.
- 7.0 Power cables data : Shall be given during detailed engg.
- 8.0 Earth Conductor Size & Material : Shall be given during detailed engg.
- 9.0 Space heater supply (for motors $\geq$ 30kW) : 240 V, 1 ϕ , 50 Hz
- 10.0 Rating up to which Single phase motor : Acceptable below 0.2 kW
- 11.0 Locked rotor current
- a) Limit as percentage of FLC : As per IS 12615
- 12.0 Makes : BHEL/ Customer approval (Package owner to take care)
- 13.0 Paint shade : Blue (RAL 5012) – Corrosion proof
- 14.0 Degree Of protection for motor/ terminal box : Degree of protection for various enclosures as per IEC60034-05 shall be as follows:-
- i) Indoor motors - IP 54
 - ii) Outdoor motors - IP 55
 - iii) Cable box-indoor area - IP 54
 - iv) Cable Box-Outdoor area - IP 55

*** LT motors of continuous duty shall be energy efficient IE3 class conforming to IS-12615**

15.0 TESTING REQUIREMENTS: IN LINE WITH SPECIFICATION

CLAUSE NO.	Bidder's Name				
	DE-1B	LT MOTORS			
	A.	GENERAL			
	5.	Manufacturer & Country of origin. (Shall be as per approved QA make)			
	6.	Equipment driven by motor			
	7.	Motor type			
	8.	Quantity			
	B.	DESIGN AND PERFORMANCE DATA			
	18.	Frame size			
	19.	Type of duty			
	20.	Type of enclosure /Method of cooling/ Degree of			
	21.	Applicable standard to which motor generally			
	22.	Efficiency class as per IS 12615			
	23.	(a)Whether motor is flame proof	Yes/No		
		(b)If yes, the gas group to which it conforms as per IS:2148			
	24.	Type of mounting			
	25.	Direction of rotation as viewed from DE END			
	26.	Standard continuous rating at 40 deg.C. ambient temp. as per Indian Standard (KW)			
	27.	Derated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW)			
	28.	Maximum continuous load demand of driven			
	29.	Rated Voltage (volts)			
	30.	Permissible variation of :			
		a. Voltage (Volts)			
		b. Frequency (Hz)			
		c. Combined voltage and frequency			
	31.	Rated speed at rated voltage and			
	32.	At rated Voltage and frequency:			
		a. Full load current			

CLAUSE NO.	Bidder's Name			
		b. No load current		
	33.	Power Factor at		
		a. 100% load		
		b. NO load		
		c. Starting.		
	34.	Efficiency at rated voltage and frequency,		
		a. 100% load		
		b. 75% load		
		c. 50% load		
	35.	Starting current (amps) at		
		a. 100 % voltage		
		b. 85% voltage		
		c. 80% voltage		
	36.	Minimum permissible starting Voltage (Volts)		
	37.	Starting time with minimum permissible voltage		
		a. Without driven equipment coupled		
		b. With driven equipment coupled		
	38.	Safe stall time with 100% and 110% of rated		
		a. From hot condition		
		b. From cold condition		
	39.	Torques :		
		a. Starting torque at min. permissible voltage(kg-		
		b. Pull up torque at rated voltage.		
		c. Pull out torque		
		d. Min accelerating torque (kg.m) available		
		e. Rated torque (kg.m)		
	40.	Stator winding resistance per phase (ohms at 20		
	41.	GD2 value of motors		

CLAUSE NO.	Bidder's Name				
	42.	No of permissible successive starts when motor is in hot condition			
	43.	Locked Rotor KVA Input			
	44.	Locked Rotor KVA/KW			
	45.	Vibration limit :Velocity (mm/s)			
	46.	Noise level limit (dBA)			
	C.	CONSTRUCTIONAL FEATURES			
	1.	Stator winding insulation			
		a. Class & Type			
		b. Winding Insulation Process			
		c. Tropicalised (Yes/No)			
		d. Temperature rise over specified maximum ambient temperature of 50 deg C			
		e. Method of temperature measurement			
		f. Stator winding connection			
	2.	Main Terminal Box			
		a. Type			
		b. Location(viewed from NDE side)			
		c. Entry of cables(bottom/side)			
		d. Recommended cable size(To be matched with cable size envisaged by owner)			
		e. Fault level (MVA),Fault level duration(sec)			
		f. Cable glands & lugs details (shall be suitable for			
	3.	Type of DE/NDE Bearing			
	4.	Motor Paint shade			
	5.	Weight of			
		a. Motor stator (KG)			
		b. Motor Rotor (KG)			
		c. Total weight (KG)			

CLAUSE NO.	Bidder's Name			
	D.	List of accessories.		
	1.	3 Space Heaters (Applicable for 30 KW & above motor) (Nos./Power in watts/supply voltage)		
	2.	Terminal Box for Space Heater (Yes/No)		
	3.	Speed switch (Yes/No)		
	4.	Insulation of bearing (Yes/No)		
	5.	Noise reducer(Yes/No)		
	6.	Grounding pads		
		i) No and size on motor body		
		ii) Nos on terminal Box		
	7.	Vibration pads		
		i) Nos and size		
		ii) Location		
	8.	Any other fitments		
	E.	List of curves.		
	1.	Torque speed characteristic of the motor		
	2.	Thermal withstand characteristic		
	3.	Starting. current Vs. Time		
	4.	Starting. current Vs speed		
	5.	P.F. and Effi. Vs Load		
	F.	Additional Data to be filled for each rating of DC Motor		
	1.	Rated armature voltage (Volt)		
	2.	Rated field excitation (Amp)		
	3.	Permissible % variation in voltage		
	4.	Minimum Permissible Starting voltage (volt)		
	5.	At rated voltage		
		i)Full load Armature current.(Amp)		

CLAUSE NO.	Bidder's Name			
		ii) Full load Field current (Amp)		
		iii) No load Armature current (Amp)		
	6.	Full load Field current (Amp)		
	7.	No load Armature current (Amp)		
	8.	Minimum permissible field current (Amp) to avoid		
		i) Maximum permissible voltage		
		ii) Rated voltage		
		iii) Minimum Permissible Voltage		
	9.	Resistance (indicative Values) in ohm		
		i) Armature winding (Arm + IP + Series) at 25		
		ii) Field Winding at 25 deg. C		
	10..	Inductance (indicative values)		
		i) Armature winding		
		ii) Field winding		
	11	Value of trimmer resistance (ohm) to be connected in series with the shunt field to		
		i) 220 V DC		
		ii) 250 V DC		
		iii) 187 V DC		
	12	Value of the external resistance (ohm) required to be connected in series with armature during starting only		
	13	Technical data sheet for external resistance box		
	14	GA drawing of motor		
	15	Starting time calculation		
	16	Starter resistance design calculation		
	17	Electrical connection diagram of motor		

CABLE SCHEDULE FORMAT

ANNEXURE III

[illegible]

Vendor to refer to this list for items in their scope only(as indicated in Electrical scope sheet between BHEL & Vendor)

एनटीपीसी NTPC						LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR ; CONTRACTOR-M/S BHEL			REVISION NO. 00 DATE 20 th April 2017	
Sl. No.	ITEM	QP / INS CAT.	QP No:- 9585- 001- QVE-	QP SUB. SCH.	QP APPL SCHE DULE	SUB-SUPPLIERS	PLACE	SUB- SUPPLIER APPL STATUS AS PER NTPC	SC APPL SCHE DULE	REMARKS
1)	L T (415 V) Motors	Refer Note 1				ABB	FARIDABAD	A		UPTO 55KW
						ABB	BANGALORE	A		55KW – 200KW
						BHARAT BIJLEE	MUMBAI	A		RQP, FOR FLAME PROOF ALSO
						CGL	AHMEDNAGAR	A		FOR FLAME PROOF ALSO
						JYOTI	BARODA	A		
						KEC	BANGALORE	A		FOR FLAMEVPROOF ALSO
						KEC	HUBLI	A		UPTO 90KW: FOR FLAME: PROOF ALSO
						LHP	SOLAPUR	A		UPTO 200KW
						MARATHON	KOLKATA	A		FOR FLAME PROOF ALSO
						NGEF	BANGALORE	A		UPTO 15KW
					SIEMENS	MUMBAI	A			
2)	HT MOTOR					BHEL	BHOPAL	A		

		LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR ; CONTRACTOR-M/S BHEL				REVISION NO. 00 DATE 20th April 2017				
Sl. No.	ITEM	QP / INS CAT.	QP No:- 9585-001-	QP SUB. SCH.	QP APPL SCHE DULE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL STATUS AS	SC APPL SCHE	REMARKS

NOTE 1 : FOR LT MOTORS

a) Less than 30 KW

Acceptance of Motor less than 30 KW is based on COC of the manufacturer & the contractor confirming as follows:
 It is hereby confirmed that the above mentioned motor /motors was/ were manufactured taking care of NTPC specific requirements regarding ambient temp., voltage & frequency variation, hot starts, pull out torque, starting KVA/KW, temp. rise, distance between centre of stud & gland plate and tested in accordance with approved drawing /data sheets.

b) 30 KW -50KW

Acceptance of Motor rating between 30 KW & 50 KW is based on NTPC review of Routine Test inspection report as per IS 325 witnessed by main contractor along with COC of the manufacturer & the contractor confirming as follows:
 It is hereby confirmed that the above mentioned motor /motors was/ were manufactured taking care of NTPC specific requirements regarding ambient temp., voltage & frequency variation, hot starts, pull out torque, starting KVA/KW, temp. rise, distance between centre of stud & gland plate, space heater and tested in accordance with approved drawing /data sheets.

c) Above 50 KW as per NTPC approved quality plan

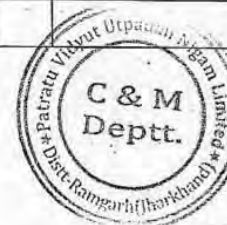
Approval Conditions attached to above vendors-as applicable shall prevail.

General Notes:

- 1) Vendor list & category of the mandatory spares shall be as mentioned above.
- 2) For item not appearing in the above list, main contractor to approach NTPC for acceptable vendors & inspection categorization of the same.
- 3) NTPC Approval conditions to above identified vendors shall be adhered to. Vendor's approval conditions will be informed on specific request of Main Contractor.



						LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR		REVISION NO. 00		
						Contractor-M/S BHEL		DATE 24 th April 2017		
Sl. No.	ITEM	QP / INS CAT	QP No:- 9578-001-QVE-	QP SUB. SCH.	QP APP L SCH EDU LE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL STATUS AS PER NTPC	SC AP PL SC HE DU LE	REMARKS
13.	Junction boxes / Link Boxes/ Test Link Box/ Adopter box, Switch Boxes, Pull Boxes (Hot Dip Galvanized)	III				Main contractor approved sources with galvanization from NTPC approved sources (Note-2)		Noted		
14.	FRP Junction boxes	II	10			Main Contractor approved sources		Noted		
16.	Cable glands	III				Main contractor approved sources		Noted		
17.	Cable lugs	III				M/s Dowell M/s Billets Elektro Werke Ltd.	Mumbai Umbergaon	A A		



							LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR Contractor-M/S BHEL			REVISION NO. 00 DATE 24 th April 2017	
Sl. No.	ITEM	QP / INS CAT	QP No:- 9578- 001- QVE-	QP SUB. SCH.	QP APP L SCH EDU LE	SUB-SUPPLIERS	PLACE	SUB- SUPPLI ER APPL STATUS AS PER NTPC	SC AP PL SC HE DU LE	REMARKS	
						(3 D)					
						M/s Chetna	Nasik	A			
						Additionally Any make's model with VDE or CE or UL or CSA marking or BIS approved with CML no. Refer Note-3		Noted			

		LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR Contractor-M/S BHEL								REVISION NO. 00 DATE 24th April 2017	
		Sl. No.	ITEM	QP / INS CAT	QP No:- 9578-001-QVE-	QP SUB. SCH.	QP APP L SCH EDU LE	SUB-SUPPLIERS	PLACE	SUB-SUPPLI ER APPL STATUS AS PER NTPC	SC AP PL SC HE DU LE

1. M/s M J Engg, Delhi	8. M/s National Galvanizer, Kolkata	16. M/s Radhakrishnan Shetty, Chennai	Additional galvanizer/s, if any, proposed by manufacturer through main contractor during detailed engineering shall be reviewed & assessed by NTPC as per the merits of the case.
2. M/s Jamna Metal, Delhi	9. M/s Unistar Galvanizer, Kolkata	17. Karamtara Mumbai	
3. M/s A.V. Engg, Kolkata	10. M/s B.P. Project. Kolkata	18. Poona Galvanizers Pune	
4. M/s Inar Profiles, Vishakapatnam	11. M/s Bajaj Pune	19. Ncha Galvanizer- Kolkata	
5. M/s Anand Udyog, Mumbai	12. M/s Electrocare Industries, Mumbai	20. Unitech galvanizers- Hoogly	
6. M/s Techno Engg, Chandigarh	13. M/s B.G. Shirke, Pune	21. Gurpreet galvanizers- Hyderabad	
7. M/s Steelite Engg, Mumbai	14. M/s Gurpreet Galvanizer, Hyderabad	22- DMP Projects- Kolkata	
	15. M/s Sigma, Mumbai		

Note-3 : VDE / CE / UL / CSA MARKING FOR PRODUCT QUALITY: SELF CERTIFICATION/VALID CERTIFICATION FROM THIRD PARTY AGENCY OR BIS APPROVAL LETTER WITH CML NO. FOR PRODUCT QUALITY SHALL BE SUBMITTED FOR NTPC's INFORMATION

Handwritten signature
NTPC



Handwritten signature
(JATIN GAHLAWAT)
BHEL

5897/2020/PS-PEM-MAX

	TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATION FOR AGITATORS	SPECIFICATION No: PE-TS-468-571-18000-A001	
		SECTION-I, SUB-SECTION-D	
		REV. 00	
		Date: April, 2020	

**SECTION-I,
SUB-SECTION-D**

LIST OF MAKES OF SUB-VENDOR ITEMS

5897/2020/PS-PEM-MAX

	TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATION FOR AGITATORS		SPECIFICATION No: PE-TS-468-571-18000-A001	
			SECTION-I, Sub Section-D	
			REV. 00	
			Date: April, 2020	

Sl.no.	Item	Category of Inspection	Sub-vendor	Place	Remarks
1.	PAINT	III	ASIAN PAINT		
		III	BERGER		
		III	KANSAI NEROLAC		
		III	JOTUN		
		III	SHALIMAR		
		III	JENSON & NICHOLSON (I) LTD		
		III	CDC CARBOLINE (I) LTD.		
		III	ADDISON PAINTS LTD		
		III	GRAND POLYCOAT		

NOTES: INSPECTION CATEGORIZATION

CAT I: INSPECTION BY OWNER, BHEL/BHEL NOMINATED TPIA & VENDOR. MDCC WILL BE ISSUED BASED ON INSPECTION REPORT IN LINE ITH APPROVED QAP.

CAT II: INSPECTION BY BHEL/BHEL NOMINATED TPIA & VENDOR. MDCC WILL BE ISSUED BASED ON INSPECTION REPORT IN LINE ITH APPROVED QAP.

CAT III: MDCC WILL BE ISSUED BASED COC & MTC ISSUED BY VENDOR AND VERIFICATION BY BHEL / OWNER IN LINE WITH APPROVED QAP/CHECK LIST

	TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATION FOR AGITATORS	SPECIFICATION No: PE-TS-468-571-18000-A001	
		SECTION-I, Sub Section-D	
		REV. 00	
		Date: April, 2020	

ANNEXURE-A

- Refer electrical specification for applicable sub-vendor list for motors.
- The list of all bought out items like gearbox, coupling, bearings etc. with makes and country of origin and contact details of the manufacturers to be mentioned along with offer to be submitted in the format attached in section II Annexure-6 as an information to BHEL.
- Acceptance of makes shall be subject to BHEL/ End customer acceptance during the detailed engineering without cost and delivery implication to BHEL.
- 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 complete list will be necessarily 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.

5897/2020/PS-PEM-MAX

	TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATION FOR AGITATORS	SPECIFICATION No: PE-TS-468-571-18000-A001	
		SECTION-I Sub Section-D	
		REV. 00	
		Date: April, 2020	

SECTION-I Sub Section-D

ANNEXURE-II

MANDATORY SPARE LIST

5897/2020/PS-PEM-MAX

TECHNICAL SPECIFICATION FOR AGITATOR 2 X 250 MW BHILAI FGD		SPECIFICATION NO. :PE-TS-468-571-18000-A001
MANDATORY SPARE LIST		ANNEXURE-II
SI. No.	PARTICULARS	Unit / Quantity (Nos.)
1.06.00	Agitators	
(A)	Auxiliary Absorbent Tank Agitator	
1	Impeller Assembly	1 no. of each type and size
2	Bearing Assembly	1 no. of each type and size
3	Motor	1 no. of each type and size
4	Belt and Pulley (If applicable)	1 no. of each type and size
5	Gear Box Assembly (If Applicable)	1 no. of each type and size
6	Agitator shaft assembly	1 no. of each type and size
7	Shaft seal	1 no. of each type and size
8	Complete Agitator assembly	1 no. of each type and size
(B)	Limestone Slurry Storage tank Agitator	
1	Impeller Assembly	1 no. of each type
2	Bearing Assembly	1 no. of each type
3	Motor	1 no. of each type
4	Belt and Pulley (If applicable)	1 no. of each type
5	Gear Box Assembly (If Applicable)	1 no. of each type
6	Agitator shaft assembly	1 no. of each type and size
7	Complete Agitator assembly	1 no. of each type and size
(C)	Primary Hydrocyclone feed tank Agitator	
1	Impeller Assembly	1 no. of each type
2	Bearing Assembly	1 no. of each type
3	Motor	1 no. of each type
4	Belt and Pulley (If applicable)	1 no. of each type
5	Gear Box Assembly (If Applicable)	1 no. of each type
6	Agitator shaft assembly	1 no. of each type and size
7	Complete Agitator assembly	1 no. of each type and size
(D)	Secondary Hydrocyclone feed tank Agitator	
1	Impeller Assembly	1 no. of each type
2	Bearing Assembly	1 no. of each type
3	Motor	1 no. of each type
4	Belt and Pulley (If applicable)	1 no. of each type
5	Gear Box Assembly (If Applicable)	1 no. of each type
6	Agitator shaft assembly	1 no. of each type and size
7	Complete Agitator assembly	1 no. of each type and size
(E)	Filtrate water tank Agitator	
1	Impeller Assembly	1 no. of each type
2	Bearing Assembly	1 no. of each type
3	Motor	1 no. of each type
4	Belt and Pulley (If applicable)	1 no. of each type
5	Gear Box Assembly (If Applicable)	1 no. of each type
6	Agitator shaft assembly	1 no. of each type and size
7	Complete Agitator assembly	1 no. of each type and size
(F)	Waste water Tank Agitator	
1	Impeller Assembly	1 no. of each type
2	Bearing Assembly	1 no. of each type
3	Motor	1 no. of each type
4	Belt and Pulley (If applicable)	1 no. of each type
5	Gear Box Assembly (If Applicable)	1 no. of each type
6	Agitator shaft assembly	1 no. of each type and size
7	Complete Agitator assembly	1 no. of each type and size
(G)	Absorber Area Drain Pit Agitator	
1	Impeller Assembly	1 no. of each type
2	Bearing Assembly	1 no. of each type
3	Motor	1 no. of each type
4	Belt and Pulley (If applicable)	1 no. of each type
5	Gear Box Assembly (If Applicable)	1 no. of each type
6	Agitator shaft assembly	1 no. of each type and size
7	Complete Agitator assembly	1 no. of each type and size
(H)	Gypsum Dewatering Area Drain Pits Agitator	
1	Impeller Assembly	1 no. of each type
2	Bearing Assembly	1 no. of each type
3	Motor	1 no. of each type
4	Belt and Pulley (If applicable)	1 no. of each type
5	Gear Box Assembly (If Applicable)	1 no. of each type
6	Agitator shaft assembly	1 no. of each type and size
7	Complete Agitator assembly	1 no. of each type and size
(I)	Limestone Area Drain Pit Agitator	
1	Impeller Assembly	1 no. of each type
2	Bearing Assembly	1 no. of each type
3	Motor	1 no. of each type
4	Belt and Pulley (If applicable)	1 no. of each type

TECHNICAL SPECIFICATION FOR AGITATOR 2 X 250 MW BHILAI FGD		SPECIFICATION NO. :PE-TS-468-571-18000-A001
MANDATORY SPARE LIST		ANNEXURE-II
Sl. No.	PARTICULARS	Unit / Quantity (Nos.)
5	Gear Box Assembly (If Applicable)	1 no. of each type
6	Agitator shaft assembly	1 no. of each type and size
7	Complete Agitator assembly	1 no. of each type and size
Note:		
1) One set means 100% complete replacement of the particular component/equipment, as mentioned i.e., Set for the particular equipment, would include all components required to replace the item. For example, a set of bearing shall include all hardware normally required while replacing the bearings. It is further, intended that the assembly / sub-assembly which have different orientation (like left hand or right hand, top or bottom), different direction of rotation or mirror image positioning or any other reasons which result in maintaining two different sets of the spares to be used for the subject assembly / sub-assembly, these shall be considered as different types of assembly/sub-assembly.		
2) Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc. these shall cover all the items supplied and installed.		
3) In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed in the above list.		
4) Any item which is quoted as "not applicable" in the above list and is found to be "applicable" at a later date shall be supplied by the Bidder without any commercial implications. The Bidder shall note that if there is any change/ variation in equipment/ system during detail engineering which causes any change/ variation in the essential spares quantity, the same shall be supplied without any commercial implications. The price indicated for the mandatory spares shall be considered for the purpose of evaluation.		
5) Mandatory spares shall not be dispatched before dispatch of corresponding main equipment. The spares shall be treated and packed for a long storage under the climatic condition prevailing at site.		
6) All spares supplied under this contract shall be strictly interchangeable with parts for which they are intended for replacements. These spares should include all mounted accessories like components, boards, add on items, fitting, connectors etc. and be complete in all respects so that the replacement of the main items by these spares does not require any additional item. The vendors must conform the pair to pair compatibility of each electrical spares modules with the modules should be supplied in the original package. All electronic modules should be pre-set and/or pre-programmed for ready use at site. Alternatively, suitable instruction sheet indicating the details of required PCB jumper position, BCD which is setting, EPROM/PROM listing etc should be packed along with each module. Also a caution mark sign should be put on all such module which needs pre-setting/pre-programming before putting them in to service. The spare shall be treated and properly packed for long term storage.		
7. Each spare shall be clearly marked and labelled on the outside of the packing with its description. When more than one spare part is packed in single case, a general description of the contents shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purpose of identification.		
8. Bidder to provide mandatory spares, as asked above, for each type of tank separately, even in case the type & size of tank of agitator is similar.		

5897/2020/PS-PEM-MAX

	TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATION FOR AGITATORS	SPECIFICATION No: PE-TS-468-571-18000-A001	
		SECTION-I Sub Section-D	
		REV. 00	
		Date: April, 2020	

**SECTION-I,
Sub Section-D**

**ANNEXURE-III
INPUT DRAWINGS**

Sizing Calculation & Selection parameter for all tanks

1. Gas condition for Tank Sizing:

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

2. Tank Sizing Basis

Tank size is decided as per the following

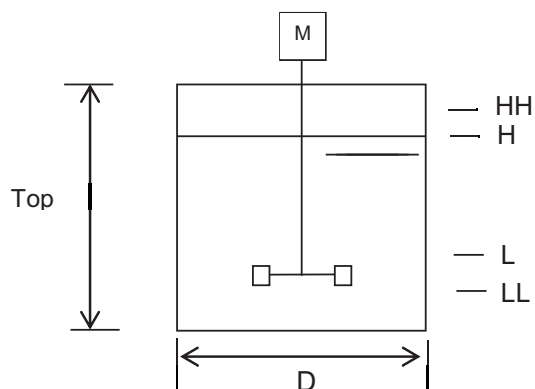
LL – Pump LL level m

L – LL + 0.2 m

H – Effective height m

HH – H + 0.2 m

Top – HH + 0.5 m(If tank Ht. <10m)
 – HH + 0.8 m(If tank Ht. >10m)



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

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

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

S. No	Item No	Service	Design Spec	Process Parameter	Design Basis
4	00HTM 03 BB001	Filtrate water Tank	4000 mm D X 4000 mmH Quantity = 1 no (Common for two units)	Process Capacity	48.442 m3/h (Stream No: <402> x 2 Units)
				Retention Time	0.5 Hr
				Required volume	48.442 m3/h x 0.5 hr =24.221 m3
				<	

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

S.No	Item No	Service	Design Spec	Process Parameter	Design Basis
5	00HTM00 BB001	Primary Hydro cyclone feed Tank	5000 mm D X 5000mmH- Quantity = 1 no.	Process Capacity	54.204 m3/h (Stream No: <201> x 2 Units)
				Retention Time	1 Hour
				Required volume	54.204 m3/h x 1 hr = 54.204 m3

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

S.No	Item No	Service	Design Spec	Process Parameter	Design Basis
6	00HTM04 BB001	Secondary Hydro cyclone feed Tank	4000 mm D X 4500mmH- Quantity = 1 no.	Process Capacity	31.32 m3/h (Stream No: <202> x 2 Units)
				Retention Time	1 Hours
				Required volume	31.32 m3/h x 1 hr = 31.32 m3
</					

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

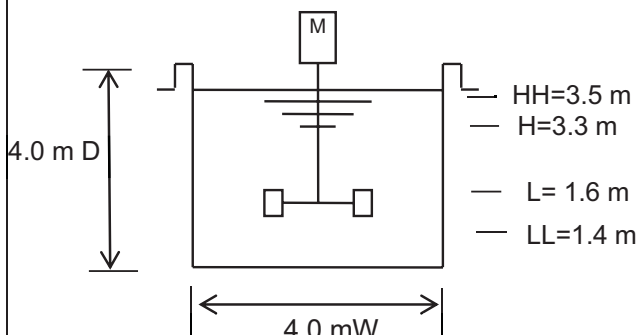
5897/2020/PS-PEM-MAX

S. No	Item No	Service	Design Spec	Process Parameter	Design Basis						
8	00HTK0 3BB001/ 002	Lime stone slurry storage Tank	9000 mmD X 10000mmH Quantity = 2 no. (1W+1S) (Common for two units)	Process Capacity for each tank	a) Limestone required = 4.662 TPH per unit from (Stream No: <501> x 2 Units) b) 20% (w/w) Limestone slurry = 4.662 TPH / 20% mass flow rate = 23.31 TPH per unit c) 20%(w/w) Limestone slurry density = 1.130 t/m3 d) 20% (w/w) Limestone slurry = 23.31 TPH / 1.130 volume flow rate = 20.63 m3/hr per unit						
				Retention Time	12.0 hr						
				Required volume	20.63 m3/h x 2 x 12 hr = 495.12 m3						
				Tank Level is designated as follows							
				<table><tr><td>Top</td><td>10.0</td></tr><tr><td>HH</td><td>9.5</td></tr><tr><td>H</td><td>9.3</td></tr><tr><td>L</td><td>1.2*</td></tr><tr><td>LL</td><td>1.0*</td></tr></table>		Top	10.0	HH	9.5	H	9.3
Top	10.0										
HH	9.5										
H	9.3										
L	1.2*										
LL	1.0*										
<											

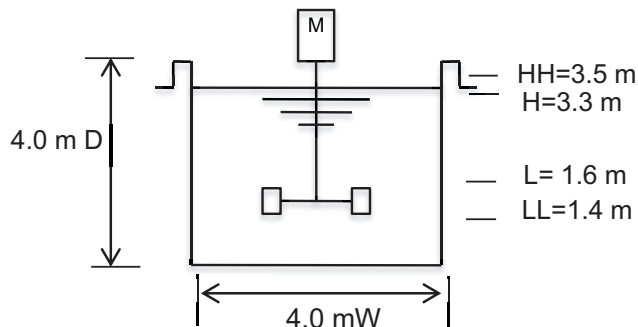
*L and LL level is finalized by vendor's information of Limestone slurry Feed pump and agitator.

S. No	Item No	Service	Design Spec	Process Parameter	Design Basis
9	00HTK0 0BB001	Auxiliary Absorbent Tank	10000mmDX 10000mmH Quantity = 1 no (Common for two units)	Process Capacity	Absorber Tank Volume = 724.8 m3 (with 20% margin)
				Retention Time	Batch Operation
				Required volume	724.8 m3
				<	

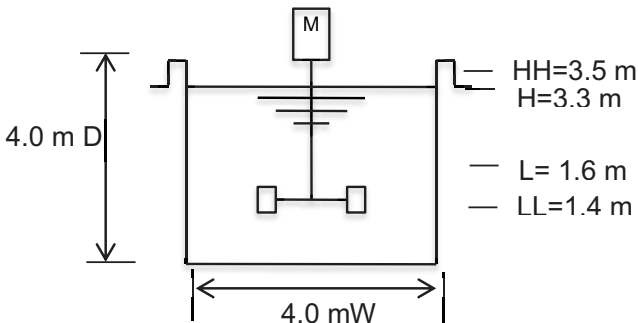
*L and LL level is finalized by vendor's information of Auxiliary Absorbent tank pump and agitator.

S. No	Item No	Service	Design Spec	Process Parameter	Design Basis
10	10/20HTT 00BB001	Absorber Area Drain Sump	4000mmW X 4000mmL X 4000mmH Quantity = 2 nos. for two Units	Process Capacity for each Sump	25 m3
				Retention Time	Batch Operation
				Required volume	25 m3
					
Tank Level is designated as follows					
Top	4.0				
HH	3.5				
H	3.3				
L	1.6*				
LL	1.4*				
Rectangular Tank					
Effective volume					
= 4.0 m x 4.0 m x (3.3-1.6) m = 27.2 m3 >25 m3					
Hold Volume					
= 4.0 m x 4.0 m x 3.5 m = 56 m3					

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

S. No	Item No	Service	Design Spec	Process Parameter	Design Basis	
11	00HTT01 BB001	Gypsum Area Drain Sump	4000mmW X 4000mmL X 4000mmH Quantity = 1 no. (Common for two units)	Process Capacity	25 m3	
				Retention Time	Batch Operation	
				Required volume	25 m3	
					Tank Level is designated as follows	
					Top	4.0
					HH	3.5
					H	3.3
					L	1.6*
					LL	1.4*
					Rectangular Tank Effective volume = 4.0 m x 4.0 m x (3.3-1.6) m = 27.2 m3 >25 m3 Hold Volume = 4.0 m x 4.0 m x 3.5 m = 56 m3	

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

S. No	Item No	Service	Design Spec	Process Parameter	Design Basis	
12	00HTT02 BB001	Lime Stone Area Drain Sump	4000mmW X 4000mmL X 4000mmH Quantity = 1 no.(Common for two units)	Process Capacity	25 m3	
				Retention Time	Batch Operation	
				Required volume	25 m3	
					Tank Level is designated as follows	
					Top	4.0
					HH	3.5
					H	3.3
					L	1.6*
					LL	1.4*
Rectangular Tank						
Effective volume = 4.0 m x 4.0 m x (3.3-1.6) m = 27.2 m3 >25 m3						
Hold Volume = 4.0 m x 4.0 m x 3.5 m = 56 m3						

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

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

Reference Documents

- Mass Flow Balance (Design Point) data – 9993-109-PVM-W-002



TITLE:

2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
AGITATORS

SPECIFICATION No: PE-TS-468-571-18000-A001

SECTION-I, SUB-SECTION- D

REV. 00

Date: April, 2020

SECTION-I, SUB-SECTION- D

ANNEXURE-IV

MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION

	TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATION FOR AGITATORS	SPEC. NO.: PE-TS-468-571-18000-A001
		SECTION-I, SUB-SECTION- D, ANNEXURE-IV
		REV. NO.: 00
		Date: April, 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 Date	Drawing Classification
1	PE-V0-468-571-18000-A001	GA drawing, Exploded view, sectional view with Material of construction, mechanical seal , gearbox for all Agitator models	2 weeks from LOI	Primary
2	PE-V0-468-571-18000-A002	Data sheet for all Agitator	2 weeks from LOI	Primary
3	PE-V0-468-571-18000-A003	Agitator Performance curve of all Agitators	2 weeks from LOI	Primary
4	PE-V0-468-571-18000-A004	Electrical motor GA drawing & Data sheet and performance curves of all motors	2 weeks from LOI	Primary
5	PE-V0-468-571-18000-A005	Quality plan & Inspection and Test Procedure	2 weeks from LOI	Primary
6	PE-V0-468-571-18000-A006	Agitator and Motor Sizing Calculation	2 weeks from LOI	Primary
7	PE-V0-468-571-18000-A007	O&M Manual for Agitator	4 weeks from LOI	Secondary
8	PE-V0-468-571-18000-A008	Utility Consumption	4 weeks from LOI	Secondary
9	PE-V0-468-571-18000-A009	Foundation Data including Anchor plan	4 weeks from LOI	Secondary
10	PE-V0-468-571-18000-A010	Lubricating oil list	4 weeks from LOI	Secondary
11	PE-V0-468-571-18000-A011	Special tools list, Start-up & Commissioning Spares	4 weeks from LOI	Secondary
12	PE-V0-468-571-18000-A012	Installation and assembly procedure including Pre Commissioning Check List	4 weeks from LOI	Secondary

	TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATION FOR AGITATORS	SPEC. NO.: PE-TS-468-571-18000-A001
		SECTION-I, SUB-SECTION- D, ANNEXURE-IV
		REV. NO.: 00
		Date: April, 2020

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

- The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.
- Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
- Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.
- All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:
 - All drawings and documents shall indicate the list of all reference drawings including General Arrangement.
 - All drawings shall include / show plan, elevation, side view, cross-section, skin section, blow-up view; all major self-manufactured and bought out items shall be labelled and included in BOQ / BOM in tabular form.
 - Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.
 - All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.
 - Drawings/ documents to be submitted for purchaser's review/ approval shall be under Revision A, B, C... etc. while drawings documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 etc.
 - Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.

	TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATION FOR AGITATORS	SPEC. NO.: PE-TS-468-571-18000-A001
		SECTION-I, SUB-SECTION- D, ANNEXURE-IV
		REV. NO.: 00
		Date: April, 2020

g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.

h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No. Documents marked for submission to BHEL's Customer shall also bear BHEL's Customer's drawing No.

i) 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.

j) Bidder to follow the following the drawing submission schedule:

k) 1st submission of drawings from date of LOI as per the submission schedule.

l) Every revised submission incorporating comments – within 7 days.

m) Bidder to submit revised drawings complete in all respects incorporating all comments.

n) The primary drawings are to be considered as the basic engineering drawings.

Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

COMPANY SEAL

SIGNATURE: _____
NAME : _____
DESIGNATION: _____
COMPANY: _____



TITLE:

**2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
AGITATORS**

SPECIFICATION No: PE-TS-468-571-18000-A001

SECTION-I, SUB-SECTION- D

REV. 00

Date: April, 2020

SECTION-I, SUB-SECTION- D

ANNEXURE-V

SEA-WORTHY PACKING PROCEDURE



Mechanical Auxiliaries Department,
PEM, PPEI Building,
NOIDA

Ref No.: PEA00-Misc/PKD

Date: 12/08/10

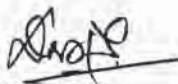
Sub: Technical specification for Seaworthy Packing for Export Jobs

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.

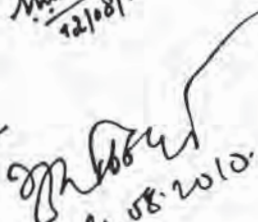

 (PK DAS)

Convener (Task Force)

GM/MAX


 12/08/10

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	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 1	OF 52

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

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 2	OF 52

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.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 3	OF 52

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.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME	II B
		SECTION	D
		REV. NO. 0	DATE 10/08/2010
		SHEET	4 OF 52

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

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME	II B
		SECTION	D
		REV. NO. 0	DATE 10/08/2010
		SHEET	5 OF 52

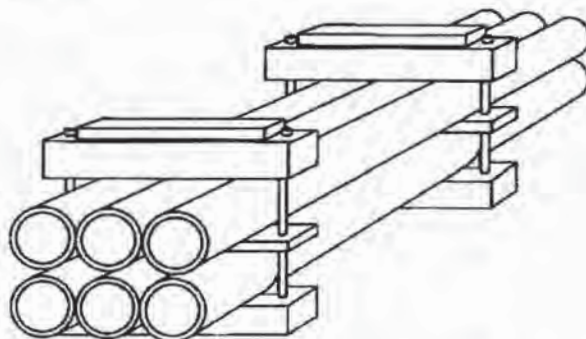
Structural Steel, reinforcing rods, bars, etc., should be packed in bundles of uniform length. Refer to articles 8.1.2, for strapping requirements. Bundle weight not normally to exceed 2,000 kg. Fabricated structures and structural steelwork, etc, should be bundled and packed using wooden beams and long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

8.2 Bundling – Packing Category I

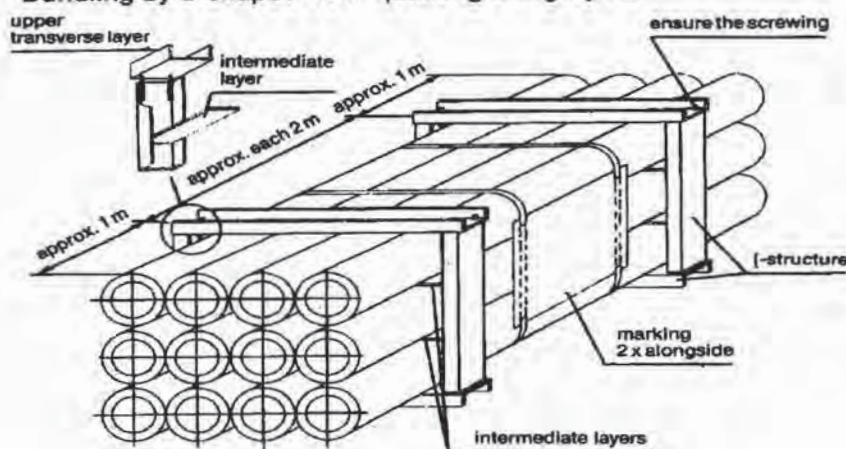
8.2.1 Type of Equipment

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

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 6	OF 52

- 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)

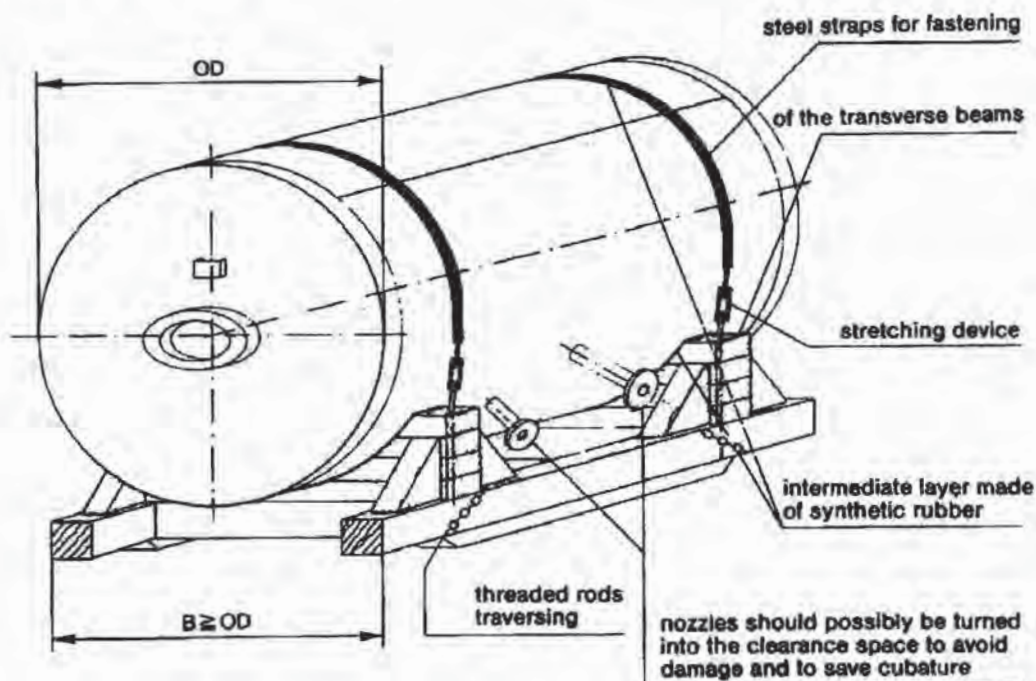
8.3.1 Type of Equipment

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



	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 7	OF 52

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

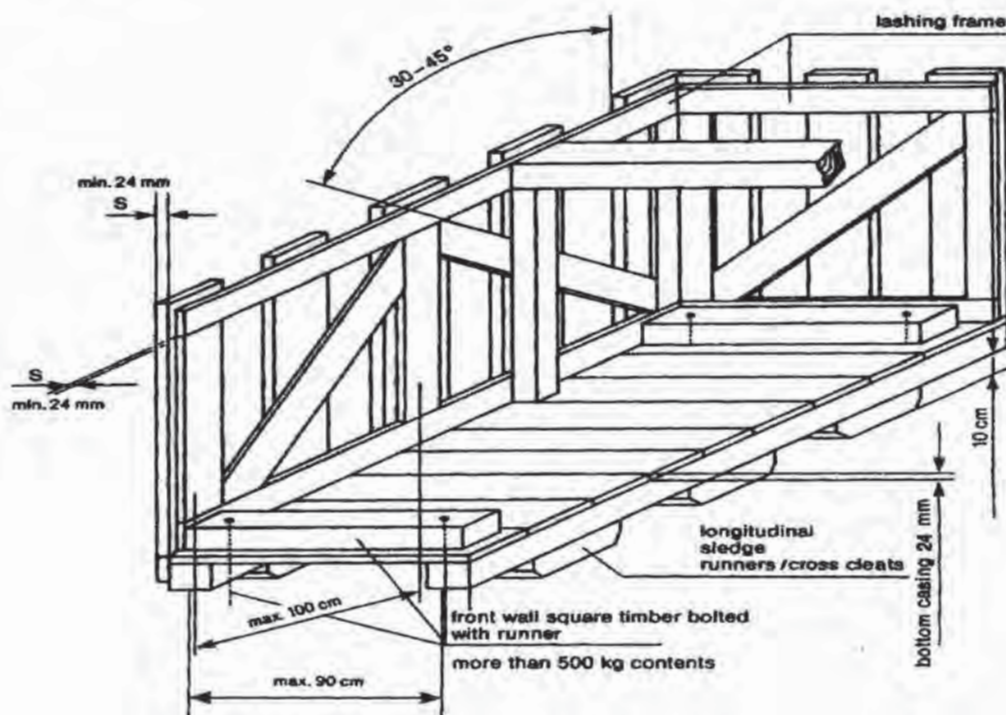
Fabricated equipment, which cannot be transported on cradles; frame-works, prefabricated piping and fittings, mechanical and electrical assemblies. *This type of packing is recommended where many parts of the equipment/component/assembly are not protruding out.*

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



	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 8	OF 52

8.4.2 Cases with Lining – Packing Category IV

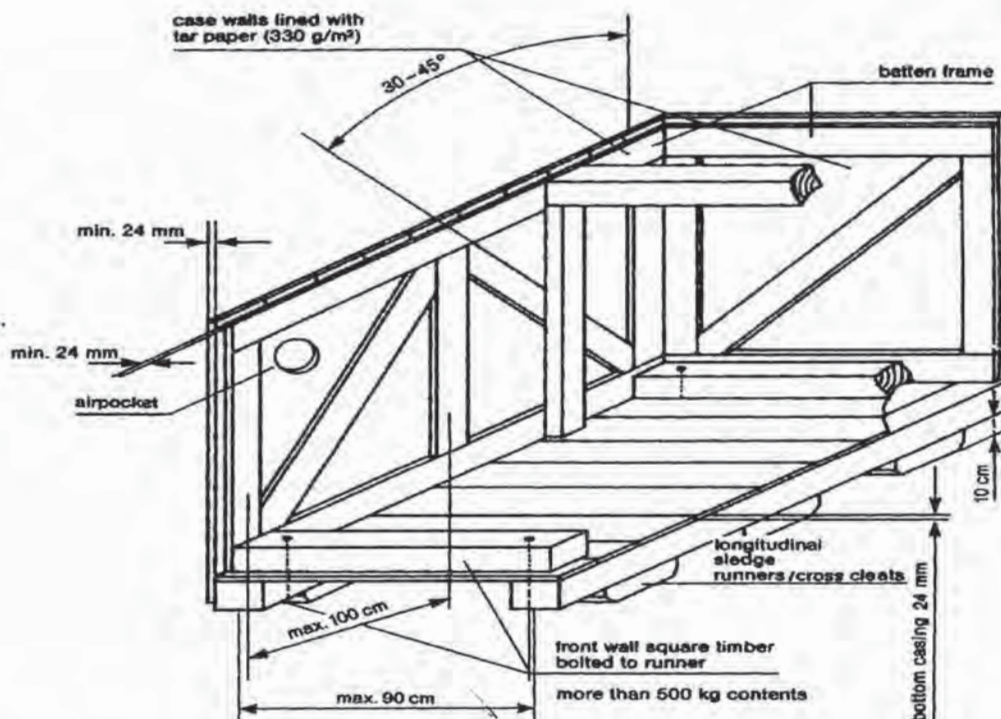
8.4.2.1 Type of Equipment

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.

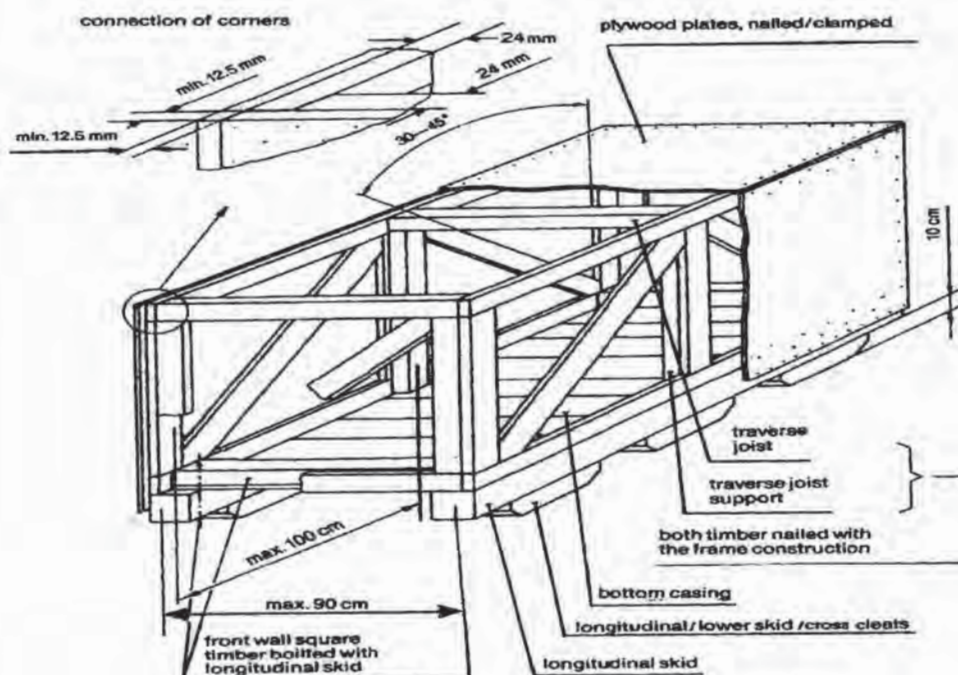
Packing Category IV



8.4.3 Cases with Alternative Surface Materials

8.4.3.1 Plywood Box – Packing Category IV A

	TITLE		SPECIFICATION NO. PE-TS-888-100-A001	
	TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS		VOLUME II B	
			SECTION D	
	REV. NO. 0	DATE 10/08/2010		
	SHEET 9	OF 52		



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

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 10	OF 52

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

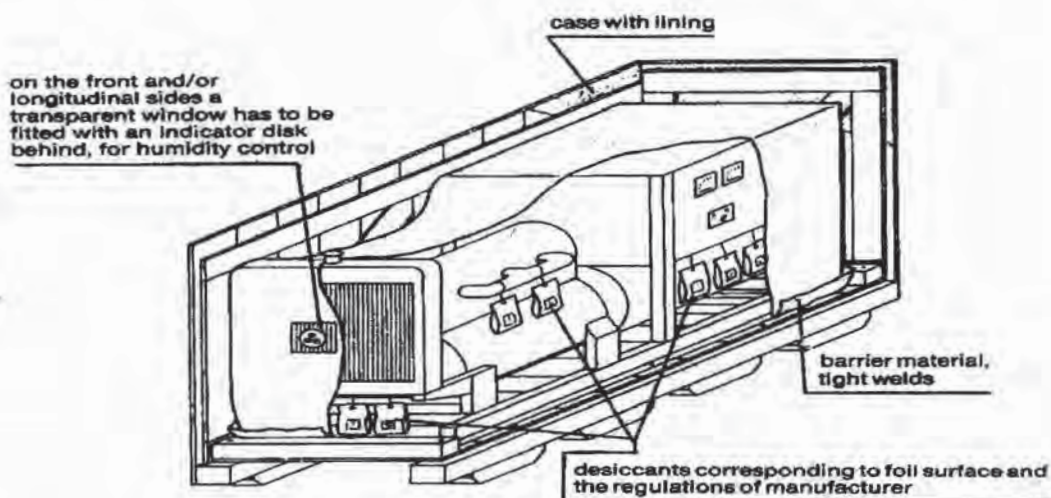
8.4.5.2 Type of Construction

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).

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 11	OF 52

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.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME	II B
		SECTION	D
		REV. NO. 0	DATE 10/08/2010
		SHEET	12 OF 52

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

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 13	OF 52

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

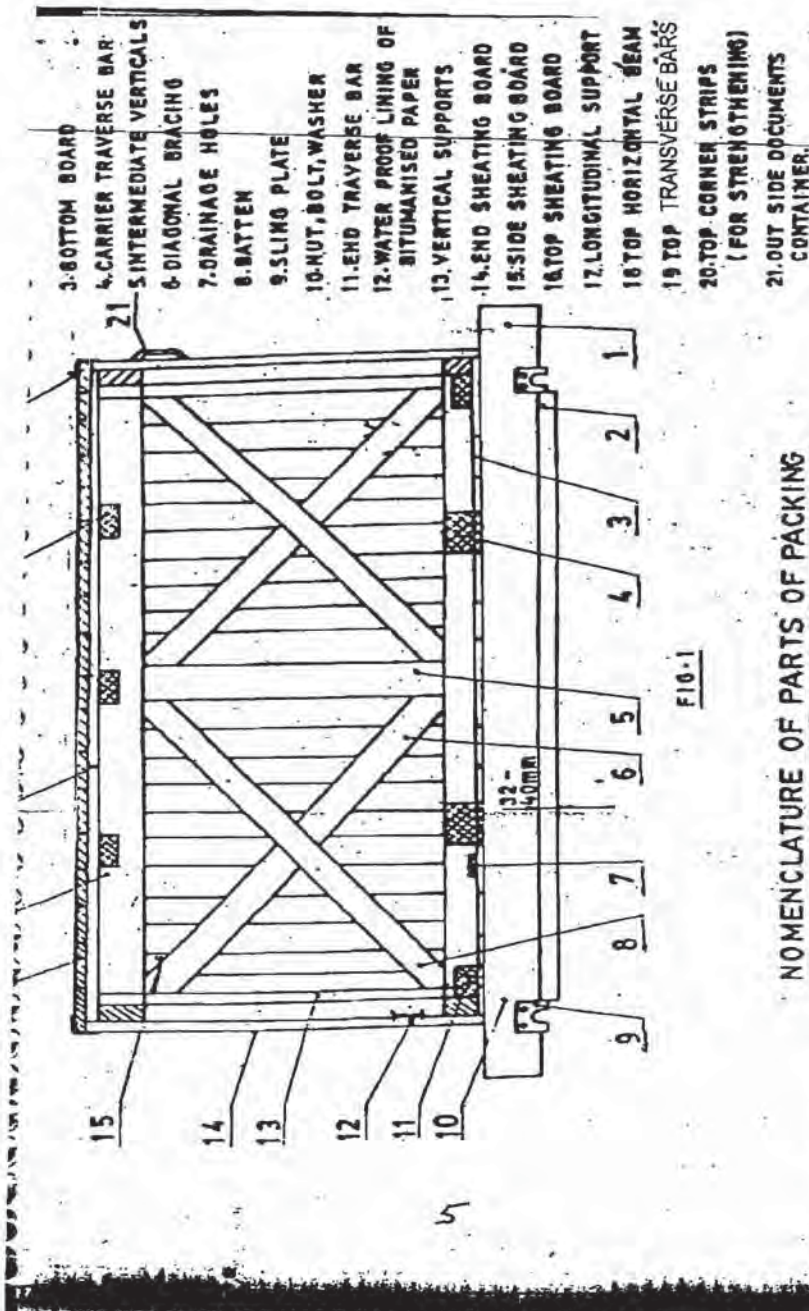
- The thickness of planks for top, bottom, side and end panels shall be at least 25mm. Planks used for this purpose shall be joined with each other by tongue and groove joint. The groove dimension shall be such that tongue fits tightly into groove to make the joint.
- Runners/slides, traverse bars, etc 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

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME	II B
		SECTION	D
		REV. NO. 0	DATE 10/08/2010
		SHEET	14 OF 52

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.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 15	OF 52



EC-009

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 16	OF 52

BOTTOM FRAME ARRANGEMENTS

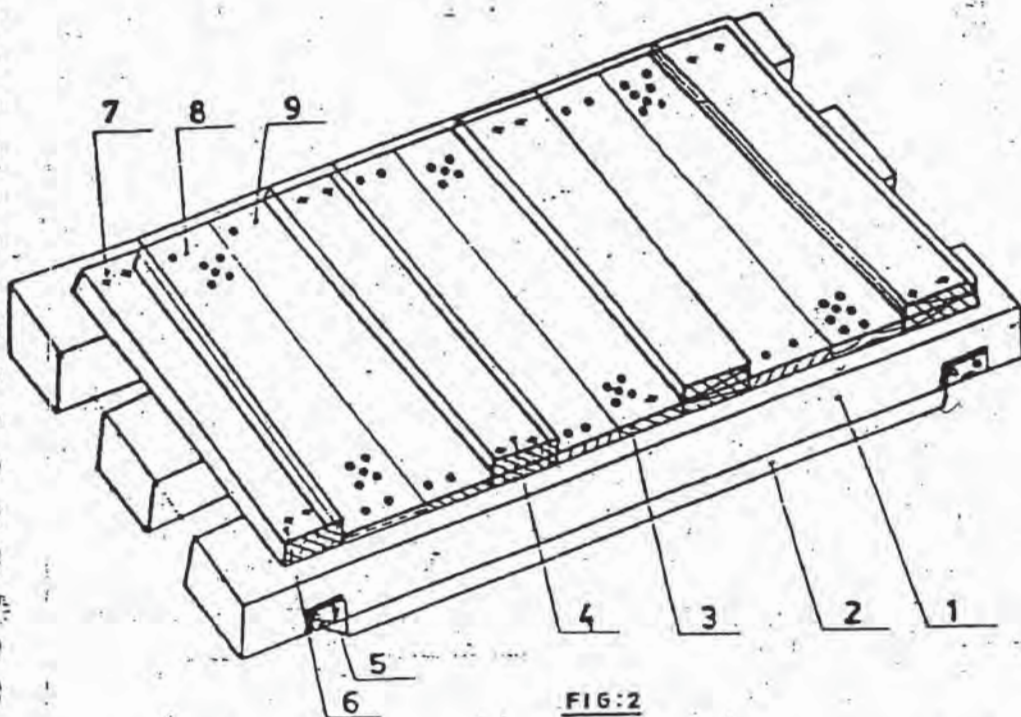


FIG:2

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; 100x100 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

027

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 17	OF 52

TOP FRAME ARRANGEMENT

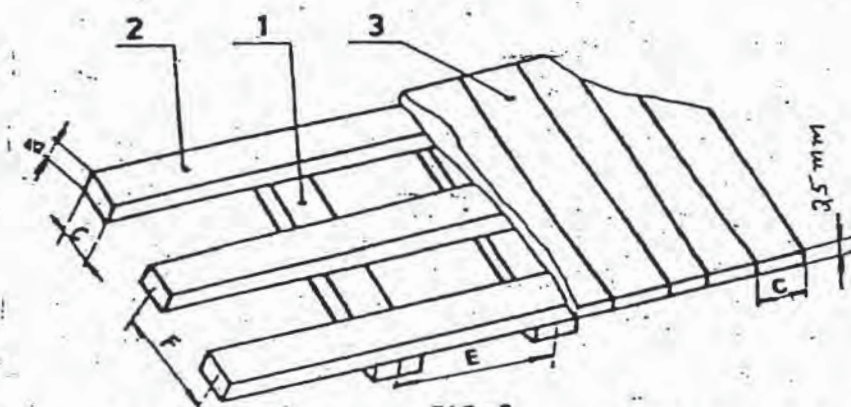
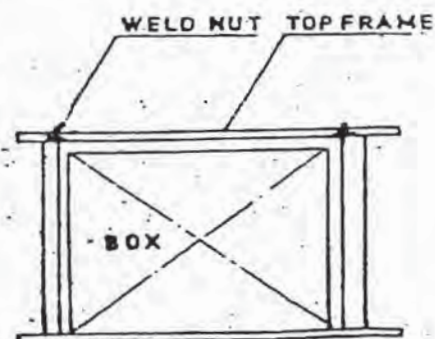
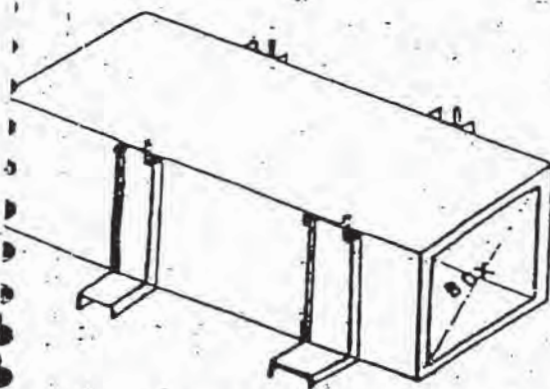


FIG-3

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

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

ARRANGEMENT OF C-CLAMPS AROUND CASES



628

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 18	OF 52

ARRANGEMENT OF DIAGONAL BRACING AND HORIZONTAL SUPPORT

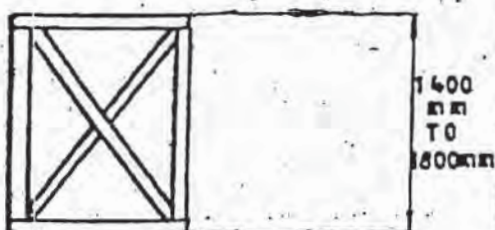


FIG: 6

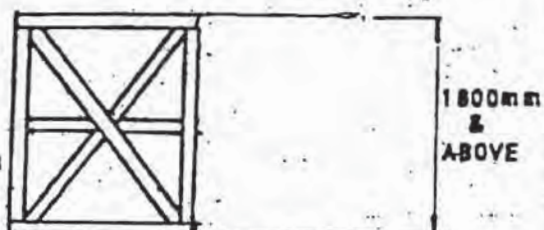


FIG: 8

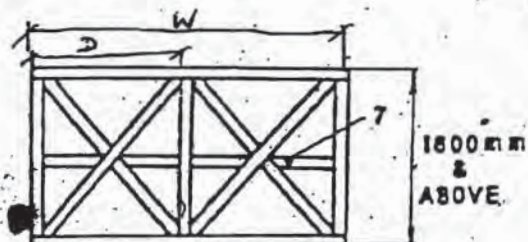


FIG: 9

7- Middle Horizontal Support

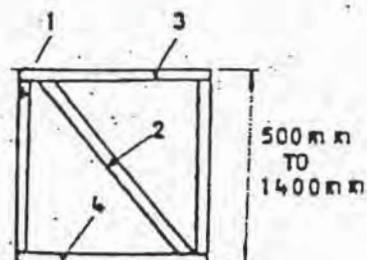


FIG: 5

1- Vertical Support

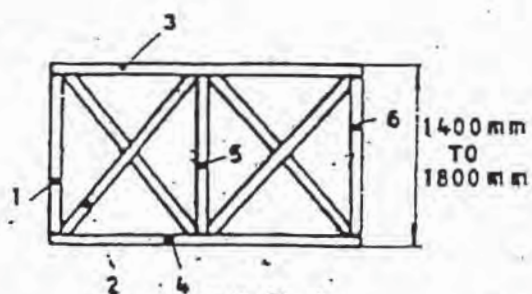


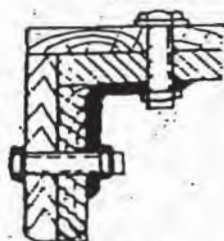
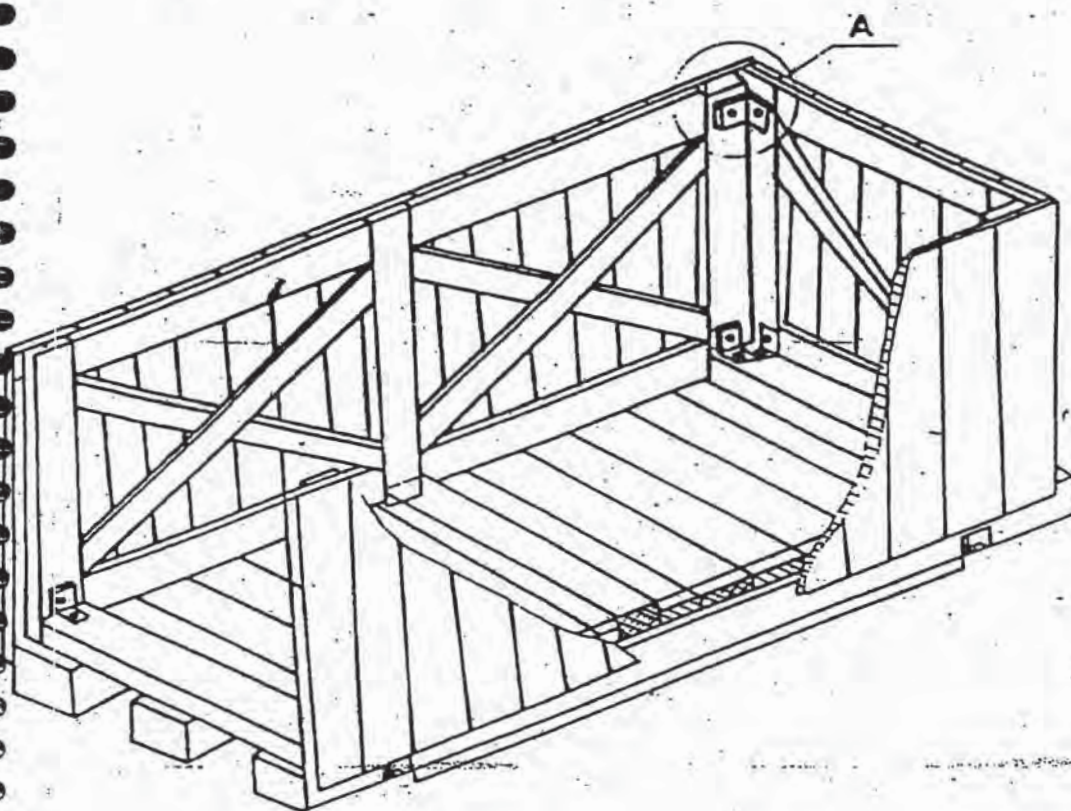
FIG: 7

1, 5, 6 - Vertical Support

029

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 19	OF 52

ARRANGEMENT OF PACKING CASE



DETAIL-A

HOLE DIAMETER
MUST CONFORM
TO BOLT DIA

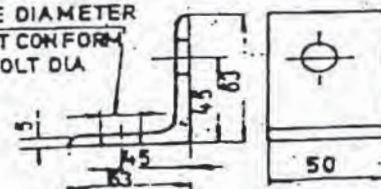


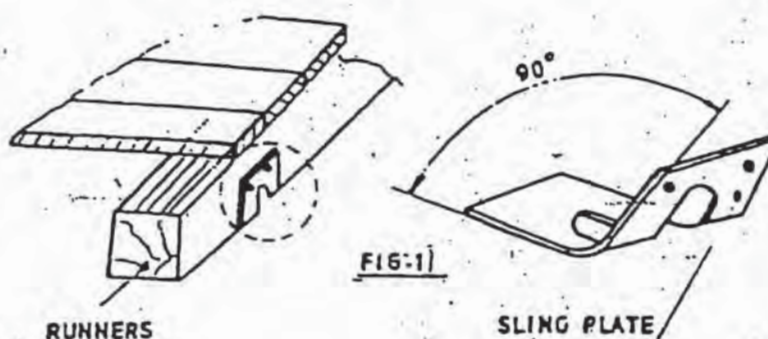
FIG:10

030

5897/2020/PS-PEM-MAX

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 20	OF 52

ARRANGEMENT OF SLING & PLATE ON CASES



031

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 21	OF 52

TABLE-1

LOADS	LENGTHS OF SLIDES						
	600	800	1000	1200	1300	1500	2000
	Cross section b x c						
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

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 22	OF 52

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	30
		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

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 23	OF 52

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.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 24	OF 52

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.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 25	OF 52

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

	TITLE	SPECIFICATION NO. PE-TS-888-100-A001	
	TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 26	OF 52

BHEL-PEM-DELHI-INDIA	
CONSIGNEE	
MATERIAL	
CUSTOMER REF.	MO. NO.
DISPATCH 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

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 27	OF 52

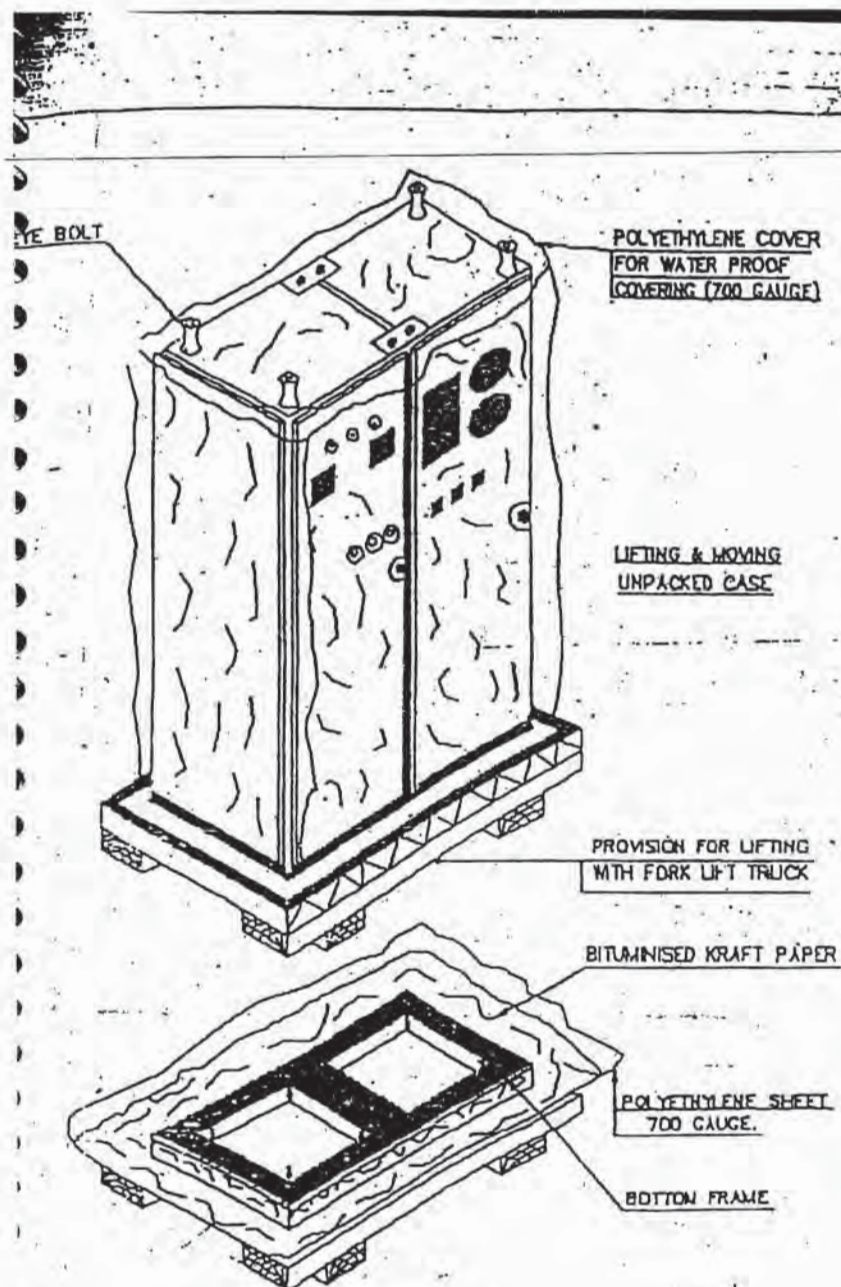


FIGURE-14

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 28	OF 52

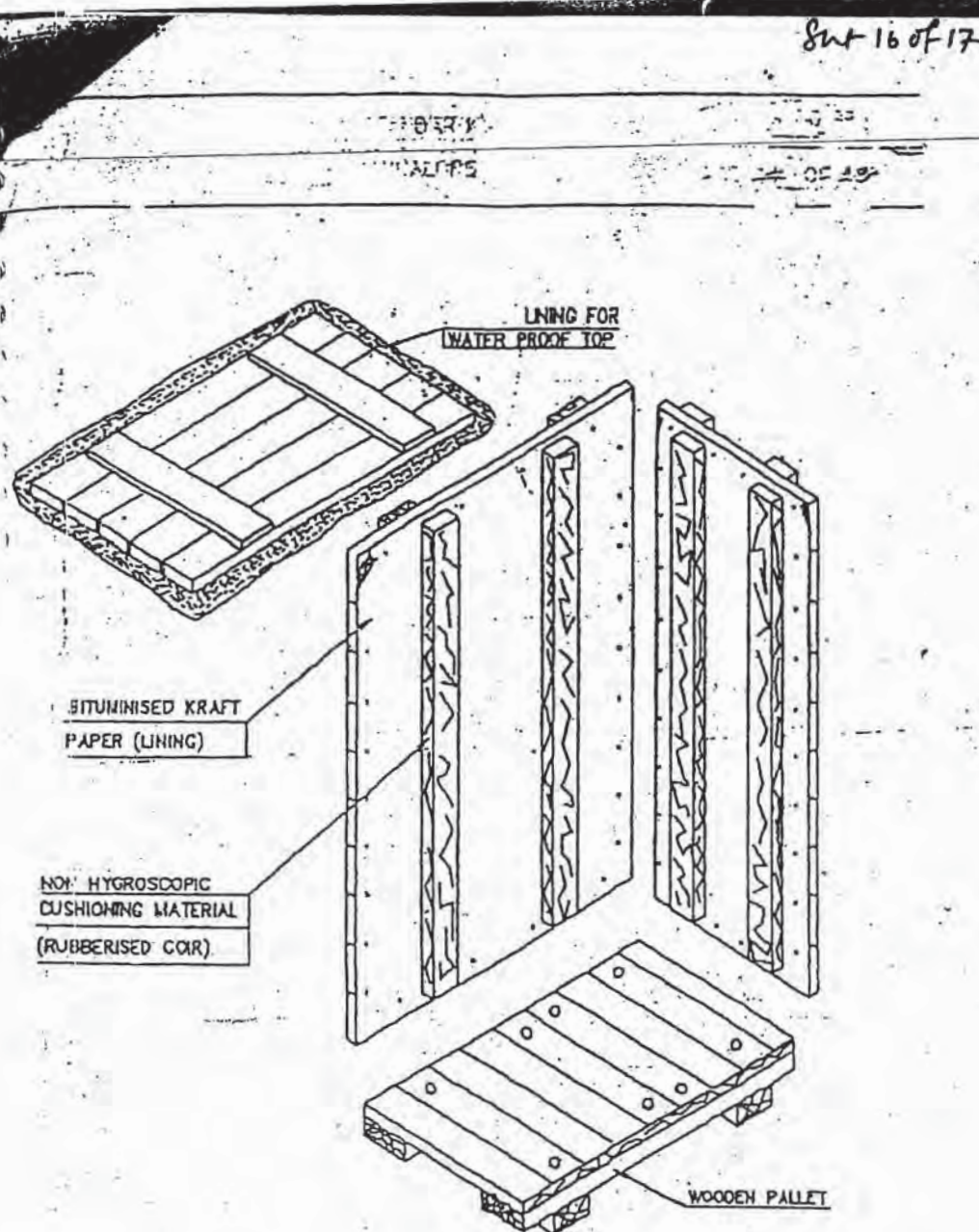


FIGURE-15

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 29	OF 52

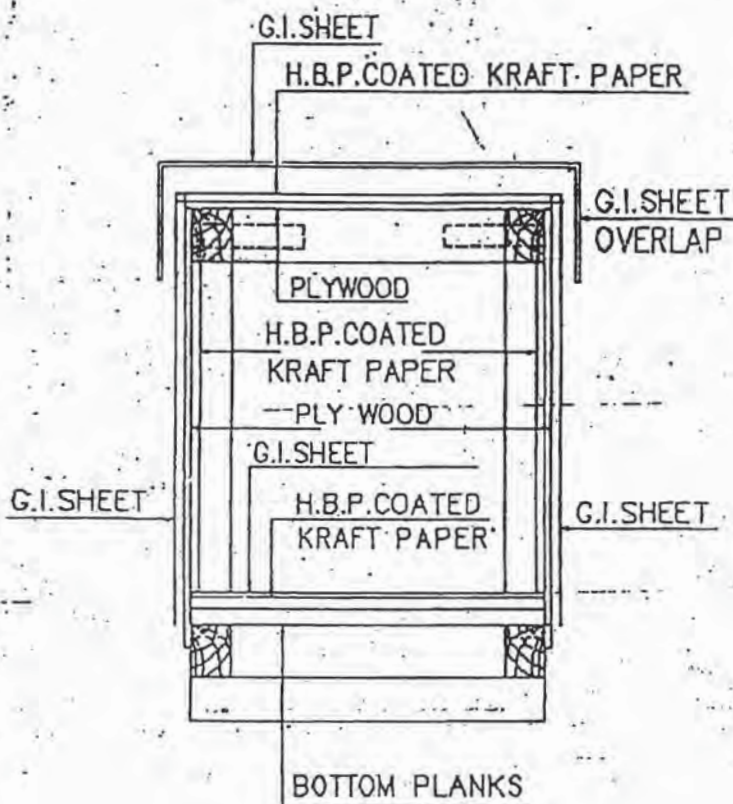


FIG-16 : CLOSED PACKING CASE WITH G.I.SHEET
SHOWING LAYERS OF PACKING MATERIALS.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 30	OF 52

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.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 31	OF 52

- 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.

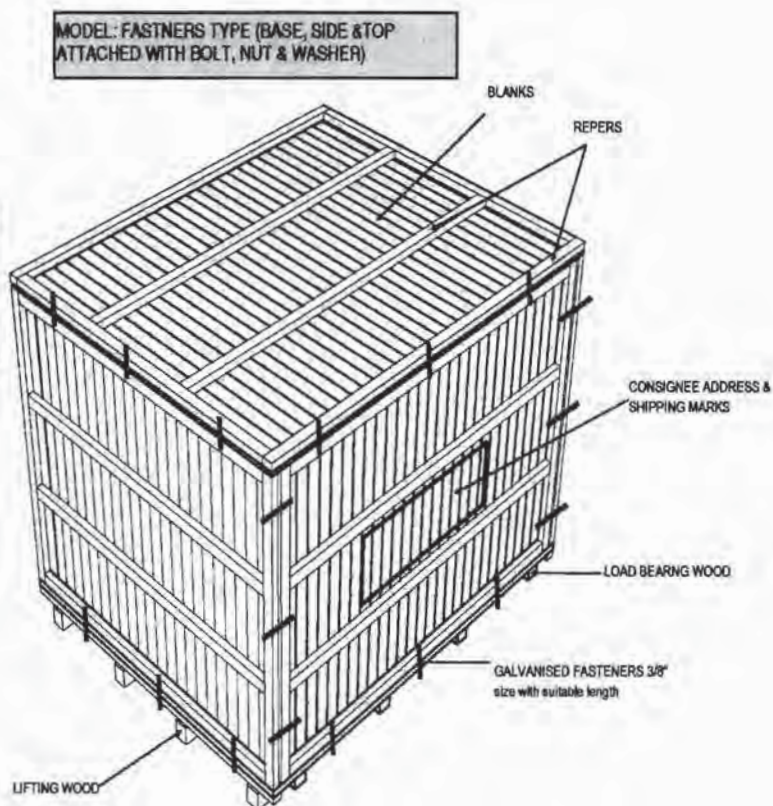
	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 32	OF 52

- 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.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 33	OF 52

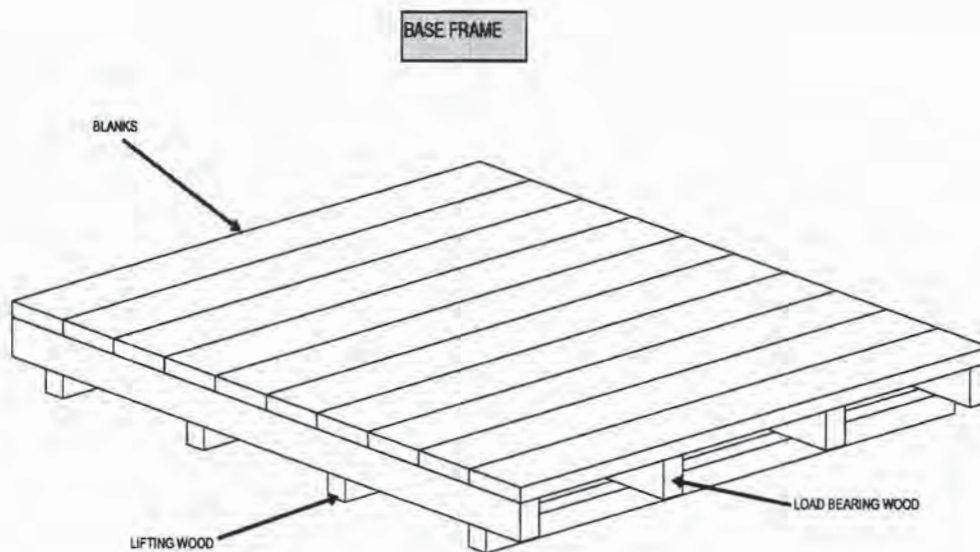
This Type of case to be used for following items:

1. BALL SEPARATOR
2. BALL COLLECTOR SKID



SHEET 05 of 10

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 34	OF 52



SHEET 06 of 10

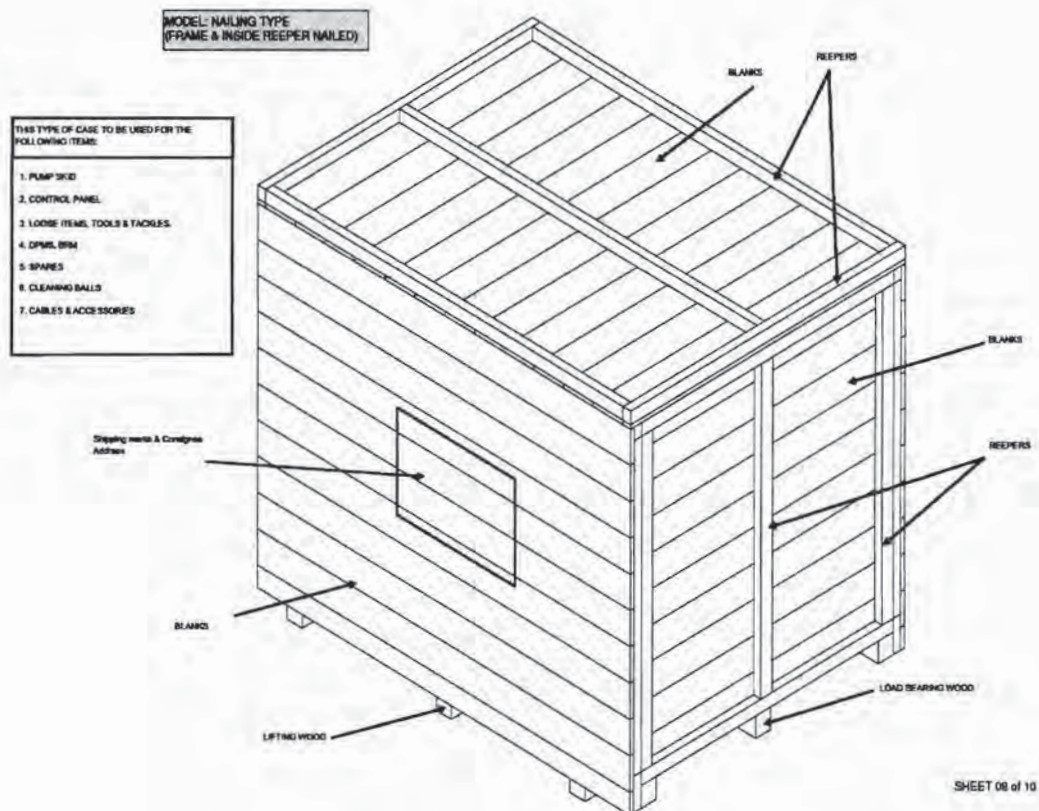
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		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 35	OF 52

MODEL: FASTNERS TYPE - WITHOUT TOP

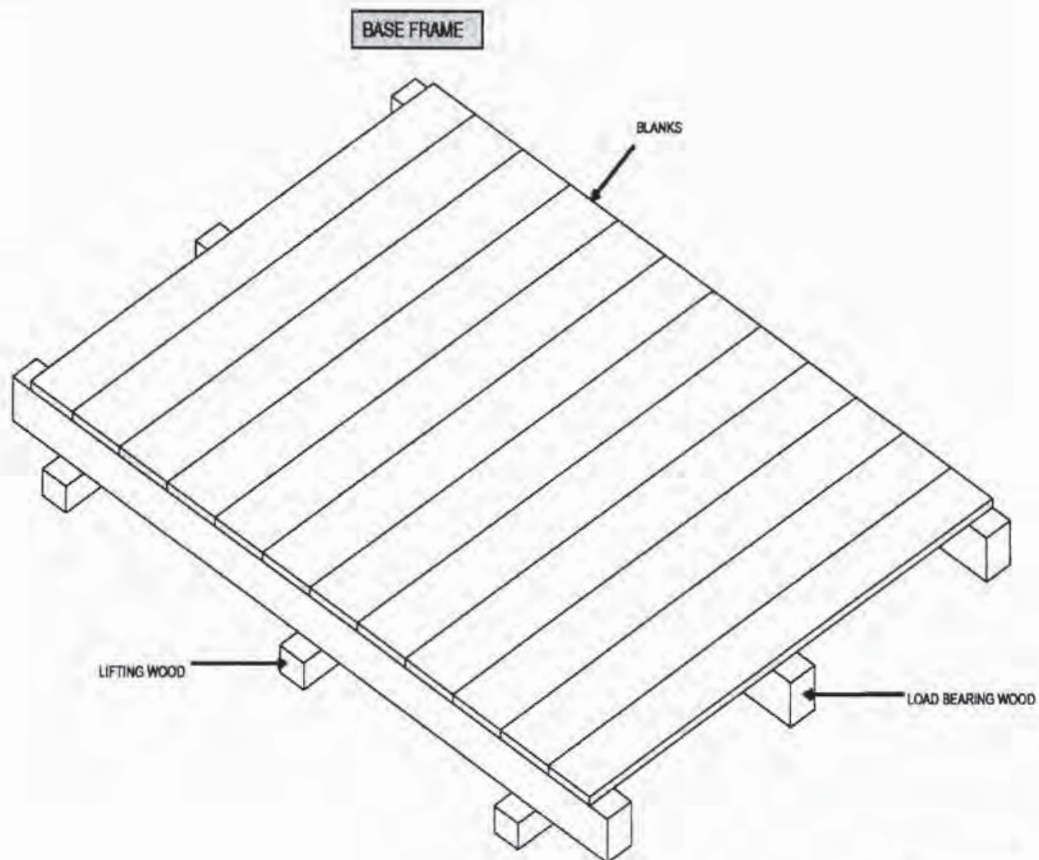


SHEET 07 of 10

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 36	OF 52



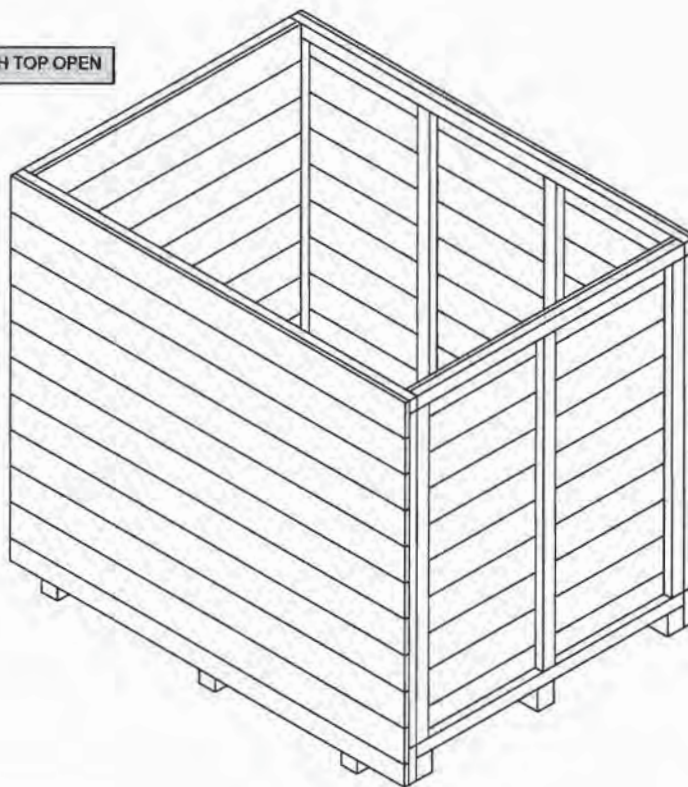
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		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 37	OF 52



SHEET 09 of 10

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 38	OF 52

NAILING TYPE MODEL WITH TOP OPEN



SHEET 10 of 10

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 39	OF 52

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

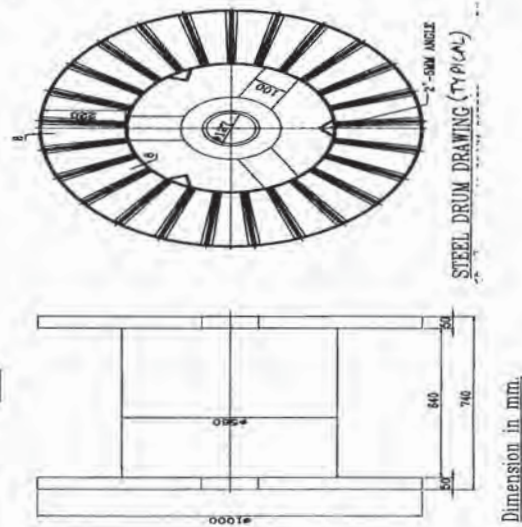
11.1.1 Type of Equipment

All type of cables..

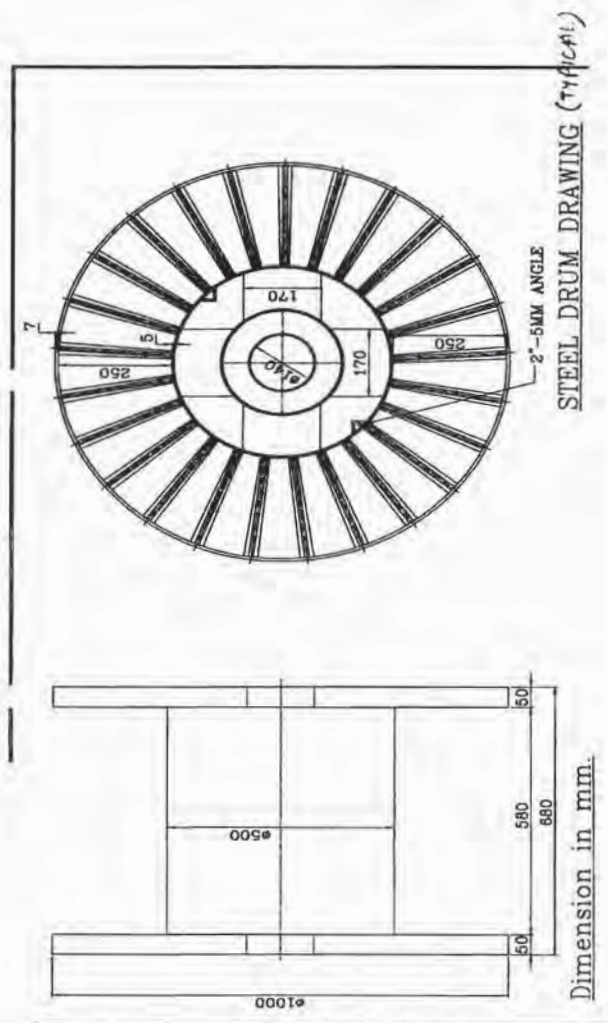
11.1.2 Type of Construction

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).

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 40	OF 52



	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 41	OF 52



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

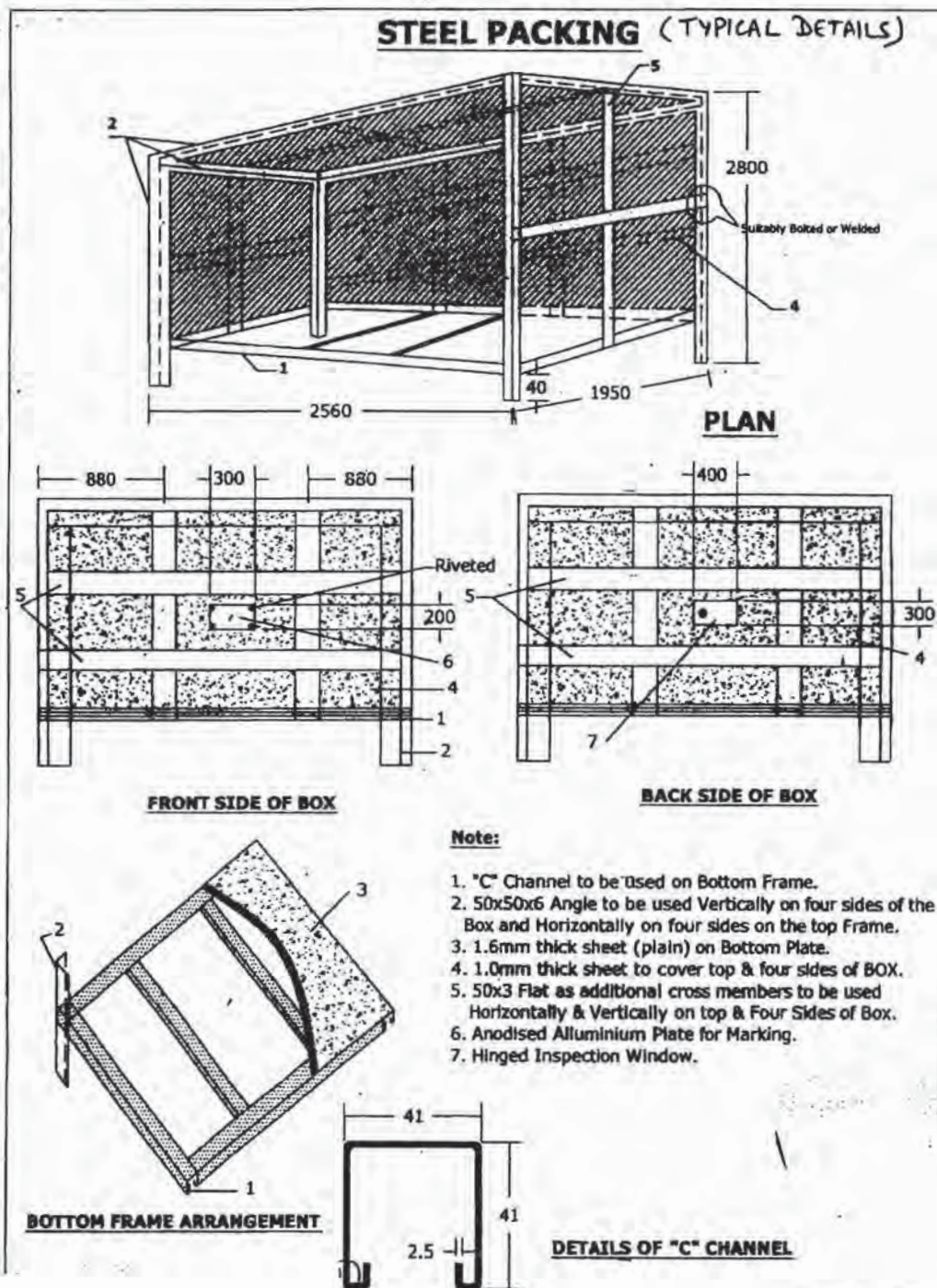
11.2.1 Cable trays can be packed in wooden boxes as per fig 1 to 11 or in steel boxes. Details of steel box construction is as indicated below.

- 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.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 42	OF 52

- 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

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 43	OF 52



	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 44	OF 52

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 DIATRIBUTION 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 CONSUMBALES

- 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

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 45	OF 52

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.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 46	OF 52

PACKING PROCEDURE FOR CONDUIT PIPE

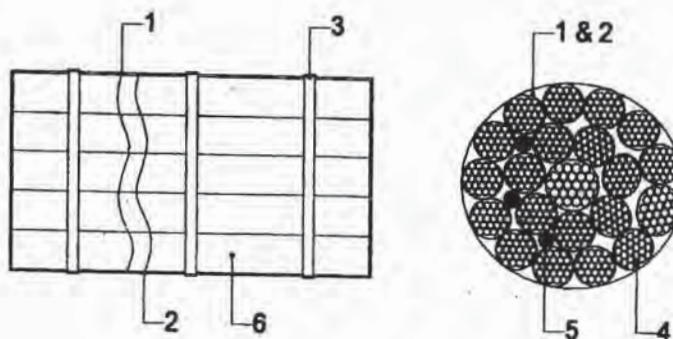


FIGURE "A"

- 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.

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 47	OF 52

PACKING PROCEDURE FOR STRUCTURAL STEEL

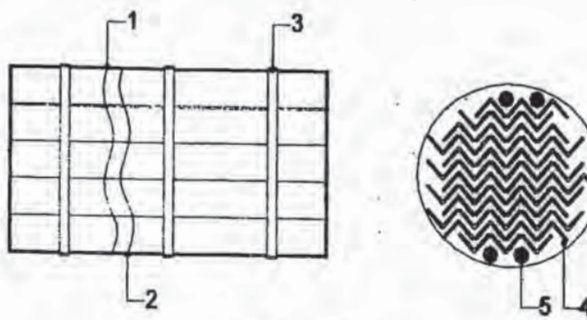
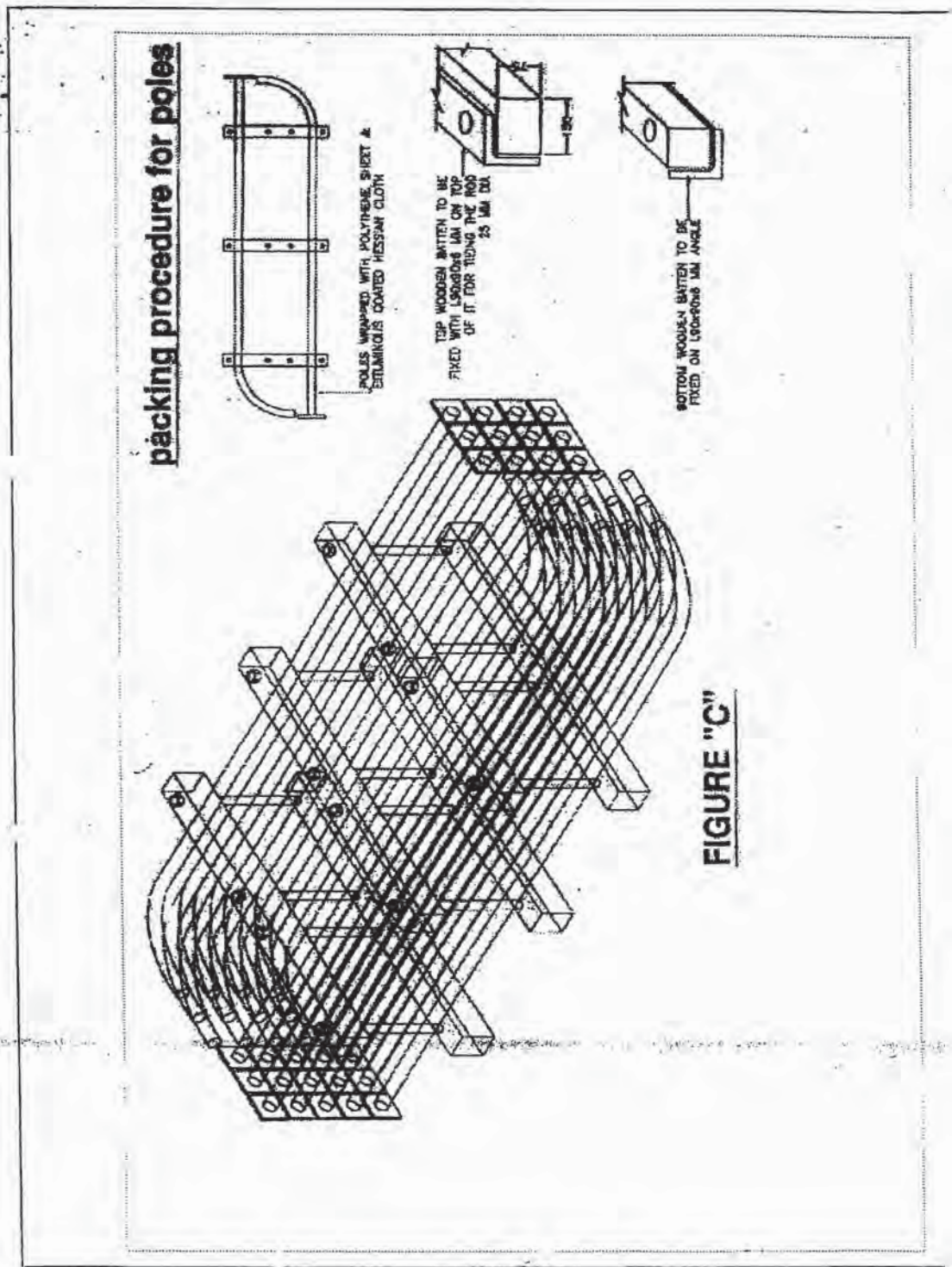


FIGURE "B"

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

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 48	OF 52



19 of 20

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME	II B
		SECTION	D
		REV. NO. 0	DATE 10/08/2010
		SHEET	49 OF 52

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 ≥ 0.175 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

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 50	OF 52

- 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:

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 51	OF 52

- 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

5897/2020/PS-PEM-MAX

	TITLE TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING FOR EXPORT JOBS	SPECIFICATION NO. PE-TS-888-100-A001	
		VOLUME II B	
		SECTION D	
		REV. NO. 0	DATE 10/08/2010
		SHEET 52	OF 52

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.



2 X 250 MW BHILAI FGD

AGITATOR
TECHNICAL SPECIFICATION

SPECIFICATION NO. PE-TS-468-571-18000-A001

SECTION-II

ANNEXURE-1

REV: 00

Date: April, 2020

SECTION-II

ANNEXURE-1

LIST OF documents to be submitted with bid

	2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATION FOR AGITATORS LIST OF DOCUMENTS TO BE SUBMITTED WITH BID	SPECIFICATION No: PE-TS-468-571-18000-A001	
		SECTION : II	
		ANNEXURE-1	
		REV: 00	
		Date: April, 2020	

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

1. Compliance cum confirmation certificate (refer annexure-2 of section-II)
2. Pre-bid clarification schedule as per format given under Section-II (Annexure-3), in case of any clarifications.
3. Deviation schedule as per format given under Section-II (Annexure-4), in case of any deviations by bidder.
4. Guaranteed power consumption format (In the format attached in the price schedule) declaring guaranteed power consumption value in KW.
5. Un priced format for main package (mentioning quoted against each item)
6. Un priced format for mandatory spare (mentioning quoted against each item)
7. Un priced format for Tools and Tackles (mentioning quoted against each item)
8. Un priced format for Commissioning spare (mentioning quoted against each item)
9. List of makes of sub vendor items (refer annexure-6 of section-II)
10. Agitator Schedule filled up by the bidder (refer annexure-8 of section-II)
11. GA drawing, Exploded view with Material of construction, total weight of all Agitators models offered
12. Agitator and Motor Sizing Calculation
- ~~13. List of makes of sub-vendor items (refer annexure-6 of section-II)~~
14. Electrical Load data filled up by the bidder (refer annexure-5 of section-II)
15. Documents for meeting the Pre-Qualification Requirement (3K format has to be submitted along with supporting documents)
16. Schedule of guarantees (refer annexure-10 of section-II)
- ~~17. Documents for meeting the Pre-Qualification Requirement (3K format has to be submitted along with supporting documents)~~
18. Priced offer



2 X 250 MW BHILAI FGD

AGITATOR
TECHNICAL SPECIFICATION

SPECIFICATION NO. PE-TS-468-571-18000-A001

SECTION-II

ANNEXURE-2

REV: 00

Date: April, 2020

SECTION-II

ANNEXURE-2

COMPLIANCE CUM CONFIRMATION CERTIFICATE



**2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
AGITATORS
COMPLIANCE CUM CONFIRMATION
CERTIFICATE**

SPECIFICATION No: PE-TS-468-571-18000-A001

SECTION : II

ANNEXURE-2

REV. NO. 00

Date: April, 2020

COMPLIANCE CUM CONFIRMATION CERTIFICATE

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

- a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions, other than those mentioned under "exclusion and those resolved as per 'Schedule of Deviations', with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.
- e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL / Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

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

- f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.
- g) All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.
- h) Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account



**2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
AGITATORS
COMPLIANCE CUM CONFIRMATION
CERTIFICATE**

SPECIFICATION No:PE-TS-468-571-18000-A001

SECTION : II

ANNEXURE-2

REV. NO. 00

Date: April, 2020

- 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.



2 X 250 MW BHILAI FGD

AGITATOR
TECHNICAL SPECIFICATION

SPECIFICATION NO. PE-TS-468-571-18000-A001

SECTION-II

ANNEXURE-3

REV: 00

Date: April, 2020

SECTION-II

ANNEXURE-3
PRE-BID CLARIFICATION SCHEDULE



2 X 250 MW BHILAI FGD AGITATOR TECHNICAL SPECIFICATION

SPECIFICATION NO. PE-TS-468-571-18000-A001

SECTION-II

ANNEXURE-3

REV 00

Date: April, 2020

PRE-BID CLARIFICATION SCHEDULE

[illegible]

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



**2 X 250 MW BHILAI FGD
AGITATOR**

SPECIFICATION NO. PE-TS-468-571-18000-A001

SECTION-II

ANNEXURE-4

REV: 00

Date: April, 2020

SECTION-II

ANNEXURE-4

**SCHEDULE OF TECHNICAL
DEVIATION**

Page 337 of 364
Page 1 of 1



2 X 250 MW BHILAI FGD

AGITATOR
TECHNICAL SPECIFICATION

SPECIFICATION NO. PE-TS-468-571-18000-A001

SECTION-II

ANNEXURE-5

REV: 00

Date: April, 2020

SECTION-II

ANNEXURE-5
LOAD DATA (ELECTRICAL)

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
ANNEXURE-IV																		
Filtrate Water Tank Agitator				1	0				C									
Primary Hydro-cyclone Feed Tank Agitator				1	0				C									
Secondary Hydro-cyclone Feed Tank Agitator				1	0				C									
Waste Water Tank Agitator				1	0				C									
Limestone Slurry Storage Tank Agitator				2	0				C									
Absorber Area Drain Sump Agitator-1				1	0				I									
Absorber Area Drain Sump Agitator-2				1	0				I									
Auxiliary Absorbent Tank Agitator				3	0				I									
Gypsum Dewatering Area Drain Sump Agitator				1	0				I									
Limestone Area Drain Sump Agitator				1	0				I									
NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)/ CUSTOMER 2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V : ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTOR CONTROLLED)																		
ANNEXURE-5 LOAD DATA (ELECTRICAL)	JOB NO.		468		ORIGINATING AGENCY		PEM (ELECTRICAL)											
	PROJECT TITLE		2 X 250 MW BHILAI FGD		NAME		DATA FILLED UP ON											
	SYSTEM		AGITATOR		SIGN.		DATA ENTERED ON											
	DEPTT. / SECTION		MAUX		SHEET 1 OF 1		REV. 00											



2 X 250 MW BHILAI FGD

AGITATOR
TECHNICAL SPECIFICATION

SPECIFICATION NO. PE-TS-468-571-18000-A001

SECTION-II

ANNEXURE-6

REV: 00

Date: April, 2020

SECTION-II

ANNEXURE-6
LIST OF MAKES OF ITEMS

5897/2020/PS-PEM-MAX



2 X 250 MW BHILAI FGD

AGITATORS
TECHNICAL SPECIFICATION

SPECIFICATION NO. PE-TS-468-571-18000-A001

SECTION : II

ANNEXURE : 6

REV 00

Date: April, 2020

LIST OF MAKES OF ITEMS

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



**2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
AGITATORS**

SPECIFICATION NO. PE-TS-468-571-18000-A001

SECTION : II

ANNEXURE-7

REV 00

Date: April, 2020

**ANNEXURE-7
LIST OF TOOLS & TACKLES**

5897/2020/PS-PEM-MAX



**2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
AGITATORS**

SPECIFICATION NO. PE-TS-468-571-18000-A001

SECTION : II

ANNEXURE-7

REV 00

Date: April, 2020

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

5897/2020/PS-PEM-MAX

	TITLE: 2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATION FOR AGITATORS	SPECIFICATION No: PE-TS-468-571-18000-A001	
		SECTION-II, ANNEXURE-8	
		REV. 00	
		Date: April, 2020	

SECTION-II, ANNEXURE-8

AGITATOR SCHEDULE

AGITATOR SCHEDULE (To be submitted with the offer by Bidder)

Sl.no.	Description	Primary Hydrocyclone feed tank Agitator	Filtrate water tank Agitator	Secondary Hydrocyclone feed tank Agitator	Waste water Tank Agitator	Limestone Slurry Storage tank Agitator	Auxiliary Absorbent Tank Agitator	Absorber Area Drain Pit Agitator	Gypsum Dewatering Area Drain Pits Agitator	LIMESTONE AREA DRAIN SUMP
1	Agitator Sl No.	1	2	3	4	5	6	7	8	9
2	Type	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Blade turbine - vertical entry or marine propeller side entry	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	Gypsum slurry	Gypsum slurry	Limestone slurry
4	Seal Type	Not required	Not required	Not required	Not required	Not required	Mechanical seal (emergency flush start) required in case of side entry	Not required	Not required	Not required
5	Duty	Continuous	Continuous	Continuous	Continuous	Continuous	Intermittent -Whenever FGD is under maintenance	Intermittent	Intermittent	Intermittent
6	Agitator Location	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor
7	Operation	Continuous	Continuous	Continuous	Continuous	Continuous	Intermittent -Whenever FGD is under maintenance	Intermittent	Intermittent	Intermittent
8	Tank details									
a)	Tank Shape	Circular	Circular	Circular	Circular	Circular	Circular	Rectangular	Rectangular	Rectangular
b)	Tank name	Primary Hydrocyclone feed tank	Filtrate water tank	Secondary Hydrocyclone feed tank	Waste water Tank	Limestone Slurry Storage tank	Auxiliary Absorbent Tank	Absorber Area Drain Pit	Gypsum Area Drain Sump	Limestone Area Drain Sump
c)	Capacity of Slurry (in m3)	88.4 m ³	43.98	50.3	118.8	604.4	746.13	56.0	56.0	56.0
9	Dimension (in m)									
d)	Diameter	5.0	4.0	4	5.5	9.0	10.0	-	-	-
e)	Length	-	-	-	-	-	-	4	4	4
f)	Breadth	-	-	-	-	-	-	4	4	4
g)	Height	5*	4*	4.5*	5.5*	10*	10*	4*	4*	4*
9	MOC of Agitator	Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be rubber lined. All fasteners used in wetted condition must be of AISI- 316L	Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be rubber lined. All fasteners used in wetted condition must be of AISI- 316L	Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be rubber lined. All fasteners used in wetted condition must be of AISI- 316L	Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be rubber lined. All fasteners used in wetted condition must be of AISI- 316L	Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be rubber lined. All fasteners used in wetted condition must be of AISI- 316L	If side entry - Agitator Shaft (which is continuously in contact with slurry) and blades shall be made with Alloy 926 or better material. If Top entry Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be rubber lined. All fasteners used in wetted condition must be of AISI- 316L	Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be rubber lined. All fasteners used in wetted condition must be of AISI- 316L	Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be rubber lined. All fasteners used in wetted condition must be of AISI- 316L	Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be rubber lined. All fasteners used in wetted condition must be of AISI- 316L
10	Minimum liquid level in the tank	1.0	1.0	1.0	1.0	1.0	1.0	1.4	1.4	1.4
11	Normal liquid level in the tank	4.3	3.3	3.8	4.8	9.3	9.3	3.3	3.3	3.3
12	Maximum liquid level in the tank	4.5	3.5	4	5	9.5	9.5	3.5	3.5	3.5
13	Quantity of Agitator per tank	1 No.	1 No.	1 No.	1 No.	1 No.	3 nos. - side entry	1 No.	1 No.	1 No.
14	Total quantity of agitators (for two units)	1 No.	1 No.	1 No.	1 No.	2 No's	3 nos. - side entry (to be suitably decided by PEM)	2 No's	1 No.	1 No.
15	Slurry Analysis									
a)	Slurry to be handled	Gypsum slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Limestone slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Limestone slurry
b)	Maximum solid particle size	200 mesh (74 μ)	6-7 mm	200 mesh (74 μ)	200 mesh (74 μ)	200 mesh (74 μ)	200 mesh (74 μ)	6-7 mm	6-7 mm	6-7 mm
c)	Normal solid particle size, d50	325 mesh (44 μ)	6-7 mm	325 mesh (44 μ)	325 mesh (44 μ)	325 mesh (44 μ)	325 mesh (44 μ)	6-7 mm	6-7 mm	6-7 mm

d)	Solid to be handled	Gypsum along with Limestone & other impurities	gypsum along with Limestone & other impurities	gypsum along with Limestone & other impurities	gypsum along with Limestone & other impurities	Limestone + impurities	gypsum along with Limestone & other impurities	gypsum along with Limestone & other impurities	gypsum along with Limestone & other impurities	Limestone + impurities
e)	Chloride concentration	max 25000 ppm	max 25000 ppm	max 25000 ppm	max 25000 ppm	max 1000 ppm	max 25000 ppm	max 25000 ppm	max 25000 ppm	max 1000 ppm
f)	Hardness of particle	5-7 mho scale	5-7 mohs scale	5-7 mohs scale	5-7 mohs scale	5-7 mohs scale	5-7 mohs scale	5-7 mohs scale	5-7 mohs scale	5-7 mohs scale
g)	Slurry concentration, wt%	30 wt%	11%	16.60%	3%	30 wt%	30%	30%	30%	30 wt%
h)	Sp. Gravity of slurry	1.213	1.066	1.109	1.02	1.215	1.213	1.213	1.213	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 -58 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 -45 deg C; Design-55 deg C.
13	Motor									
a)	Total Power consumed	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
b)	Motor Rating	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
c)	Motor Explosion Proof Class	Non-Flame Proof	Non-Flame Proof	Non-Flame Proof	Non-Flame Proof	Non-Flame Proof	Non-Flame Proof	Non-Flame Proof	Non-Flame Proof	Non-Flame Proof
d)	Motor Protection Class	IP-55/ Outdoor	IP-55/ Outdoor	IP-55/ Outdoor	IP-55/ Outdoor	IP-55/ Outdoor	IP-55/ Outdoor	IP-55/ Outdoor	IP-55/ Outdoor	IP-55/ Outdoor
e)	Motor Efficiency Class	IE-3	IE-3	IE-3	IE-3	IE-3	IE-3	IE-3	IE-3	IE-3
14	Minimum Liquid level In the tank	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
15	Impeller									
a)	Type of impeller	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
b)	No. of impeller per agitator	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
c)	Impeller diameter	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
d)	Impeller tip speed	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
e)	Operating speed	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
f)	Agitator Pumping Capacity	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
g)	Volume/Agitator	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
16	Baffle Plates (not in bidder's scope)									
a)	No. & size of baffle plates	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
c)	Thickness of baffle plates (mm)	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
d)	Distance from Bottom of the tank	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
17	Nozzle (not in bidder's scope)									
a)	Size of the nozzle on which agitator frame is mounted	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	NA	NA	NA
18	Loads									
a)	Static Load	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
b)	Dynamic load	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
c)	Torsional Moment (Nm)	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder

d)	Bending Moment (Nm)	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
19	Power loading for Auxiliary power consumption	Applicable	Applicable	Applicable	Applicable	Applicable	Not applicable	Not applicable	Not applicable	Not applicable
20	Parameters to be considered compulsarily by bidder for design of Agitators									
a)	Uniform suspension of solids by Agitators	The agitators shall keep the solid particles in suspended mode in liquid slurry with "Full off-Bottom Suspension" of solid particles to 98% of liquid column to virtually "Uniform Solid Concentration".								
b)	Mounting of Agitaor	The Agitators shall be mounted on the Agitator platform which shall be approximately at a height of 1.0 m from the tank roof. However, the Agitator platform is excluded from bidder's scope.								
c)	Power Number for Agitator	03 - 0.35	03 - 0.35	03 - 0.35	03 - 0.35	03 - 0.35	03 - 0.35	03 - 0.35	03 - 0.35	03 - 0.35
d)	Impeller tip dia/ tank dia	1/3 (approx)	1/3 (approx)	1/3 (approx)	1/3 (approx)	1/3 (approx)	1/3 (approx)	1/3 (approx)	1/3 (approx)	1/3 (approx)
e)	Minimum number of stage of impeller	2	2	2	2	2	2	1	1	1
Notes										
1	There shall be complete re-suspension of all solids after a 24 hour outage. Accumulation of solids shall not prevent agitator restart.									
2	Agitation shall be provided to prevent settlement of slurry by side entry agitators . Sufficient number of agitators (3 nos.) shall be provided in the tank by the bidder to prevent the solids from settling down. All the side-entry agitators shall be similar.									
3	Tank low level trip requirement shall be provided by the bidder									
4	Maximum Sound Pressure Level at a height of 1.5 m above floor level in elevation, and at a distance of 1.0 m horizontally shall be 85 dBA.									
5	*Although the height of all tanks is fixed above, same may vary slightly during detailed engineering as per design calculation of tanks.									



**2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
AGITATORS**

SPECIFICATION No: PE-TS-468-571-18000-A001

SECTION : II

ANNEXURE-9

REV 00

Date: April, 2020

ANNEXURE-9

LIST OF COMMISSIONING SPARES

[illegible]

NOTE -

1) 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.



2 X 250 MW BHILAI FGD

AGITATOR
TECHNICAL SPECIFICATION

SPECIFICATION NO. PE-TS-468-571-18000-A001

SECTION-II

ANNEXURE-10

REV: 00

Date: April, 2020

SECTION-II

ANNEXURE-10

Schedule of Guarantees
(TO BE FILLED FOR EACH AGITATOR)



**2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
AGITATORS**

SPECIFICATION No: PE-TS-468-571-18000-A001

SECTION : II

ANNEXURE-10

REV 00

Date: April, 2020

Annexure-X-Schedule of Guarantees (TO BE FILLED FOR EACH AGITATOR)

Project:

Enquiry No:

Sl. No.	Description	Unit	Data
1	Rated Input Power at Motor Terminal at Normal water level and at Normal voltage and Frequency (*)	KW	
2	Possible Rate of deposit of solid particles at tank bottom of total solid particle inflow/outflow	%	
2	Noise level at a distance of 1.0 meter from the equipment at site	dB(A)	85
3	Maximum vibration velocity (at site) (RMS)	mm/sec	
4	Life of Agitator components parts from the date of Commissioning for continuous operation		24 months
5	Anti-friction Bearing		25000 hrs.

BIDDER SIGN : _____

DESIGNATION : _____

DATE : _____



2 X 250 MW BHILAI FGD

AGITATOR
TECHNICAL SPECIFICATION

SPECIFICATION NO. PE-TS-468-571-18000-A001

SECTION-II

ANNEXURE-11

REV: 00

Date: April, 2020

SECTION-II

ANNEXURE-11
ATTACHMENT – 3K

CLAUSE NO.	INTENT OF SPECIFICATION	एनटीपीसी NTPC														
4.00.00	Qualifying Requirements for Equipment/Systems The Bidder / Bidder's sub-vendor(s) is required to meet the provenness criteria and/or qualification requirement for the items/ services listed below as per the stipulated criteria indicated in the respective clauses. For the purpose of qualification of Bidders / Sub-vendor(s), experience shall be reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder unless otherwise specified in the respective clauses.															
4.01.00	Provenness criteria for critical equipment, auxiliaries, systems and bought out items: The Bidder / Bidder's sub-vendor(s) is required to meet the provenness criteria and/or qualification requirement for critical equipments, auxiliaries, systems and bought out items as per criteria stipulated below:															
4.01.01	Booster Fans, Slurry Recirculation Pumps, Oxidation Blowers, Wet Limestone Grinding Mills, Slurry Pumps, Agitators & Vacuum Belt Filters for the Wet Limestone based Flue Gas Desulphurisation (FGD) System offered by the Bidder shall be only from such manufacturer(s) who has previously designed (either by itself or under collaboration / licensing agreement), manufactured / got manufactured the respective equipment(s) of the type, application and minimum equipment rating as stipulated below such that the respective equipment(s) should have been in successful operation in at least one (1) plant for a period not less than one(1) year. <u>Type and Rating for Qualification</u>															
<table><tr><th>Sl. No.</th><th>Name of Equipment</th><th>Type of Equipment</th><th>Application</th><th>Equipment Rating</th></tr><tr><td rowspan="3">(a)</td><td rowspan="3">Booster Fans</td><td rowspan="3">Axial type with variable pitch control</td><td rowspan="3">Coal fired power plant</td><td>Unit size of 660 MW – Flow 610 m3/s (min.) with Head 400 mmwc (min.) & Fan Speed 900 rpm (max.)</td></tr><tr><td>Unit size of 500 MW – Flow 490 m3/s (min.) with Head 400 mmwc (min.) & Fan Speed 900 rpm (max.)</td></tr><tr><td>Unit size of 250 MW & Below – Flow 225 m3/s (min.) with Head 400 mmwc (min.) & Fan Speed 900 rpm (max.)</td></tr></table>		Sl. No.	Name of Equipment	Type of Equipment	Application	Equipment Rating	(a)	Booster Fans	Axial type with variable pitch control	Coal fired power plant	Unit size of 660 MW – Flow 610 m3/s (min.) with Head 400 mmwc (min.) & Fan Speed 900 rpm (max.)	Unit size of 500 MW – Flow 490 m3/s (min.) with Head 400 mmwc (min.) & Fan Speed 900 rpm (max.)	Unit size of 250 MW & Below – Flow 225 m3/s (min.) with Head 400 mmwc (min.) & Fan Speed 900 rpm (max.)			
Sl. No.	Name of Equipment	Type of Equipment	Application	Equipment Rating												
(a)	Booster Fans	Axial type with variable pitch control	Coal fired power plant	Unit size of 660 MW – Flow 610 m3/s (min.) with Head 400 mmwc (min.) & Fan Speed 900 rpm (max.)												
				Unit size of 500 MW – Flow 490 m3/s (min.) with Head 400 mmwc (min.) & Fan Speed 900 rpm (max.)												
				Unit size of 250 MW & Below – Flow 225 m3/s (min.) with Head 400 mmwc (min.) & Fan Speed 900 rpm (max.)												
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 7 OF 21												

CLAUSE NO.	INTENT OF SPECIFICATION				
Sl. No.	Name of Equipment	Type of Equipment	Application	Equipment Rating	
(b)	Slurry Recirculation Pumps	Centrifugal type	Wet Limestone based FGD application in Coal fired power plant	Unit size of 500 MW & Above - Flow 10200 m3/hr (min.) with Head 16 Meters of Liquid Column (min.)	
				Unit size of 250 MW & Below – Flow 5680 m3/hr (min.) with Head 16 Meters of Liquid Column (min.)	
(c)	Oxidation Blowers	Centrifugal/ positive displacement type blower	Wet Limestone based FGD application in Coal fired power plant or any other process application	Unit size of 500 MW & Above - Flow 7300 Nm3/hr Dry Basis (min.) with Head 8500 mmwc (min.) for spray tower process Or Head 3500 mmwc (min.) for bubbling type process	
				Unit size of 250 MW & Below - Flow 5000 Nm3/hr Dry Basis (min.) with Head 6500 mmwc (min.) for spray tower process Or Head 3500 mmwc (min.) for bubbling type process	
(d)	Wet limestone Grinding mills	Horizontal Wet Ball mill	Wet Limestone based FGD application in Coal fired power plant	Station size of 3000 MW -Capacity 40 T/hr (min.) with pulverizing fineness not less than 90% thru 325 mesh	
				Station size of 1980 MW-2000 MW - Capacity 30 T/hr (min.) with pulverizing fineness not less than 90% thru 325 mesh	
				Station Size of 1500 MW - Capacity 20 T/hr (min.) with pulverizing fineness	
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9		SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 8 OF 21

CLAUSE NO.		INTENT OF SPECIFICATION			
Sl. No.	Name of Equipment	Type of Equipment	Application	Equipment Rating	
				not less than 90% thru 325 mesh	
				Station size of 500 MW & Below - Capacity 10 T/hr (min.) with pulverizing fineness not less than 90% thru 325 mesh	
(e)	Slurry Pumps	Centrifugal type	Wet Limestone based FGD application or ash slurry application in Coal fired power plant	Unit size of 500 MW & Above - Flow 50 m ³ /hr (min.) with head 30 Meters of Liquid Column (min.)	
				Unit size of 250 MW & Below - Flow 25 m ³ /hr (min.) with head 30 Meters of Liquid Column (min.)	
(f)	Agitators	Vertical/Horizontal	Wet Limestone based FGD application in Coal fired power plant	Agitator rating not less than that supplied for 500 MW or higher size unit for similar application	
(g)	Vacuum Belt filters	Belt type	Wet Limestone based FGD application in Coal fired power plant or in any other process application	Station size of 3000 MW-Capacity 65 T/hr (min.)	
				Station size of 1980 MW-2000 MW-Capacity 50 T/hr (min.)	
				Station Size of 1500 MW-Capacity 35 T/hr (min.)	
				Station size of 500 MW & Below-Capacity 17 T/hr (min.)	
The provenness criteria for equipment (Booster Fans) stipulated at Sl. No. 4.01.01(a) above shall also be considered acceptable provided the rating parameters (i.e., flow, head and rated rpm) is covered within the operating regime of the respective fan performance curve of the reference plant equipment. The provenness criteria for equipment (Slurry Recirculation Pumps) stipulated at Sl. No. 4.01.01(b) above shall also be considered acceptable provided the rating parameters (i.e., flow and head) is covered within the operating regime of the					
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION - VI, PART-A BID DOC. NO.:CS-0011-109(2)-9		SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 9 OF 21

CLAUSE NO.	INTENT OF SPECIFICATION			एनटीपीसी NTPC						
4.01.02	respective Slurry Recirculation Pump performance curve of the reference plant equipment. In case the Bidder or the proposed sub-vendor is not manufacturer of proven Booster Fans as per clause 4.01.01(a) above but is a manufacturer of such equipment for units of at least * MW rating, the Bidder or the proposed sub vendor shall be considered qualified for manufacturing such equipment for ** MW units also, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such equipment in India with such manufacturer who meets the requirements stipulated at clause 4.01.01(a) above for the Booster Fans. For value of * and ** refer table below. <table><tr><td>*</td><td>**</td></tr><tr><td>195</td><td>195/ 250/ 500</td></tr><tr><td>500</td><td>660</td></tr></table>				*	**	195	195/ 250/ 500	500	660
*	**									
195	195/ 250/ 500									
500	660									
4.01.03	A JV / Subsidiary Company formed for manufacturing and supply of equipment(s) as listed at clause no. 4.01.01 above in India, shall also be considered qualified for manufacturing such equipment(s), provided that it has a valid collaboration or licensing agreement for design, engineering, manufacturing of such equipment(s) in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 4.01.01 above (or the technology provider of the qualified equipment manufacturer) for the respective equipment(s). Before taking up the manufacturing of such equipment(s), the bidder/ his sub-vendor(s) must create /have created manufacturing facilities at his works as per collaborator's/licenser's design, manufacturing and quality control system for such equipment(s). Further, in such a case, such qualified equipment manufacturers should have, directly or indirectly through its holding company/ subsidiary company, at least 26% equity participation in the Indian Joint Venture Company/ Subsidiary Company, which shall be maintained for a lock-in period of seven (7) years from the date of incorporation of such Joint Venture/ Subsidiary or upto the end of defect liability period of the contract, whichever is later.									
4.01.04	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Oxidation Blowers as per clause 4.01.01(c) above but is a manufacturer of Blowers/compressors for minimum 50 NM³/min capacity, the Bidder or the proposed sub-vendor shall also be considered qualified for manufacturing Oxidation Blowers, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Oxidation Blowers in India with such manufacturer who meets the requirements stipulated at clause 4.01.01(c) above for the Oxidation Blowers. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipments.									
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 10 OF 21						

CLAUSE NO.	INTENT OF SPECIFICATION	एनटीपीसी NTPC		
4.01.05 (i)	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Wet limestone Grinding mills as per clause 4.01.01 (d) above but is a manufacturer of dry Grinding mills for power or cement industry of minimum 20 T/h capacity, the Bidder or the proposed sub-vendor shall also be considered qualified for manufacturing Wet limestone Grinding mills, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Wet limestone Grinding mills in India with such manufacturer who meets the requirements stipulated at clause 4.01.01 (d) above for the Wet limestone Grinding mills. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipments. In addition, the Bidder shall be required to furnish a letter of support from Collaborator(s) / Licensor / Technology provider for successful performance of the equipment valid up to the end of defect liability period of the contract as per the format enclosed in the bidding documents, at the time of placement of order on the approved sub-vendor. OR			
4.01.05 (ii)	In case, the bidder or proposed sub vendor is not a manufacturer of proven Wet Limestone Grinding Mills as per clause 4.01.01(d) above, but have designed, manufactured & supplied dry Grinding Ball Tube mills for at least 500 MW pulverized coal fired power plant, the Bidder or the proposed sub-vendor shall also be considered qualified for manufacturing Wet limestone Grinding Mills provided it has a licensing agreement with a Wet limestone Grinding mills manufacturer who meets the requirements stipulated at clause 4.01.01(d) above for the Wet limestone Grinding mills and provides extended warranty of three (3) years for the Wet Limestone Grinding Mills.			
4.01.06	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Agitators as per clause 4.01.01(f) above but is a manufacturer of Agitators for similar process/duty application in petrochemical or metals and mining industry, the Bidder or the proposed sub-vendor shall also be considered qualified for manufacturing Agitators, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Agitators in India with such manufacturer who meets the requirements stipulated at clause 4.01.01(f) above for the Agitators. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipments.			
4.01.07	In case the Bidder or the proposed sub-vendor is a manufacturer of Slurry Pumps who meets the requirements stipulated at clause 4.01.01(e) above, the Bidder or the proposed sub-vendor shall also be considered qualified for manufacturing Slurry Recirculation Pumps, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such equipment in India with such manufacturer who meets the requirements stipulated at clause 4.01.01(b) above for the Slurry Recirculation Pumps. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipment.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-I INTENT OF SPECIFICATION	PAGE 11 OF 21

CLAUSE NO.	INTENT OF SPECIFICATION	एनटीपीसी NTPC	
4.01.08	Before taking up the manufacturing of such equipment(s) as per clause 4.01.02, 4.01.03, 4.01.04, 4.01.05(i), 4.01.06 & 4.01.07 above, the Bidder / its sub vendor(s) must create (or should have created) manufacturing and testing facilities at its works as per Collaborator / licensor's design, manufacturing and quality control system for such equipments duly certified by the Collaborator / licensor. Further, the Collaborator / Licensor shall provide (or should have provided) all design, design calculation, manufacturing drawings and must provide (or should have provided) technical and quality surveillance assistance and supervision during manufacturing, erection, testing, commissioning of equipments.		
4.01.09	Bidder shall offer and supply only the type of the above equipment(s) for which it, itself or the manufacturer / Collaborator(s) / Licensor(s) proposed by the Bidder for the above equipment(s) is qualified.		
4.01.10	The Employer reserves the right to fully satisfy himself regarding capability and capacity of Bidder / its sub-vendor(s) and the proposed arrangement and may prescribe additional requirement before allowing manufacture of the equipment listed above for this contract. Note to clause 4.01.01 Whenever the term 'coal fired' is appearing above, "Coal" shall be deemed to also include bituminous coal/brown coal/Anthracite Coal/lignite.		
4.02.00	Sub QR for Civil Works:		
4.02.01	Bidder or its agency should have in past executed civil and structural works for * or higher capacity (applicable for project having ** MW unit rating) coal based/Lignite based power plant including earthwork in filling involving mechanical compaction and cutting in hard rock, piling, foundations, Bulk material handling plant involving underground storage hopper and underground tunnels.		
4.02.02	Bidder can engage more than one agency, in case the Bidder itself is not able to meet the requirement at 4.02.01. The agency being engaged for a particular work should have in the past executed such works of * or higher capacity plant (applicable for project having ** MW unit rating).		
4.02.03	For Chimney, Bidder or its agency should have in the past built at least one (1) reinforced concrete chimney of minimum 100m height.		
4.02.04	In case Bidder or its agency do not meet the requirements at 4.02.01 and the Bidder proposes to engage agency (ies) for civil & structural works on work volume basis (except for Chimney), Bidder or its agency (ies) should have executed such works in the past and the annual rate of execution in the reference works should not be less than eighty percent (80%) of the asking rate of such works, (structural steel fabrication, erection, RCC, earthwork in filling involving mechanical compaction and		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9	SUB-SECTION-I INTENT OF SPECIFICATION PAGE 12 OF 21

**FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE
FOR
LOT-2 PROJECTS
BIDDING DOCUMENT NO. CS-0011-109(2)-9**

Bidder's Name and Address:

To
Contract Services-I
NTPC Limited
Noida-201301

Summary of Critical Equipment indicated under clause 4.01.00, sub-section-I, Part-A of Section-VI.

Equipment Name	Sub-Vendor Name	Collaborator's Name, if applicable	Seeking Qualification as per clause..... Sub-Section-I, Part-A of Section-VI
~~Booster Fans~~			~~*4.01.01 / *4.01.02 / *4.01.03~~
~~*Slurry Recirculation Pumps~~			~~*4.01.01 / *4.01.03 / *4.01.07~~
Oxidation Blowers			*4.01.01 / *4.01.03 / *4.01.04
Wet limestone Grinding mills			*4.01.01 / *4.01.03 / *4.01.05 (i)/ 4.01.05 (ii)
~~Slurry Pumps~~			~~*4.01.01 / *4.01.03~~
Agitators			*4.01.01 / *4.01.03 / *4.01.06
~~Vacuum Belt filters~~			~~*4.01.01 / *4.01.03~~

Note : *Strike-off whichever is not applicable.

Signature of authorized signatory.....

ATTACHMENT - 3K
PAGE 2 OF 102

1. If qualification sought as per clause 4.01.01, sub-section-I-A, Part-A of Section-VI then the details of the sub vendor (manufacturer) shall be filled by the bidder in the format A to G.
- ~~2. If the qualification sought as per the clause 4.01.02, sub-section-I-A, Part-A of Section-VI, then the details of proposed sub vendor (i.e manufacturer of such equipment for at least *195/*250/*500/*660 MW unit rating) shall be filled individually by the bidder in the format A and the details of collaborator who meets the requirement stipulated at 4.01.01, sub-section-I-A, Part-A of Section-VI shall also be filled by the bidder in the format A separately. Further, in case of qualification vide clause 4.01.02, sub-section-I-A, Part-A of Section-VI a copy of valid ongoing collaboration and technology transfer agreement for design, engineering, manufacturing, supply of such equipment in India with the collaborator who meets the requirement stipulated at 4.01.01, sub-section-I-A, Part-A of Section-VI shall also be furnished.~~
3. If the qualification sought as per the clause 4.01.03, sub-section-I-A, Part-A of Section-VI then the details of JV/Subsidiary Company formed for manufacturing of such equipment in India shall be furnished individually for each equipment by the bidder such as,
 - i) Copy of document of incorporation of JV/Subsidiary company in India
 - ii) Copy of valid ongoing collaboration and technology transfer agreement for design, engineering, manufacturing, supply of such equipment in India with the collaborator who meets the requirement stipulated at 4.01.01, sub-section-I-A, Part-A of Section-VI.
 - iii) Copy of document of at least 26% equity participation of qualified equipment manufacturer in the Indian JV company/subsidiary company directly or indirectly through its holding company /Subsidiary company, which shall be maintained for a lock -in period of seven (7) years from the date of incorporation of such JV/subsidiary or up to the end of defect liability period of the contract which ever is later.

Further, the details of collaborator or technology provider of the qualified equipment manufacturer who meets the requirement stipulated at 4.01.01, sub-section-I-A, Part-A of Section-VI shall be filled by the Bidder in the format A to G (format given at 1.00.00). In addition to that, the sub vendor along with the Indian JV company/subsidiary company, qualified equipment manufacturer and its holding company/subsidiary company as applicable shall furnish the Letter of Support as per the format enclosed at Annexure-I.

*** strike out whichever is not applicable.**

- 1.00.00 (Applicable for Bidder/his sub vendors seeking qualification as per clause no. 4.01.01, Sub section-I, Part-A of Section-VI. Bidder shall furnish the required data only for those equipments / auxiliaries which are proposed to be sourced under this route.)

Signature of authorized signatory.....

ATTACHMENT - 3K
PAGE 3 OF 102

We, hereby furnish the data on proveness criteria for critical equipment, auxiliaries, systems and Bought Out Items such as Booster Fans, *Slurry Recirculation Pumps, Oxidation Blowers, Wet Limestone Grinding Mills, Slurry Pumps, & Agitators which have been designed (either by self manufacturer or under valid ongoing collaboration and technology transfer agreement), *manufactured/ *got manufactured and supplied by us /Manufacturer (or manufactured/ got manufactured & supplied by our proposed sub-vendors) and these are in successful operation in at least one (1) plant for a period not less than one year reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder. The details of type and minimum equipment rating of such equipment are given below :

A. For Booster Fans: We declare that, we/our Sub-Vendor, have designed (either by itself or under collaboration / licensing agreement),*manufactured/*got manufactured and supplied at least one (1) number of Booster Fan of required flow & head of the offered Booster Fan with Fan Speed 900 rpm (maximum), Axial type with variable pitch control working in a Coal fired power plant and which has been in successful operation for minimum one(1) year reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder, as per the details furnished below:

Sl. No.	Description	Reference Work
1.	Name of the reference plant & location:	
2.	Client name and his address:	
3.	No. of units and capacity in MW of unit:	
4.	Whether equipment operating in a coal fired power plant	-*Yes/*No
5.	Name of equipment manufacturer & address:	

Signature of authorized signatory.....

- F. Agitators:** We declare that, we/our Sub-Vendor, have designed (either by itself or under collaboration / licensing agreement),*manufactured/*got manufactured and supplied at least one (1) number of Agitators with rating not less than that supplied for 500 MW or higher size unit for similar application, Vertical/Horizontal type working in Wet Limestone based FGD application in Coal fired power plant and which has been in successful operation for minimum one(1) year reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder, as per the details furnished below::

Sl. No.	Description	Reference Work
1.	Name of the reference plant & location:	
2.	Client name and his address:	
3.	No. of units and capacity in MW of unit:	
4.	Whether power plant is coal fired	-*Yes/*No
5.	Whether operating in a Wet Limestone based FGD application in coal fired power plant	-*Yes/*No
6.	Name of equipment manufacturer & address:	
7.	Date of commission of the equipments:	
8.	Model no. of the equipment:	
9.	Brief Technical particulars of the equipments:	
10.	Agitators supplied for	MW unit size

Signature of authorized signatory.....

Sl. No.	Description	Reference Work
11.	Whether the equipment(s) are in successful operation in atleast one(01) plant for a period not less than one(01) year reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder	-*Yes/*No
12.	Flue gas Desulphurization system details:	*Technical extract/ *paper letter/ *email/ *Drwaing from user or *contract document or *scheme or *any document in public domain enclosed at annexure....to Attachment-3K
13.	Scope of Work:	*Letter of Award or *Contract or *P.O. enclosed at Annexure.....to Attachment-3K
14.	Performance details:	*Certificate/*Letter/*E-mail from End user enclosed at Annexure.....to Attachment-3K

* Strike off whichever is not applicable.

Signature of authorized signatory.....

***7.00.00** **Applicable for Bidder/his sub vendors seeking provenness criteria as per clause no. 4.01.06, Sub section-I, Part-A of Section-VI.**

7.01.00 We, hereby confirm that *we/*our sub-vendors is a manufacturer of a manufacturer of Agitators for similar process/duty application in petrochemical or metals and mining industry. (Details of references enclosed at Annexure)

(Data to be furnished in line with format given at 1.00.00 of this Attachment))

7.02.00 We further confirm that details in respect of collaboration / valid licencing agreement for the Agitator between *us/*our sub-vendors, as per 6.01.00 above, and with qualified Agitator manufacturer, who meets the requirement stipulated at clause **4.01.01**, sub-section-I, Part-A, Section-VI are enclosed at **Annexure-.....** to this Attachment. The data in respect of proveneness criteria for the qualified Agitator manufacturer, which is in successful operation in at least one (1) plant for a period not less than one reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder are furnished below.

We further confirm that before taking up the manufacturing of such Agitator, *we/ *our sub vendor(s) *will create /*have created manufacturing facilities at his works as per collaborator's/licenser's design, manufacturing and quality control system.

(Data to be furnished in line with format given at 1.00.00 of this Attachment)

Signature of authorized signatory.....