

BHILAI FGD (2X250MW)

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

TECHNICAL SPECIFICATION FOR MISCELLANEOUS FGD TANKS

SPECIFICATION NO.: PE-TS-468-167-A101



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



2 X 250 MW BHILAI FGD

SPECIFICATION No:PE-TS-468-167-A101

**MISC. FGD TANKS
TECHNICAL SPECIFICATION**

SECTION-I, SECTION-II & SECTION-III

REV. 00

Date: March, 2020

CONTENTS

SECTION - I

SUB- SECTIONS	TITLE		Page No.
Sub-Section-A	INTENT OF SPECIFICATION		04
Sub-Section-B	PROJECT INFORMATION WITH WIND AND SEISMIC DESIGN CRITERIA		08
Sub-Section-C	TECHNICAL SPECIFICATIONS		
	Sub Section-C1	SPECIFIC TECHNICAL REQUIREMENT– MECHANICAL	38
		C1-A SPECIFIC TECHNICAL REQUIREMENT-TANKS	39
		C1-B SPECIFIC TECHNICAL REQUIREMENT-RUBBER LINING	48
		C1-C SPECIFIC TECHNICAL REQUIREMENT-FLAKE GLASS LINING	52
	Sub Section-C2	CUSTOMER SPECIFICATION	61
		C2 - A TECHNICAL REQUIREMENT	62
		C2 - B PROJECT SPECIFIC GENERAL REQUIREMENTS INCLUDING:	77
		GENERAL TECHNICAL REQUIREMENT, PACKING PROCEDURE, DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE	78
		QUALITY ASSURANCE	207
		C2 - C PAINTING SPECIFICATION	214
Sub Section-D	ANNEXURE-I	LIST OF MAKES OF SUB-VENDOR ITEMS	245
	ANNEXURE-II	QUALITY PLANS	250
	ANNEXURE-III	INPUT DRAWINGS	256
	ANNEXURE-IV	MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION	271

SECTION - II

SUB SECTIONS	TITLE		Page No.
Sub-Section-A	STANDARD TECHNICAL SPECIFICATIONS-MECHANICAL	STANDARD TANK SPECIFICATION	275
		GUIDANCE FOR DESIGNING AND FABRICATION OF STEEL CONSTRUCTIONS FOR RUBBER LINING	284
Sub-Section-B	FORMAT FOR OPERATION AND MANITENANCE		294
Sub-Section-C	SITE STORAGE AND PRESERVATION GUIDELINES		298



2 X 250 MW BHILAI FGD

SPECIFICATION No:PE-TS-468-167-A101

SECTION-I, SECTION-II & SECTION-III

**MISC. FGD TANKS
TECHNICAL SPECIFICATION**

REV. 00

Date: March, 2020

SECTION - III

SUB SECTIONS	TITLE	Page No.
Annexure-1	LIST OF DOCUMENTS TO BE SUBMITTED WITH BID	315
Annexure-2	COMPLIANCE CUM CONFIRMATION CERTIFICATE	317
Annexure-3	PRE BID CLARIFICATION SCHEDULE	320
Annexure-4	DEVIATION SHEET (COST OF WITHDRAWAL)	322
Annexure-5	LIST OF MAKES OF SUB VENDOR ITEMS	324
Annexure-6	LIST OF TOOLS & TACKLES	326
Annexure-7	LIST OF COMMISSIONING SPARES	328
Annexure-8	TANK SCHEDULE & GA DRAWING (TYPICAL) WITH AGITATOR PLATFORM	330
Annexure-9	TANK NOZZLE SCHEDULE	336-338.



TITLE:

2 X 250 MW BHILAI FGD

**TECHNICAL SPECIFICATIONS FOR
MISC. FGD TANKS**

SPECIFICATION No: PE-TS-468-167-A101

SECTION-I, SUB-SECTION-A

REV. 00

Date: April, 2020

SECTION-I, SUB-SECTION-A

INTENT OF SPECIFICATION

	2 X 250 MW BHILAI FGD	SPECIFICATION NO. PE-TS-468-167-A101	
	TECHNICAL SPECIFICATION FOR MISCELLANEOUS FGD TANKS	SECTION I , SUB-SECTION-A	
		REVISION 00	DATE: April, 2020

1.0

SCOPE OF ENQUIRY/ INTENT OF SPECIFICATION

1.1

This specification includes, but not limited to Supply part, Services part comprising of design (i.e. Preparation and submission of drawing /documents including “As Built” drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles(as applicable) along with spares for erection, start up and commissioning as required, forwarding, proper packing, shipment and delivery at site, unloading, handling, transportation & storage at site, in-site transportation, assembly, erection & commissioning, Rubber lining, Vinyl Ester Glass Flake lining, Epoxy lining, final painting at site, minor civil work and carrying out Performance guarantee / Functional / Demonstration tests at site (as applicable) and handover in flawless condition of Miscellaneous FGD Tanks turnkey package specified above for 2 X 250 MW BHILAI FGD complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.

1.2

The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve them of the responsibility of providing such facilities to complete the supply, erection and commissioning, performance and guarantee/demonstration testing of **Miscellaneous FGD Tanks** within quoted price.

1.3

It is not the intent to specify herein all the details of design and manufacture. However, the equipment / system shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.

1.4

The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing. Similarly, the extent of supply also includes all items required for completion of the system for its safe, efficient, reliable and trouble free operation and maintenance shall also be in supplier's scope unless specifically excluded and notwithstanding that they may have been omitted in drawings / specifications or schedules.

1.5

Items though not specifically mentioned but needed to make the system complete as stipulated under these specifications are also to be furnished unless otherwise specifically excluded.

1.6

The general terms and conditions, instructions to tenderer and other attachment referred to elsewhere are hereby made part of the tender specifications. The equipment / material and works covered by this specification is subject to compliance to all the attachments referred in the specification. The tenderer shall be responsible for adherence to all requirements stipulated herein.

1.7

While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the

Page 5 of 338

	2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATION FOR MISCELLANEOUS FGD TANKS	SPECIFICATION NO. PE-TS-468-167-A101	
		SECTION I, SUB-SECTION-A	
		REVISION 00	DATE: April, 2020

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

Note:

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

- Internet explorer version – Minimum Internet Explorer 7.
- Internet speed – 2 mbps (Minimum preferred).
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked.

	2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATION FOR MISCELLANEOUS FGD TANKS	SPECIFICATION NO. PE-TS-468-167-A101	
		SECTION I , SUB-SECTION-A	
		REVISION 00	DATE: April, 2020

- Vendor’s internal proxy setting should not block DMS application’s link (<http://dmsserver.bhelpem.com/Wrench%20Web%20Access/Login.aspx>).

Page 7 of 338



TITLE:

2 X 250 MW BHILAI FGD

**TECHNICAL SPECIFICATION FOR
MISC. FGD TANKS**

SPECIFICATION No: PE-TS-468-167-A101

SECTION-I, SUB-SECTION-B

REV. 00

Date: April, 2020

SECTION-I, SUB-SECTION-B

PROJECT INFORMATION WITH WIND AND SEISMIC DESIGN CRITERIA

CLAUSE NO.	PROJECT INFORMATION			एनटीपीसी NTPC
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

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
(In units of 'g')

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

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
(In units of 'g')

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
1.450	1.315	1.192	1.021
1.500	1.271	1.152	0.987
1.550	1.230	1.115	0.955
1.600	1.192	1.080	0.925
1.650	1.156	1.047	0.897
1.700	1.122	1.016	0.871
1.750	1.090	0.987	0.846
1.800	1.059	0.960	0.822
1.850	1.031	0.934	0.800
1.900	1.004	0.909	0.779
1.950	0.978	0.886	0.759
2.000	0.954	0.864	0.740
2.050	0.930	0.843	0.722
2.100	0.908	0.823	0.705
2.150	0.887	0.804	0.688
2.200	0.867	0.785	0.673
2.250	0.848	0.768	0.658
2.300	0.829	0.751	0.643
2.350	0.811	0.735	0.630
2.400	0.795	0.720	0.617
2.450	0.778	0.705	0.604
2.500	0.763	0.691	0.592
2.550	0.748	0.678	0.580
2.600	0.733	0.665	0.569
2.650	0.720	0.652	0.558
2.700	0.706	0.640	0.548
2.750	0.693	0.628	0.538
2.800	0.681	0.617	0.529
2.850	0.669	0.606	0.519
2.900	0.658	0.596	0.510
2.950	0.646	0.586	0.502
3.000	0.636	0.576	0.493
3.050	0.625	0.567	0.485
3.100	0.615	0.557	0.477

Annexure-A

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
(In units of 'g')

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
3.150	0.605	0.549	0.470
3.200	0.596	0.540	0.463
3.250	0.587	0.532	0.455
3.300	0.578	0.524	0.448
3.350	0.569	0.516	0.442
3.400	0.561	0.508	0.435
3.450	0.553	0.501	0.429
3.500	0.545	0.494	0.423
3.550	0.537	0.487	0.417
3.600	0.530	0.480	0.411
3.650	0.522	0.473	0.405
3.700	0.515	0.467	0.400
3.750	0.509	0.461	0.395
3.800	0.502	0.455	0.389
3.825	0.496	0.452	0.387
3.850	0.490	0.449	0.384
3.900	0.477	0.443	0.379
3.950	0.465	0.437	0.375
4.000	0.454	0.432	0.370

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 7.00.01 7.00.02 7.00.03 7.00.04 FOUNDATION SYSTEM AND GEOTECHNICAL DATA Geotechnical data and foundation system for the respective project are enclosed at Annexure-III. The corresponding bore logs are enclosed at Annexure-IV. 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. 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. 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. <tr><td colspan="2">LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION – VI, PART-A BID DOC. NO.:CS-0011-109(2)-9</td><td>SUB-SECTION-II-A5 PROJECT INFORMATION (BHILAI 2X250 MW)</td><td>PAGE 9 OF 30</td></tr>				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
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/drain 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.		
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 10 OF 30

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. - The minimum width of foundation shall be 1.0 m. - Minimum depth of foundation shall be 1.0m below Ground Level. - It shall be ensured that all foundations of a particular structure/ buildings/ facility shall rest on one bearing stratum. - 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 : - 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. - 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: - Only straight shaft piles shall be used. Minimum cast length of pile above cutoff level shall be 1.0 m. - 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. - 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. - 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			
	contractor. Contractor shall carry out chemical analysis during detailed geotechnical investigation and required treatment shall be provided accordingly.			
7.04.00	Excavation, Filling and Dewatering			
7.04.01	For excavation works, comprehensive dewatering with well point or deep wells arrangement, if required, shall be adopted. Scheme for dewatering and design with all computations and back up data for dewatering shall be submitted for the owner's information. The water table shall be maintained at 0.5m below the founding depth.			
7.04.02	Excavation for shallow foundations shall be covered with PCC immediately after reaching the founding level. In case of any local loosening of soil or any loose pockets are encountered at founding level during excavation the same shall be removed and compensated by PCC M7.5. The final layer of about 300 mm thickness above the founding level shall be excavated by suitable means, so as to avoid disturbance to founding stratum.			
7.04.03	Backfilling around foundations, pipes, trenches, sumps, pits, plinths, etc. shall be carried out with approved material in layers not exceeding 300 mm compacted thickness (higher thickness of layers upto 500mm with heavy mechanical compacting equipment) and each layer shall be compacted to 90% of standard proctor density for cohesive soils and to 80% of relative density for non-cohesive soils			
	Rock pieces having size less than 150 mm and interstices filled with soil may be used for backfilling around foundation, plinths etc. and shall be compacted to minimum of 85% of original stack of material after filling the interstices.			
7.04.04	Founding level for trenches/channels shall be decided as per functional requirement. The bottom of excavation shall be properly compacted prior to casting of bottom slab of trenches / channels.			
7.04.05	CBR tests for pavement/road design shall be carried out by the Contractor after earth filling (if applicable) has been completed upto the formation level.			
7.04.06	The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding of material or article from any bank or side of such excavation which is more than one and a half meter above the footing by providing adequate piling, shoring, bracing etc. against such bank or sides. Adequate and suitable warning signs shall be put up at conspicuous places at the excavation work to prevent any persons or vehicles falling into the excavation trench. No worker should be allowed to work where he may be stuck or endangered by excavation machinery or collapse of excavations or trenches.			
7.05.00	EXCAVATION IN ROCK			
	Excavation in rock shall be carried out by mechanical means and if blasting is required for founding of some of the structures under this package, control blasting only shall be carried out.			
7.05.01	Controlled blasting shall be done by a specialised agency duly approved by Engineer. All controlled blasting shall be done by using time delay detonators (i.e. excel type).			
7.05.02	a) Contractor shall engage an agency expert in blasting such as, NIRM (National Institute of Rock Mechanics), CMPDIL, Central Institute of Mining and Fuel Research Dhanbad, Dept. of Mining of Govt. Institutions etc. to design detailed blasting scheme and get the same approved from Engineer before carrying out the blasting 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											
1	FGD	Minimum 14 Nos.	Depth of boreholes shall be 25m to 35m.	Depth of boreholes											
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	

CLAUSE NO.	PROJECT INFORMATION			एनटीपीसी NTPC
	ANNEXURE-I			
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 18 OF 30	

CLAUSE NO.

PROJECT INFORMATION



ANNEXURE-II

STATION : Raipur										देशांतर LAT 21°14' N LONG 81°38' E		समुद्री सतह से ऊँचाई HEIGHT ABOVE M.S.L.		299 METRES		वर्षा 1951 से 1980 तक के अवधि के अवलोकन पर आधारित BASED ON OBSERVATIONS FROM			
वायु तापमान										शून्य		सर्वा		वर्षा		वर्षा			
MEAN										EXTREMES		HUMIDITY		CLOUD AMOUNT		RAINFALL			
MONTH	STATION LEVEL PRESSURE	DRY BULB	WET BULB	DAILY MAX	DAILY MIN	HIGHEST IN THE MONTH	LOWEST IN THE MONTH	DATE AND YEAR	DATE AND YEAR	RELATIVE HUMIDITY	ALL CLOUDS	LOW CLOUDS	NO. OF RAINY DAYS	MONTHLY TOTAL	TOTAL IN DRIEST MONTH WITH RAIN	TOTAL IN WETTEST MONTH WITH RAIN	HEAVIEST FALL IN 24 HOURS	DATE AND YEAR	
																			°C
JAN	982.7	12.6	13.5	27.5	13.5	30.9	9.2	35.0	22 1955	5.0	1.8	0.4	6.7	0.8	134.4	0.0	55.4	22 1955	
FEB	980.7	21.0	15.1	31.1	16.5	35.2	11.7	37.8	25 1893	5.0	0.9	0.5	12.3	1.0	118.9	0.0	57.4	04 1917	
MAR	978.7	25.9	17.5	35.5	20.8	39.6	16.1	43.3	28 1892	8.3	0.4	0.5	24.6	1.7	106.2	0.0	55.9	17 1908	
APR	975.5	30.9	21.0	39.6	25.3	43.2	20.1	46.1	30 1942	15.0	02	0.5	15.7	1.8	131.1	0.0	38.3	18 1909	
MAY	971.1	33.9	23.2	42.0	28.3	45.2	23.8	47.7	10 1973	14.4	27	0.5	18.8	1.8	147.1	0.0	80.3	27 1904	
JUN	968.1	30.2	24.4	37.4	28.5	43.8	21.9	47.2	11 1931	16.1	21	5.5	189.8	9.3	636.1	18.5	197.8	11 1918	
JUL	965.2	28.4	24.5	30.8	24.0	35.4	21.7	38.9	01 1931	20.0	01	7.0	301.0	16.0	988.8	143.5	228.7	02 1970	
AUG	962.0	26.1	24.4	30.2	23.9	33.4	21.9	37.5	03 1972	20.0	20	7.0	344.7	15.7	1884	191.1	187.0	02 1970	
SEP	972.5	26.9	24.5	31.3	23.9	34.0	21.7	37.2	19 1899	18.3	28	5.5	23.0	9.7	778.9	8.4	196.2	18 1900	
OCT	977.8	25.8	22.1	31.8	21.5	34.1	17.8	37.8	11 1899	13.9	30	3.2	53.9	3.8	246.4	0.0	148.8	08 1908	
NOV	981.7	21.6	17.2	29.6	16.5	32.0	13.0	35.6	02 1935	8.3	22	0.4	7.4	0.8	130.2	0.0	70.4	02 1930	
DEC	983.2	18.1	14.0	27.3	13.2	30.2	9.7	32.3	27 1876	3.9	29	0.2	3.7	0.4	68.6	0.0	52.1	28 1909	
वर्षा योग	975.8	25.4	20.1	32.8	21.1	45.5	8.8	47.7	3.9	62	20.0	3.5	1.4	126.8	62.3	2181.4	658.9	370.3	8.9
TOTAL OR MEAN	972.0	30.4	21.5							47	19.0	4.0	2.1			1884	1899		30
वर्षा के दिनों की संख्या	30	30	30	30	30	30	30	100	100	30	30	22	30	30	100	100	100		30

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 19 OF 30

CLAUSE NO.	PROJECT INFORMATION	एनटीपीसी NTPC																		
	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><tr><th>STRUCTURE</th><th>TYPE OF FOUNDATION TO BE ADOPTED</th></tr><tr><td>FGD and related structures</td><td>Open</td></tr></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><tr><th rowspan="3">Founding Depth/ Stratum</th><th colspan="3">Net Allowable Bearing PressureT/m2</th></tr><tr><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 rowspan="2">Rafts (width > 6m) for 75mm permissible settlement in case of soil and 12mm in case of rocky strata</td></tr><tr><td colspan="2">Width upto 6.0m</td></tr><tr><td colspan="4">In case of Soil</td></tr></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																			
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																				
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 PP2										GEOLOGICAL LOG OF DRILL HOLE										FEATURE				
HOLE NO. BH 31										LOCATION : MAIN PLANT AREA PP 2										TOTAL DEPTH : 30 MTR.				
BEARING OF HOLE -										CD COORDINATES : X 2200 Y 9100										GROUND WATER TABLE : 1.50 MTR. (SEEPAGE WATER)				
COLLAR ELEVATION -										ANGLE WITH HORIZONTAL : VERTICAL										TYPE OF CORE BARREL USED : DOUBLE TUBE				
TYPE OF USED (WITH DEPTH) : DIAMOND										GROUND RL : 296.815m										DATE OF COMPLETION : 17.08.2003				
STARTED : 08.08.2003																								
DEPTH IN METRE	FROM	TO	DATE	DESCRIPTION	LITHOLOGY	LOG	PIECES WITH SIZES	STRUCTURAL	SAMPLING-TEST	RECOVERY	ROD (%)	WATER LOSS	NO PARTIAL	WATER LOSS	NO PARTIAL	WATER LOSS	NO PARTIAL	WATER LOSS	NO PARTIAL	WATER LOSS	NO PARTIAL	WATER LOSS	NO PARTIAL	SPECIAL OBSERVATION AND
0.00	0.50	8.8.03		Reddish brown clay with organic materials and kankers					DS															
0.50	1.50	8.8.03		Reddish brown clay with kankers and gravels					USGS															
1.50	2.25	8.8.03		Reddish brown clay with kankers and gravels					SPT 4.5, 10 N x 16															
2.25	3.00	8.8.03		Reddish brown clay with kankers and gravels					DS															
3.00	3.75	8.8.03		Reddish brown clay with kankers and gravels					USGS															
3.75	4.50	8.8.03		Yellowish brown clay with kankers and gravels					DS															
4.50	5.25	8.8.03		Vergated clayey siltstone					SPT 40.40, 45 N x 85															
5.25	6.00	8.8.03		Vergated clayey siltstone					DS															
6.00	6.75	8.8.03		Vergated clayey siltstone					USGS															
6.75	7.50	8.8.03		Vergated clayey siltstone					DS															
7.50	8.25	8.8.03		Vergated clayey siltstone					SPT 45, N x 100 10cm penet															
8.25	9.00	8.8.03		Vergated clayey siltstone					DS															
9.00	9.75	8.8.03		Vergated clayey siltstone					USGS															
9.75	10.50	8.8.03		Vergated clayey siltstone					DS															
10.50	11.25	8.8.03		Vergated clayey siltstone					SPT 50, N x 100 8 cm penet															
11.25	12.00	11.8.03		Reddish brown clay (stereic) clay with kankers					DS															
12.00	12.75	11.8.03		Reddish brown clay (stereic) clay with kankers					USGS															
12.75	13.50	11.8.03		Reddish brown clay (stereic) clay with kankers					DS															
13.50	14.25	12.8.03		Weathered silty shale of redish yellow colour					SPT N > 100															
14.25	15.00	13.8.03		Dark brown coloured lime stone with stromatolite fossil					DS															
15.00	15.75	13.8.03		Dark brown coloured lime stone with stromatolite fossil			1		CS CR - 31% ROD 20%															
15.75	16.50	14.8.03		Dark brown coloured lime stone with stromatolite fossil			1	2	CS CR - 26% ROD 17%															
16.50	17.25	14.8.03		Dark brown coloured lime stone with stromatolite fossil			1		CS CR - 25% ROD 13%															
17.25	18.00	14.8.03		Dark brown coloured lime stone with stromatolite fossil			1	1	CS CR - 26% ROD 17%															
18.00	18.75	15.8.03		Dark brown coloured lime stone with stromatolite fossil			1	1	CS CR - 30% ROD NIL															
18.75	19.50	15.8.03		Dark brown coloured lime stone with stromatolite fossil			2	2	CS CR - 32% ROD NIL															
19.50	20.25	15.8.03		Dark brown coloured lime stone with silty shale having carbonate veins			1	1	CS CR - 40% ROD NIL															
20.25	21.00	15.8.03		Yellowish silty shale with carbonate veins			3	1	CS CR - 35% ROD NIL															
21.00	21.75	16.8.03		Yellowish silty shale with carbonate veins			3	1	CS CR - 36% ROD NIL															
21.75	22.50	16.8.03		Yellowish silty shale with carbonate veins			1		CS CR - 38% ROD NIL															
22.50	23.25	16.8.03		Yellowish silty shale with carbonate veins			1		CS CR - 40% ROD NIL															
23.25	24.00	16.8.03		Yellowish silty shale with carbonate veins			2	3	CS CR - 34% ROD NIL															
24.00	24.75	16.8.03		Yellowish silty shale with carbonate veins			1	2	CS CR - 36% ROD NIL															
24.75	25.50	16.8.03		Yellowish silty shale with carbonate veins			1	2	CS CR - 38% ROD NIL															
25.50	26.25	16.8.03		Yellowish silty shale with carbonate veins			1	1	CS CR - 40% ROD NIL															
26.25	27.00	16.8.03		Dark brown colour lime stone with stromatolite fossil			2	4	CS CR - 37% ROD 16%															
27.00	27.75	16.8.03		Dark brown colour lime stone with stromatolite fossil			2	2	CS CR - 38% ROD 18%															
27.75	28.50	17.8.03		Dark brown colour lime stone with stromatolite fossil			3	3	CS CR - 42% ROD 22%															
28.50	29.25	17.8.03		Dark brown colour lime stone with stromatolite fossil			2	3	CS CR - 44% ROD 34%															
29.25	30.00	17.8.03		Dark brown colour lime stone with stromatolite fossil			1	2	CS CR - 52% ROD 16%															

THE ROCK IS
SEMENTARY
SOFT
WEATHERED
ALSO CORE
SAMPLE BREAK
FROM THE
CARBONATE VEIN
PART OF A
SAMPLE. THERE
IS ALTERNATE
LAYER OF LIMESTONE
AND SHALE. WATER
LOGGING IS
ENCOUNTERED
AT 20 MTR. TILL
END.

THE ROCK IS
GROSSLY
SPLIT,
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																					
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 COORDINATES 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 09.09.00	
STARTED 03.09.2002																					
MT		LITHOLOGY			PIECES WITH SIZES			STRUCTURAL		SAMPLING		RECOVERY		ROCK (%)		WATER LOSS		SPECIAL OBSERVATION AND			
FROM	TO	DATE	DESCRIPTION	LOG	10	20	30	40	50	ST-RUN	20	40	60	80	100	NO PARTIAL	NO PARTIAL	RECOR COLOUR	RECOR COLOUR		
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							UCS/CS											
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							UCS											
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 RQD NIL							190				
9.00	10.50	5.9.03	Yellowish green slaty shale with fossil impression and carbonate veins							CS CR - 37 RQD NIL							190				
10.50	12.00	6.9.03	Yellowish green slaty shale with fossil impression and carbonate veins							CS CR - 36 RQD NIL							190				
12.00	13.50	6.9.03	Yellowish green slaty shale with fossil impression and carbonate veins							CS CR - 42 RQD NIL							180				
13.50	15.00	6.9.03	Yellowish green slaty shale with fossil impression and carbonate veins			3	1	-	-	CS CR - 60 RQD NIL							200				
15.00	16.50	6.9.03	Dark brown colour lime stone with stromatolite fossil impression along with grayish slaty shale having carbonate veins			5	8	2	-	CS CR - 60 RQD 26%							28	200			
16.50	18.00	6.9.03	Grayish slaty shale with carbonate veins			6	6	3	-	CS CR - 90 RQD 15%							15	190			
18.00	19.50	7.9.03	Grayish slaty shale with carbonate veins			5	4	3	-	CS CR - 91 RQD 28%							28	190			
19.50	21.00	7.9.03	Grayish slaty shale with carbonate veins			4	3	1	-	CS CR - 76 RQD 14%							14	180			
21.00	22.50	7.9.03	Grayish slaty shale with carbonate veins			3	1	6	1	CS CR - 92 RQD 34%							34	200			
22.50	24.00	8.9.03	Grayish slaty shale with carbonate veins			3	-	5	2	CS CR - 93 RQD 45%							45	210			
24.00	25.50	8.9.03	Grayish slaty shale with carbonate veins			2	2	7	2	CS CR - 90 RQD 56%							56	220			
25.50	27.00	8.9.03	Grayish slaty shale with carbonate veins			3	2	-	2	CS CR - 98 RQD 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	-	1	CS CR - 88 RQD 38%							38	220			
28.50	30.00	9.9.03	Grayish slaty shale with carbonate veins			6	4	1	-	CS CR - 90 RQD 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 23 OF 30

CLAUSE NO.

PROJECT INFORMATION



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 30										LOCATION : MAIN PLANT AREA PP 2										TOTAL DEPTH : 30 MTR.				
BEARING OF HOLE : -										CD COORDINATES : X 1700 Y 9400										GROUND WATER TABLE : 1 MTR.BELOW 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 : 09.09.03				
STARTED : 03.09.2003																								
FROM MT	TO MT	DATE	DESCRIPTION	LOG	PIECES WITH SIZES					STRUCTURAL	SAMPLING STR. RUN	RECOVERY					ROD (%)	WATER LOSS					R OF WASH DRILL	SPECIAL OBSERVATION AND REMARKS
					<10 mm	10 to 20 mm	20 to 75 mm	75 to 150 mm	>150 mm			LOG DESCRIPTION	20	40	60	80		100	NO PARTIAL	25	50	75		
0.00	0.00	3.9.03	Reddish brown clay with organic materials with lankers and gravels (Red colour)								DS													
0.00	0.50	3.9.03	Reddish brown clay with lankers and gravels								UC5/G5													
0.50	1.50	3.9.03	Reddish brown clay with lankers and gravels								SPT 7,12,19 Nil													
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								UC5													
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 Nil													
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								US LK - 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 - 40 ROD NIL							-	200					
15.00	16.50	6.9.03	Dark brown colour lime stone with stromatolitic fossil impression alongwith 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	1			CS CR - 92 ROD 34%								34	200				
22.50	24.00	8.9.03	Grayish slaty shale with carbonate veins		3	-	5	2			CS CR - 93 ROD 45%								45	210				
24.00	25.50	8.9.03	Grayish slaty shale with carbonate veins		2	2	7	2			CS CR - 90 ROD 56%								56	220				
25.50	27.00	8.9.03	Grayish slaty shale with carbonate veins		2	2	-	2			CS CR - 96 ROD 62%								62	230				
27.00	28.50	9.9.03	Grayish slaty 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 slaty shale with carbonate veins		6	4	1	-			CS CR - 90 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

Table-1
COAL AND ASH CHARACTERISTICS

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

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
	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																																				

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
---	--	---	---------------

CLAUSE NO.	PROJECT INFORMATION 																																																																									
	TABLE - 2 FUEL OIL CHARACTERISTICS <table border="1"> <thead> <tr> <th>Sl. No.</th><th>Characteristics</th><th>Heavy Furnace oil IS 1953-1971 Grade HV</th><th>Low Sulphur Heavy Stock (LSHS)</th><th>Heavy Petroleum Stock (HPS)</th></tr> </thead> <tbody> <tr><td>1.</td><td>Total Sulphur Content</td><td>4.5% Max</td><td>1.0% Max</td><td>4.5% Max</td></tr> <tr><td>2.</td><td>Gross Calorific Value (Kcal/kg)</td><td>Of the order of 11,000</td><td>Of the order of 11,000</td><td>9,500 (min)</td></tr> <tr><td>3.</td><td>Flash point (Min)</td><td>66deg C</td><td>75 deg C</td><td>75deg C</td></tr> <tr><td>4.</td><td>Water content by volume (Max)</td><td>1.0%</td><td>1.0%</td><td>1.0%</td></tr> <tr><td>5.</td><td>Sediment by weight (Max)</td><td>0.25%</td><td>0.25%</td><td>0.25%</td></tr> <tr><td>6.</td><td>Asphaltene content by weight (Max)</td><td>2.5%</td><td>2.5%</td><td>2.5%</td></tr> <tr><td>7.</td><td>Kinematic viscosity in centistokes at 50 deg C (Max)</td><td>370</td><td>180</td><td>500</td></tr> <tr><td>8.</td><td>Ash content by weight (Max)</td><td>0.1%</td><td>0.05%</td><td>0.1%</td></tr> <tr><td>9.</td><td>Addity (Inorganic)</td><td>Nil</td><td>Nil</td><td>Nil</td></tr> <tr><td>10.</td><td>Pour Point (Max)</td><td>-</td><td>57Deg C</td><td>72 Deg C</td></tr> <tr><td>11.</td><td>Sodium Content</td><td>-</td><td>-</td><td>100 ppm</td></tr> <tr><td>12.</td><td>Vanadium content</td><td>25 ppm</td><td>25 ppm</td><td>25 ppm</td></tr> <tr><td>13.</td><td>Specific heat below pour point (Kcal/KG0C)</td><td>-</td><td>0.65</td><td>-</td></tr> </tbody> </table> Table-3 NOT USED				Sl. No.	Characteristics	Heavy Furnace oil IS 1953-1971 Grade HV	Low Sulphur Heavy Stock (LSHS)	Heavy Petroleum Stock (HPS)	1.	Total Sulphur Content	4.5% Max	1.0% Max	4.5% Max	2.	Gross Calorific Value (Kcal/kg)	Of the order of 11,000	Of the order of 11,000	9,500 (min)	3.	Flash point (Min)	66deg C	75 deg C	75deg C	4.	Water content by volume (Max)	1.0%	1.0%	1.0%	5.	Sediment by weight (Max)	0.25%	0.25%	0.25%	6.	Asphaltene content by weight (Max)	2.5%	2.5%	2.5%	7.	Kinematic viscosity in centistokes at 50 deg C (Max)	370	180	500	8.	Ash content by weight (Max)	0.1%	0.05%	0.1%	9.	Addity (Inorganic)	Nil	Nil	Nil	10.	Pour Point (Max)	-	57Deg C	72 Deg C	11.	Sodium Content	-	-	100 ppm	12.	Vanadium content	25 ppm	25 ppm	25 ppm	13.	Specific heat below pour point (Kcal/KG0C)	-	0.65	-
Sl. No.	Characteristics	Heavy Furnace oil IS 1953-1971 Grade HV	Low Sulphur Heavy Stock (LSHS)	Heavy Petroleum Stock (HPS)																																																																						
1.	Total Sulphur Content	4.5% Max	1.0% Max	4.5% Max																																																																						
2.	Gross Calorific Value (Kcal/kg)	Of the order of 11,000	Of the order of 11,000	9,500 (min)																																																																						
3.	Flash point (Min)	66deg C	75 deg C	75deg C																																																																						
4.	Water content by volume (Max)	1.0%	1.0%	1.0%																																																																						
5.	Sediment by weight (Max)	0.25%	0.25%	0.25%																																																																						
6.	Asphaltene content by weight (Max)	2.5%	2.5%	2.5%																																																																						
7.	Kinematic viscosity in centistokes at 50 deg C (Max)	370	180	500																																																																						
8.	Ash content by weight (Max)	0.1%	0.05%	0.1%																																																																						
9.	Addity (Inorganic)	Nil	Nil	Nil																																																																						
10.	Pour Point (Max)	-	57Deg C	72 Deg C																																																																						
11.	Sodium Content	-	-	100 ppm																																																																						
12.	Vanadium content	25 ppm	25 ppm	25 ppm																																																																						
13.	Specific heat below pour point (Kcal/KG0C)	-	0.65	-																																																																						
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 27 OF 30																																																																						

CLAUSE NO.	PROJECT INFORMATION																																																													
	Table-4 DESIGN CLARIFIED WATER ANALYSIS <table><tr><th>S.No</th><th>Constituent</th><th>As</th><th>mg/l (except pH & turbidity)</th></tr><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></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><tr><th>S.N.</th><th>Characteristics</th><th>Value</th></tr><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></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
	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																																																												
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 28 OF 30																																																										

CLAUSE NO.	PROJECT INFORMATION		एनटीपीसी NTPC		
	Table-6				
	STEAM GENERATOR DATA				
	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/cm²(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)		
	ESP DATA				
	1.	Location:	Downstream side of Air preheaters		
	2.	Operation:	Base load		
	3.	Type:	Rigid Discharge frame		
	4.	Rapping:	Intermittent		
	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 29 OF 30



TITLE:

**2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
MISCELLANEOUS FGD TANKS**

SPECIFICATION No: PE-TS-468-167-A101

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 SPECIFICATION FOR
MISCELLANEOUS FGD TANKS**

SPECIFICATION No: PE-TS-468-167-A101

SECTION-I, SUB-SECTION-C1

REV. 00

DATE: April, 2020

**SECTION-I,
SUB SECTION-C1A
SPECIFIC TECHNICAL REQUIREMENT-TANKS**



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS FGD TANKS
2 X 250 MW BHILAI FGD**

SPECIFICATION NO. PE-TS-468-167-A101

SECTION –I, SUB SECTION –C1-A

REVISION 00

Date: April, 2020

1.0 SCOPE OF SUPPLY

- 1.1 Supply of Steel plates and fabrication of tanks at site under this specification shall be as per enclosed FGD Tank schedule (Section-III, Annexure-8). Detailed GA & fabrication dwgs. of each type of tank shall be submitted by bidder during detail engineering to suit good engineering practice to the satisfaction of the customer.
- 1.2 General design, selection of rubber lining, Vinyl Ester (VE) Flake glass lining, Epoxy lining materials, construction features, manufacturing, shop inspection, testing at manufacturer's works, surface preparation, lining, inspection & testing of the lined surface at 2 X 250 MW BHILAI FGD site. For detail specification of rubber lining & Vinyl Ester Flake glass lining refer Sub Section-C1-B and Sub Section-C1-C respectively of section-1.
- 1.3
- a) The connections and accessories which are required to be supplied with each tank by the bidder shall be as indicated in the enclosed FGD Tank schedule (Section-III, Annexure-8).
- b) The piping material inside the tank shall be supplied by the bidder. All inlet piping shall be extended up to the bottom of the tank and the clearance between the bottom of the tank and the edge of the inlet piping shall be kept as 500 mm (maximum). The inlet pipes shall be lined with replaceable wear resistant natural rubber lining of minimum 06 mm thickness from inside. Additional thickness of 2 mm in rubber lining shall be provided at bends.
- c) The inside piping shall be adequately supported and shall be provided with adequately sized vent (anti-siphoner) connection at pipe top.
- d) Weir plates of adequate thickness (minimum 8 mm) shall be provided for all inlet piping.
- e) Pad plates on the tanks for supporting outside piping shall be provided by the bidder. Details of the pad plates (sizes, quantity etc.) shall be informed to bidder during detail engineering.
- f) Fabrication and supply of all flanges and counter flanges for all nozzles of tank connections shall be included in the scope of work of the bidder. Necessary bolts, nuts and gaskets for these connections shall also be supplied by the bidder. Further rubber lining / VE Flake glass lining of these nozzles including flanges, counter-flanges shall be in bidder's scope of work.
- g) The manhole shall be of hinged and bolted type with nuts, bolts and gaskets in bidder's scope of supply. The size of the manhole shall be minimum 800 mm and subjected to customer approval. Bidder shall provide two nos. manhole for each tank, i.e. one no. manhole on shell and one no. manhole at roof.
- h) Supply and erection of vent valves shall be in bidder's scope.
- 1.4 The scope of works shall also include supply and installation of special accessories including agitator supporting arrangements, agitator platform, baffle plates etc. as indicated in FGD Tank schedule (Section-III, Annexure-8). The necessary fixtures and other accessories for mounting these special accessories shall be included in the scope of work of the bidder.
- 1.5 Baffle plates for the agitators shall be mounted on the tank. The supply and erection of the baffle plates shall be in bidder's scope of work. The minimum no. of baffle plates and minimum dimension of the

	TECHNICAL SPECIFICATION FOR MISCELLANEOUS FGD TANKS 2 X 250 MW BHILAI FGD	SPECIFICATION NO. PE-TS-468-167-A101	
		SECTION –I, SUB SECTION –C1-A	
		REVISION 00	
		Date: April, 2020	

baffle plates have been indicated in the FGD Tank schedule (Section-III, Annexure-8). The final quantity and dimensions of the baffle plates shall be decided during detail engineering.

1.6 Quantity and size of spare nozzles as per FGD Tank schedule (Section-III, Annexure-8) shall be supplied by the bidder.

1.7 Pipes, fittings, nozzles, flanges and counter flanges along with the rubber lining / VE Flake glass lining shall be supplied by the bidder. The minimum requirement like quantity, size, type etc. are indicated in the FGD Tank schedule (Section-III, Annexure-8) and may undergo change during detail engineering stage and these shall be supplied by the bidder as per the approved drawings / documents for which no commercial implication shall be entertained by BHEL. Material of construction of all pipes, fittings, nozzles, flanges and counter flanges shall be as per tank schedule (Section-III, Annexure-8).

1.8 The minimum number of anchor bolts along with its size shall be finalized during detail engineering. Further, any additional anchor bolts of higher size if found applicable during detailed Engineering as per customer comment shall be provided by bidder without any commercial implication. The material of construction for anchor bolts shall be IS 1367 Part-3.

1.9 Painting of the tanks is included in bidder’s scope of work. Painting specifications of storage tanks are given under Painting schedule in Sub Section-C2-C, section-1. Painting requirement specified under Painting schedule are minimum requirement. Any modification in painting requirement found applicable during detained engineering, shall be under bidder’s scope without any commercial implication.

1.10 Commissioning spares as required for commissioning of the tanks are in bidder’s scope.

1.11 Platforms, inter-connecting platforms, platforms for agitator maintenance, monkey ladder inside tank and for agitator platform approach, staircase (hand railing, knee guard and toe guard (in stair case, agitator platform and all along the periphery of roof of the tank) etc. as per the relevant design code / good engineering practice (as indicated in the tank schedule) shall be included in bidder’s scope of work. All staircase treads and platforms shall be 32 mm steel fabricated gratings. Gratings shall be galvanized as given for handrails in painting specification.

2.0 SCOPE OF SERVICES

Services shall include but not be limited to the followings:

2.1 Design, engineering, preparation of detailed fabrication drawings, design calculation, bill of material, tag and piece numbers, welding procedures etc. Stiffeners and other structural framing for supporting the tank shall be designed by the fabricator and properly shown in the fabrication drawings.

2.2 Erection & Commissioning of Tanks. Erection of the agitators, agitator mounting arrgt., agitator supporting arrangements, shall be in bidder scope. The Agitator shall be provided by BHEL as a free issue item.

2.3 Erection & Commissioning of rubber lining / VE Flake glass lining.

2.3 Erection of all foundation bolts / anchor bolts etc. as required for any equipment/ foundation /concrete.

2.4 Minor civil work like chipping of foundation, grouting below base plate for all structures, equipment, grouting of pockets, excavation & filling of earth for buried MS pipes if and as required.

Page 41 of 338

	TECHNICAL SPECIFICATION FOR MISCELLANEOUS FGD TANKS 2 X 250 MW BHILAI FGD	SPECIFICATION NO. PE-TS-468-167-A101	
		SECTION –I, SUB SECTION –C1-A	
		REVISION 00	
		Date: April, 2020	

2.5 Inspection & testing and carrying out demonstration test.

2.6 Inspection & testing and carrying out demonstration test for the rubber lining / VE Flake glass lining of tanks.

2.7 Painting of tank and other equipment within the battery limit.

2.8 Any other equipment / material / services as required to make the installation complete in all respects shall be deemed to be included in bidder’s scope of work whether mentioned above or not.

3.0 DESIGN CONSIDERATIONS

3.1 The successful bidder shall furnish design calculations to BHEL during detailed engineering stage for approval along with the Xerox copies of relevant pages of authentic supporting literature e.g. Code, Hand book, National / international Standards etc. Calculation shall be necessarily done in **SI UNITS** only for the followings: -

a) Tanks shall be designed as per IS – 803 / API – 650 / AWWA – D 100 / IS –2825 / BS – 2594 / Good engineering practice as applicable and referred code shall be of latest edition. However, requirement of codes and standards shall be as indicated in the tank schedule, Annexire-8.

b) Weight calculation of plates, appurtenances, platforms & structures separately shall be included in the Design calculation.

c) Design of roof and roof structures for vertical storage tanks along with agitators & agitator platforms shall be designed based on guidelines given in the book titled “Process equipment design” by Brownell and Young. Further, roof structure shall preferably be constructed on external side of roof.

d) Tank stability calculation (wind load / seismic / overturning stability) considering static and dynamic loads of Agitator and its platforms and supporting arrangement shall be done as per API – 650/IS-803, latest edition. However, factors / coefficients as required for the design of tank shall be obtained from BHEL by the bidder after placement of order.

d) Vent sizing calculation shall be done as per API – 2000, latest edition

e) Sizing calculation for vent valve.

3.2 The successful bidder shall indicate references of all the clauses indicating their page number from respective standard in the design calculation during detail engineering stage. All calculations shall necessarily be done in SI units only. All steps including formulas and abbreviations shall be clearly shown in the calculation. All inputs / assumptions shall be indicated in the first sheet of the calculation.

3.3

a) Bottom plate shall be 8.0 mm thick (minimum). Minimum 6 mm (excluding tolerance on plate as per relevant IS) thick plates including corrosion allowance shall be provided for shell plates and minimum 8 mm for roof plates for all tanks. However, Auxiliary absorbent tank shall be provided with minimum 8 mm thickness for shell, refer min. shell plate thickness defined in tank schedule Annexure-8. Calculation for the plate thickness shall be got approved from BHEL / Customer during detailed engineering stage. However, if the addition / summation of calculated value of plate thickness

Page 42 of 338



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS FGD TANKS
2 X 250 MW BHILAI FGD**

SPECIFICATION NO. PE-TS-468-167-A101

SECTION –I, SUB SECTION –C1-A

REVISION 00

Date: April, 2020

(excluding tolerance on plate as per relevant IS) / nominal minimum thickness specified in the relevant design code / standard and corrosion allowance of 1.5 mm comes out more than 6 mm then the nearest available (higher side) plate thickness in the market shall be provided for shell and roof plates without any commercial implication. For calculating shell plate thickness, IS 803 to be used. Further minimum thickness of bottom, shell and roof plates have been specified in tank schedule Annexure-8.

- b) Negative tolerance on plate thickness shall not be considered in the plate thickness calculation and also shall not be provided in the tank. Only positive tolerance shall be considered.
- 3.4 All appurtenances and mountings shall also be designed as per relevant clauses of IS: 803 / API – 650.
- 3.5 Tank shall be suitably constructed for safe, proper and continuous operation under all conditions that can be expected in a plant life without undue strain, corrosion or other operating difficulties.
- 3.6 In calculating the minimum plate thickness, the specific gravity of the liquid shall be taken as per tank schedule (Section-III, Annexure-8).
- 3.7 For cylindrical tanks, the plates shall be cold rolled through plate bending machine by several number of passes to true curvature.
- 3.8 Vessels seams shall be so positioned that they do not pass through vessel connections. For cylindrical vessels consisting of more than two sections longitudinal seams shall be offset.
- 3.9 Wherever possible, the inside seam weld shall be ground smooth, suitable for application of corrosion resistant primer.
- 3.10 Due consideration shall be given by the supplier for wind load and earthquake effect in the design of tanks.
- 3.11 For the tanks being of diameter larger than 3.75 m added structural supports in the form of rafter shall be provided.
- 3.12 Reinforcement in tanks shall be provided as per design code. The reinforced connection shall be completely pre - assembled into shell plate.
- 3.13 The joint efficiency factor to be adopted for design calculation of shell thickness shall be 0.7.
- 3.14 All roofs and supporting structures shall be designed to support dead load plus a uniform live load of not less than 150 kg/m² of projected area. Further, the static and dynamic loads of the agitator assembly along with the agitator platform shall be considered over and above the uniform live load.
- 3.15 Staircase / access ladder and hand railing shall be provided as per the relevant codes and standards and tank schedule (Section-III, Annexure-8).
- 3.16 -VOID-
- 3.17 Code conformance for flanges / counter flanges shall be ANSI B 16.5. Code conformance for bolts and nuts shall be SA 193 & 194 respectively. Further, all fasteners used in wetted condition must be of Alloy 926 or better material so that even if it comes in contact with liquid by swelling of rubber,



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS FGD TANKS
2 X 250 MW BHILAI FGD**

SPECIFICATION NO. PE-TS-468-167-A101

SECTION –I, SUB SECTION –C1-A

REVISION 00

Date: April, 2020

thread remains unaffected. Raw material of fastener must undergo Inter-Granular Corrosion test as per ISO-3651, Part-1 for Nitric Acid test.

- 3.18 The number & size of nozzles (including flanges, counter flanges and inside piping) indicated in the tank schedule (Section-III, Annexure-8) & Input dwgs (annexure-III, sub Section-D, Section-I) are tentative and bidder guidance purpose only and the same may undergo change during detail engineering stage for which no commercial implication shall be entertained by BHEL.
- 3.19 Bidder shall furnish the STADD calculation along with the roof structure calculation during detail engineering for checking the stability of roof.
- 3.20 The tank shall be designed for filled water head / atmospheric pressure and design temperature for the tank shall be as specified tank schedule (Section-III, Annexure-8).
- 3.21 Bidder to note that surface cleaning shall be of Blast clean type. However, Grit blasting shall be decided during detail engineering for which no commercial implication shall be entertained by BHEL. Further, the surface cleaning of the tanks shall be in line with the requirements specified in the specification for rubber lining / VE Flake glass lining.
- 3.22 Bidder to note that foundation drawing along with loading data & anchor bolt details shall be provided by bidder within two weeks' time from the LOI. However, Bidder to provide minimum anchor bolts for the Miscellaneous FGD tanks, as specified in the tank schedule (Section-III, Annexure-8).
- 3.23 All materials, furnished shall conform to the latest editions of America National Standard Code for Pressure piping, Power piping, ANSI B311.1, ANSI B16.11, ASME Boiler and Pressure Vessel Codes, IBR and other applicable ASME, ANSI and Indian Standards. Schedule numbers, sizes and dimensions of all carbon steel, stainless steel and alloy seamless steel pipe shall confirm to ANSI B.36.10 and of stainless steel pipe shall confirm to ANSI B 36.19 unless otherwise specified.

4.0 WELDING

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

5.0 TEST AND INSPECTION

- 5.1 The particulars of the proposed tests and the procedure for the tests shall be submitted to the Owner / Engineer for approval before conducting the tests. The successful bidder shall submit FQP (field quality plan) and demonstration test procedure for BHEL / customer / consultant's approval during detail engineering stage. In the event of any change in the field quality plan and demonstration test



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS FGD TANKS
2 X 250 MW BHILAI FGD**

SPECIFICATION NO. PE-TS-468-167-A101

SECTION –I, SUB SECTION –C1-A

REVISION 00

Date: April, 2020

procedure, the same shall be incorporated by the bidder in the document and approved document shall be adhered by the bidder without any commercial implication.

5.2 DPT / MPI on all welds (100%).

5.3 All cross / Tee joints and butt welds to be Radio graphed in line with the joint efficiency as specified in the design code / Tank schedule, Annexure-8.

5.4 For the offered tanks, fill test shall be carried out for at least 24 hours. Atmospheric storage tanks on inside surface shall be leak tested before painting / rubber lining / VE glass flake lining.

5.5 All quality plans / checklists for various items shall be furnished during detail engineering stage for BHEL / customer's approval and any changes required by BHEL / customer shall be incorporated in the documents and adhered without any price implication. However, minimum requirement of MQP as indicated in the technical specification shall be followed. All necessary items as required for inspection and testing of the tank including instruments shall be arranged by the bidder.

6.0 MANDATORY SPARES:

Not Applicable.

7.0 LIST OF COMMISSIONING SPARES:

SL. NO.	DESCRIPTION OF ITEMS	QUANTITY
1	Rubber Gasket of each size	2 nos.
2	Nuts, bolts & washers of each size (nos. of bolts, nuts & washers as required for each nozzle) as per approved Drg.	1 lot
3	Any other item required for successful commissioning of the tanks including rubber lining / VE Flake Glass lining (to be specified clearly by bidder)	1 lot

8.0 TERMINAL POINTS

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

9.0 EXCLUSIONS

- 1) Tank foundation & associated civil works, all instruments like level gauges, Level Transmitters, etc are excluded from bidder's scope of work. However, required no. of nozzles for the same shall be in bidder's scope of work.
- 2) All agitators including the agitator of drain pits/ sumps shall be provided as a free issue item to the bidder. The erection and commissioning of the agitators shall be in bidder's scope of work.



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS FGD TANKS
2 X 250 MW BHILAI FGD**

SPECIFICATION NO. PE-TS-468-167-A101

SECTION –I, SUB SECTION –C1-A

REVISION 00

Date: April, 2020

However, BHEL shall arrange for the supervision of the erection and commissioning of the agitator assembly to the bidder as a free issue service.

- 3) The Sumps/drain pits indicated in the tank schedule (Section-III, Annexure-8) is excluded from bidder's scope of work. However, the erection and commissioning of the agitators and VE Flake glass lining within the sump/drain pits shall be in bidder's scope of work.
- 4) All valves are excluded from bidder's scope of work.
- 5) All external piping from the counter flange of the nozzles of respective tanks is excluded from bidder's scope of work. However, matching counter flanges for all nozzle shall be in bidder's scope of work. Further the supply and erection of the piping material inside the tank shall be in bidder's scope. The rubber lining / VE Flake glass lining of the inlet pipes shall be in bidder's scope of work.

10.0 DRAWINGS AND DOCUMENTS TO BE SUBMITTED WITH THE BID

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

11.0 DRAWINGS/ DOCUMENTS REQUIRED DURING DETAIL ENGINEERING

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

12.0 OTHER TECHNICAL REQUIREMENTS

- 1) 15 days' time is required by BHEL to offer their comments on the drawings and documents being submitted by the bidder (during detailed engineering stage in the event of L.O.I being placed) from the date of receipt.
- 2) Bidder to depute competent designer (s) at BHEL's office during detailed engineering stage to discuss drawings and other technical documents as and when required by BHEL.
- 3) Bidder to assess the capability of their sub-vendors in terms of preparation of drawings, calculations, documents, quality assurance, supply of material etc. as per project schedule before placing the order on them. No deviations shall be entertained.
- 4) Commercial implication includes price implication as well as delivery implication.
- 5) Size of hand rails on stairway and tank roof / top shall be minimum 32 NB and shall conform to IS 1239 (M). Handrails shall be galvanized as per painting specification.
- 6) Type of roof for vertical cylindrical storage tanks shall be either supported cone roof or self-supporting cone roof as per latest edition of relevant design code.
- 7) Commissioning of tanks will consist of installation of all accessories of tanks as per approved drawing/specification, charging of tank, water-fill test (for minimum 24 hours after complete filling of



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS FGD TANKS
2 X 250 MW BHILAI FGD**

SPECIFICATION NO. PE-TS-468-167-A101

SECTION –I, SUB SECTION –C1-A

REVISION 00

Date: April, 2020

tank), satisfactory functioning of all accessories, emptying of tank, subsequent painting of complete tanks and changing of gaskets as per specification requirement.

- 8) Bidder to furnish prices and unit price of each item of proposed tanks as per BHEL's price format only along with the final price bid.
- 9) Bidder shall check that specifications of all the items are available in the NIT specification. However, in the event of absence of specification for any item, bidder will approach BHEL to furnish the specification of missing items and new specification will be adhered by the bidder for which no commercial implication shall be entertained by BHEL.
- 10) All tools and plants including welding machines, crane, hydra, fork lift, batching plant etc. and instruments as required for construction, erection and commissioning, trial run and functional demonstration test at site shall be arranged by the bidder.
- 11) Bidder to furnish list of sub-vendors based on sub-vendor list enclosed with the specification during detail engineering stage for BHEL's / Customer review and approval and items shall be procured from these suppliers only.
- 12) Dealers are not acceptable for any item of the package. Bidder shall procure all items including plates, structural, flanges, counter flanges etc. from BHEL approved sub vendor only. No argument on this account shall be entertained.
- 13) All rubber lined pipes shall be provided with flanged type connections only. In other words, Rubber lined pipes shall be flange joined only.
- 14) Minimum staircase width to be considered as 1200 mm.
- 15) Bird screen for vents shall be provided by bidder.
- 16) Drop down pipe within the tanks, for each tank shall be provided by bidder.



TITLE:

**2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
MISCELLANEOUS FGD TANKS**

SPECIFICATION No: PE-TS-468-167-A101

SECTION-I, SUB-SECTION-C1

REV. 00

DATE: April, 2020

**SECTION-I,
SUB SECTION-C1B**

**SPECIFIC TECHNICAL REQUIREMENT-RUBBER
LINING**



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS FGD TANKS
2 X 250 MW BHILAI FGD**

SPECIFICATION NO. PE-TS-468-167-A101

SECTION –I, SUB SECTION –C1-B

REVISION 00

Date: April, 2020

1.0 SCOPE OF SUPPLY

- 1 Design, manufacture, testing and supply of rubber lining material for the duty condition for FGD Tanks as specified in Annexure- 8 (Tank schedule).
- 2 Erection and Commission. Delivery of material at site, surface preparation for lining surfaces, lining the surface to the satisfaction of the customer shall be under bidder's scope, cost for Erection and Commission shall be included in the offer.
- 3 10 copies of Operation manuals containing all details of reference drawings and technical data shall be furnished by the Bidder.

2.0 SURFACE PREPARATION

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

3.0 GUIDELINES FOR DESIGN & FABRICATION OF STEEL CONSTRUCTIONS FOR RUBBER LINING:

- 1 Please refer Section-II, Sub-Section-A

4.0 RUBBER LINING

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

Refer Annexure-8



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS FGD TANKS
2 X 250 MW BHILAI FGD**

SPECIFICATION NO. PE-TS-468-167-A101

SECTION –I, SUB SECTION –C1-B

REVISION 00

Date: April, 2020

Sl. No	Tank	Rubber Lining
1	Auxiliary absorbent tank	Bromine butyl rubber lining with hardness 55±5 (Shore A Hardness).
2	Limestone slurry Tank, Waste water Tank, Primary hydro cyclone Tank, Secondary Hydro cyclone Tank, Filtrate water Tank, , Process water Tank, Belt Filter Water Tank, Clarified (Cake wash) Water Tank, Absorber Area Drain Pit, Gypsum Dewatering Area Drain Pits, Ball Mill Area Drain Pit.	Bromine butyl rubber lining with hardness 55±5 (Shore A Hardness).

- 3 After Rubber sheet applied on the surface, rubber sheets should be systematically pressed to the metal surface by the help of mechanical tools like Rubber Rollers and metal thin rollers to remove the air between metal and rubber sheet. All rubber joints are properly overlapped by 25 to 35 mm wide tapered cut rubber sheet. All the joints will be covered by 75 mm X 1.5 - 1.7 mm thick rubber strip.
- 4 Vendor shall specify the shelf life of the rubber material being supplied and shall furnish the storage methods to be followed at site to ensure that the rubber material shall not be spoilt during storage.
- 5 Vendor shall submit the surface preparation and lining procedure to the purchaser for approval. The lining work shall start only after obtaining approval from Purchaser.

5.0 INSPECTION AND TESTING OF RUBBER LINING

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

5.1 FINISHING & INTERNAL TESTING

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



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS FGD TANKS
2 X 250 MW BHILAI FGD**

SPECIFICATION NO. PE-TS-468-167-A101

SECTION –I, SUB SECTION –C1-B

REVISION 00

Date: April, 2020

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

5.2 REPAIRING PROCEDURE

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

6.0 PERFORMANCE GUARANTEE

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

7.0 PACKING

1. The part items of the Rubber lining should be identified by Tag numbers and should be packed as to minimize the possibility of damage during storage or transit. The packing should be suitable for tropical conditions. Vendor should specify the storage requirements for the Rubber lining materials.
2. The list of items identified as dispatch able units shall be furnished along with unit weight and the quantity for preparation of packing slip at BHEL end for dispatch to site and for easy identification, storage and erection at site.
3. Please refer Sub Section- C2 – B, SECTION – I for Packing Procedure.

8.0 DOCUMENTATION

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

- 1 List of Drawing and documents to be submitted for review, approval and information with submission dates
- 2 Quality Assurance Plan to be submitted for approval.
- 3 Detailed dimensional General Arrangement drawing of the lining surfaces.
- 4 This drawing shall indicate all the design data and information about the material, scope of work and weight of the material supply, Packing procedure etc.
- 5 Installation, operation and maintenance manual.
- 6 Surface preparation and Lining procedures.



TITLE:

**2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
MISCELLANEOUS FGD TANKS**

SPECIFICATION No: PE-TS-468-167-A101

SECTION-I, SUB-SECTION-C1

REV. 00

DATE: April, 2020

**SECTION-I,
SUB SECTION-C1C**

**SPECIFIC TECHNICAL REQUIREMENT –
FLAKE GLASS LINING**



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS FGD TANKS
2 X 250 MW BHILAI FGD**

SPECIFICATION NO. PE-TS-468-167-A101

SECTION –I, SUB SECTION –C1-C

REVISION 00

Date: April, 2020

1. INTENT OF SPECIFICATION

- a) This Specification defines the minimum requirements of glass flake lining of Slurry Tanks & Slurry sumps in the Flue Gas Desulphurization (FGD) plant.
- b) Tanks / Sumps to be lined contain Limestone Slurry / Gypsum Slurry / Process water. Slurry Tank Details and Slurry conditions are given in Annexure-8 Tank Schedule. The glass flake lining shall offer better resistance to corrosion/erosion and shall be based on Vinyl ester resin. Thickness of glass flake lining required is 3 mm thk.
- c) This specification covers the general design, selection of suitable glass flake material/resin, manufacture, shop inspection (as per latest applicable statutes, regulation and safety codes in the locality where the lining are to be carried out) and delivery at site, surface preparation of lining surface, lining the surface to the satisfaction of the customer, jointly calculation of total area lined, inspection of the lining at site, handling over to the ultimate customer.
- d) Compliance to this specification shall not relieve the vendor of the responsibility of furnishing glass flake lining materials of proper design, materials and workmanship to meet the specified requirements.
- e) In case of deviation, it shall be listed in the vendor's proposal under separate section titled as "list of deviations/exceptions" to the enquiry documents. Any deviation not mentioned in this list, but mentioned elsewhere in the proposal will not be considered.

2.0 CODES AND STANDARDS:

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

REFERENCE STANDARDS:

ASTM D 4285	Standard Test Method for Indicating Oil or Water in Compressed Air
ASTM D 4541	Standard Test Method for Pull-Off Strength of Coating Using Portable Adhesion Testers
ASTM E 337	Standard test Method for Relative Humidity by Wet and Dry Bulb Psychrometer
ASTM D 4618	Standard Specification for Design and Fabrication of Flue Gas Desulfurization System Components for Protective Lining Application



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS FGD TANKS
2 X 250 MW BHILAI FGD**

SPECIFICATION NO. PE-TS-468-167-A101

SECTION –I, SUB SECTION –C1-C

REVISION 00

Date: April, 2020

ASTM D 5162	Practice for Discontinuity (Holiday) Testing of Non-Conductive Protective Coating on Metallic Substrates
NACE Standard RP0178-2003	Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels to be lined for Immersion Service
ISO 8501-1, 1988	Preparation of Steel Substrates Before Application of Paints and Related Products - Visual Assessment of Surface Cleanliness
SSPC"PA2	Measurement of Dry Paint Thickness with Magnetic Gauges

3.0 SCOPE OF SUPPLY

- a) Complete selection and procurement/manufacture of all materials required for lining, storage, preparation of the surfaces for lining near site and installation of lining. All equipments required for lining shall be arranged by the vendor. Testing and supply of glass flake lining material for the duty condition specified in Table-1.
- b) Erection and Commissioning of the glass flake lining as per the requirement. Delivery of material to site, Storage of the material, surface preparation of the surfaces to be lined, lining the surface to the satisfaction of the customer and testing the lined surface for proper adhesion, complete coverage and intactness with the base material/surface shall be under bidder's scope, cost for Erection and Commissioning shall be included in the offer. The lining shall extend through all internal surfaces and over flange faces. The lining shall cover all the baffles inside the tank.
- c) To install the linings, full scaffolding access shall be provided to reach the internal walls and the entire area. Scaffold shall be properly erected with full planking in all work areas. Scaffolding shall not contact wall surfaces in work areas during lining application and surface preparation
- d) The execution of the surface preparation and lining shall be carefully planned in stages to obtain optimum lining quality with freedom from contamination and overspray or damage to lined surfaces from preparation in adjacent areas. Surface preparation will commence from the top and proceed progressively to the wall base and floor.
- e) Lining and preparation works shall be staggered or proceed progressively in order to meet cleanliness requirements or over coating times indicated in this specification.
- f) Air-Compressor, Airless Spray pumps, hopper, blasting hose, lining hose, spray tip, blasting gun, spray gun and other equipment for blasting and spray application has to be arranged by lining vendor. Power & water required will be as per NIT. In case of Diesel compressor, vendor to arrange the diesel themselves. Compressed air and instrument air will not be



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS FGD TANKS
2 X 250 MW BHILAI FGD**

SPECIFICATION NO. PE-TS-468-167-A101

SECTION –I, SUB SECTION –C1-C

REVISION 00

Date: April, 2020

provided. Any cold storage container, if required, shall be arranged by vendor. Any scaffolding shall be made of Steel only. Scaffolding material shall be arranged by vendor. All travel, TA/DA, Stay charges, site visit charges shall be in vendor's scope.

- g) Copies of Operation and Maintenance Manuals containing all details of reference drawings and technical data shall be furnished by the Bidder as specified elsewhere in the specification.

5.0 ATMOSPHERIC CONDITION REQUIREMENTS

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

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



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS FGD TANKS
2 X 250 MW BHILAI FGD**

SPECIFICATION NO. PE-TS-468-167-A101

SECTION –I, SUB SECTION –C1-C

REVISION 00

Date: April, 2020

8. In cases where dehumidification is not possible, alternate methods of warming up the work front like use of halogen lights, room heaters are to be adopted.
9. Humidity is to be taken at the location where the blasting coating operations taking place.

5.1 APPLICATION & MEDIUM:

Glass flake lining is done in order to protect the slurry tanks & sumps which contain limestone/gypsum slurry. Coated surfaces are exposed to slurry whose conditions are given in Annexure-8.

6.0 PRELIMINARY CHECK REQUIREMENTS

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

6.1 CHLORIDE CONTAMINATION TEST:

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

1. Apply de-mineralized water on approximate 12 cm² area of substrate and wait for 3 to 4 minutes.
2. Remove excess moisture by patting the substrate with clean lint free cloth.
3. Press a ferricyanide paper of approximate 12 cm² area against the substrate for approximately 5 seconds and remove the paper.
4. Total absence of blue spots on paper indicates the substrate is free from soluble salts
5. Light speckling paper indicates the substrate has still contamination but it is as the acceptance level. The component should be released for further process.
6. Large blue spots on the paper indicate the substrate is heavily contaminated.
7. In this case the following procedure to be done before coating.
 - i. Pressures wash the substrate with copious amount of town water.
 - ii. Dry the substrate completely.
 - iii. Re-blasts the surface.
 - iv. Follow the salt contamination checking procedure again till you get the desired results.
8. The Ferricyanide papers should be stored by vendor in air tight container before and after use and the shelf life of Ferricyanide paper shall be one month.

6.2 ABRASIVE DRYNESS CHECK:

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

6.3 COMPRESSED AIR DRYNESS CHECK:

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



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS FGD TANKS
2 X 250 MW BHILAI FGD**

SPECIFICATION NO. PE-TS-468-167-A101

SECTION –I, SUB SECTION –C1-C

REVISION 00

Date: April, 2020

7.0 SURFACE PREPARATION

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

7.1 MASKING:

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

7.2 SURFACE PREPARATION METHODS:

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

1. Surface to be coated shall be abrasive blasted. Before this operation, removal of existing coating to be carried out by chipping, grinding or by other suitable means. The walls of the tanks are painted with min 60μ DFT of Red Oxide Phosphate(rust proof primer), which is to be removed by vendor during blasting. Clean & dry Copper Slag Abrasive shall be used for ferrous base substrate.
2. Bidder is requested to go through all sections of the Typical GAD drawing of Slurry tank. Vendor may raise their observations during pre-bid query. Any other new requirements brought forward during technical evaluation stage shall not be considered by BHEL.
3. The minimum recommended compressed air required for Blasting shall be 7.0 m³/min at 6 kg/cm² pressure. NACE No.1/SSPC-SP-5 equivalent to SA 2½ of Swedish Standard blast profile (75 to 100 Microns) to be followed for cleaning the surface.
4. The blasted surface shall be cleaned with dry compressed air/vacuum cleaner or with clean brush so that there is no presence of Dust & other foreign material. The surface will be then checked for chloride contamination (Refer Clause.5.1 for Chloride contamination check procedure). If contamination is found then the surface to be washed and reblasted till contamination gets removed. Vendor to ensure that the blasted surface free from chloride contamination
5. When cleanliness and blast profile are acceptable, the masking tape adjacent to the area to be coated shall be peeled back to prevent overlap and subsequent edge contamination.
6. If the blasted surface has not been primed within specified time or if there is any previous visible sign of blast condition change then the surface shall be checked for metallic salt contamination and shall be reblasted. Where large areas are required to be blasted in a day, blasting shall be carried out from morning to evening ensuring weather condition. This shall be followed by a light sweep blast of the entire area, before priming. The blast cleaned surface shall be blown off with dry oil free compressed air or vacuum cleaned. A cell tape shall be thoroughly pasted to the cleaned surfaces. The tape shall be removed after a minute to check presence of dust if any. Comparator shall be used by vendor for checking the blast profile.

8.0 COATING APPLICATION

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

8.1 MIXING:

1. All coating material tins shall be individually stirred thoroughly to obtain a homogenous consistency.



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS FGD TANKS
2 X 250 MW BHILAI FGD**

SPECIFICATION NO. PE-TS-468-167-A101

SECTION –I, SUB SECTION –C1-C

REVISION 00

Date: April, 2020

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

8.2 APPLICATION PROCESS:

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

8.3 CURING & FINISH:

1. Curing:

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

2. Finish:

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

9.0 INSPECTION AND TESTING OF GLASS FLAKE LINING

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



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS FGD TANKS
2 X 250 MW BHILAI FGD**

SPECIFICATION NO. PE-TS-468-167-A101

SECTION –I, SUB SECTION –C1-C

REVISION 00

Date: April, 2020

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

10.0 REPAIRING PROCEDURE FOR GLASS FLAKE COATING

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

11.0 PERFORMANCE GUARANTEE

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

12.0 PACKING

The part items of the Glass flake lining should be identified by Tag numbers and should be packed as to minimize the possibility of damage during storage or transit. The packing should be suitable for tropical conditions. BHEL site will arrange for the space for storage. Vendor shall make arrangements for storing the Glass flake lining materials in AC containers at site. The list of items identified as



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS FGD TANKS
2 X 250 MW BHILAI FGD**

SPECIFICATION NO. PE-TS-468-167-A101

SECTION –I, SUB SECTION –C1-C

REVISION 00

Date: April, 2020

despatchable units shall be furnished along with unit weight and the quantity for preparation of packing slip at BHEL end for dispatch to site and for easy identification, storage and erection at site.

Notes:

1. Lining material chosen shall withstand a maximum service temperature of 85 deg C.
2. Procedure for lining application duly certified by lining manufacturer shall be submitted for approval.

13.0 DOCUMENTATION

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

1. List of Drawing and documents to be submitted for review, approval and information with submission dates.
2. Quality Assurance Plan to be submitted for approval.
3. Detailed dimensional General Arrangement drawing of the lining surfaces. This drawing shall indicate all the design data and information about the material, scope of work and weight of the material supply, Packing procedure etc.
4. Installation, operation and maintenance manual.
5. Surface preparation and Lining procedures.



TITLE:

2 X 250 MW BHILAI FGD

**TECHNICAL SPECIFICATION FOR
MISC. FGD TANKS**

SPECIFICATION No: PE-TS-468-167-A101

SECTION-I, SUB-SECTION-C2

REV. 00

Date: April, 2020

**SECTION-I,
SUB-SECTION-C2
CUSTOMER SPECIFICATION**



TITLE:

2 X 250 MW BHILAI FGD

**TECHNICAL SPECIFICATION FOR
MISC. FGD TANKS**

SPECIFICATION No: PE-TS-468-167-A101

SECTION-I, SUB-SECTION-C2

REV. 00

Date: April, 2020

**SECTION-I,
Sub Section-C2 - A**

CUSTOMER SPECIFICATION: TECHNICAL REQUIREMENT

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
6.05.05 6.05.06 6.05.07 6.05.08 6.05.09 6.06.00 6.06.01 6.06.02 6.06.03 6.06.04 6.07.00 6.07.01	guaranteed wear life of not less than 8000 hrs without reversal of the liners. The guaranteed capacity and fineness of the mill shall not be affected within the guaranteed life of the mill wear parts. The material of the balls shall be chosen to ensure that the balls do not lose their original shape and to ensure minimum ball consumption. The contractor shall also guarantee ball consumption per ton of limestone throughput. The contractor shall furnish the minimum ball diameter below which the balls shall be replaced. Facility shall be provided for on-load loading of steel balls to the mill. The ball mill shall be driven by a motor through a peripheral gear/ central drive system. An auxiliary motor shall also be provided for inching of mills after trip and during maintenance. The lube oil system shall have 100% stand-by arrangement for lube oil pumps and oil coolers of each circuit with independent pump / cooler. Wherever required duplex oil filters shall be provided. The mill auxiliaries like separator tanks, mill circuit pump, hydro-cyclones and all connecting pipes handling limestone slurry shall have replaceable rubber linings. Limestone Slurry Preparation / Storage Tank The contractor shall provide two (2 nos.) slurry storage tank, common for all mills. Each tank shall be sized to meet 12 hours continuous limestone requirement of all the units operating at Design point. For tank volume calculation, solid concentration (by weight) in the slurry shall be assumed, not more than 20% or actual required whichever is lower. The storage tanks shall be equipped with sufficient number of agitators, to avoid settling of limestone, as per the proven practice of the supplier. The agitators shall be designed to meet the requirements stipulated in Cl. No. 11.00.00 of this Sub-Section. The limestone mill circulation tanks shall be installed indoor beneath the hydro cyclone stations. The slurry storage tank shall be located outdoor. The slurry preparation tank shall be CS construction with replaceable chlorobutyl/bromobutyl rubber lining of minimum 5 mm thickness. Limestone Slurry Supply Pumps & Piping 2x100% centrifugal type limestone slurry pump shall be provided for each unit. Each limestone slurry pump shall be sized to supply the limestone requirement of one (1 no.) unit, under the following conditions all occurring together.			
	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 24 OF 52		

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC															
	<table> <tr> <td>(i)</td><td>Load</td><td>Design point</td></tr> <tr> <td>(ii)</td><td>Flow</td><td>110% of one absorber requirement with the limestone requirement at Design point.</td></tr> <tr> <td>(iii)</td><td>Head</td><td>As per system requirement.</td></tr> <tr> <td>(iv)</td><td>Margins</td><td>Flow 10% (minimum) Heads 15% (minimum)</td></tr> <tr> <td>(v)</td><td>Solids Concentration</td><td>Max. 30% by weight or actual as per suppliers practice, whichever is minimum.</td></tr> </table>	(i)	Load	Design point	(ii)	Flow	110% of one absorber requirement with the limestone requirement at Design point.	(iii)	Head	As per system requirement.	(iv)	Margins	Flow 10% (minimum) Heads 15% (minimum)	(v)	Solids Concentration	Max. 30% by weight or actual as per suppliers practice, whichever is minimum.	
(i)	Load	Design point															
(ii)	Flow	110% of one absorber requirement with the limestone requirement at Design point.															
(iii)	Head	As per system requirement.															
(iv)	Margins	Flow 10% (minimum) Heads 15% (minimum)															
(v)	Solids Concentration	Max. 30% by weight or actual as per suppliers practice, whichever is minimum.															
6.07.02	The limestone slurry pumps shall be designed to meet the requirements stipulated in Cl. No.8.00.00. of this Sub-Section.																
6.07.03	The limestone slurry pipes shall be sized to minimize erosion and avoid settling of the limestone at part load operation. The slurry pipes shall be lined with replaceable wear resistant natural rubber lining of minimum 6 mm thickness. Additional thickness of 2 mm in rubber lining shall be provided at bends.																
6.07.04	Automatic flushing equipment for all lime slurry pumps and pipes shall be supplied.																
7.00.00	GYPSUM DEWATERING SYSTEM																
7.01.00	A common gypsum dewatering system for all the units operating at Design point is envisaged. Contractor shall supply a two stage gypsum dewatering system, consisting of a primary stage of sets of hydro-cyclones and secondary stage of vacuum belt filters for dewatering of gypsum from absorber up to less than 10% moisture. All the equipments supplied shall be proven design with previous installations for similar capacities.																
7.02.00	The Contractor shall provide 2x100% gypsum dewatering system with each stream sized to dewater 110% of the maximum gypsum produced by all the units operating at Design point. All other stipulations with respect to sizing and design of the dewatering system, auxiliaries and other systems shall be in line with this specification.																
7.03.00	Primary Dewatering Hydro-cyclones																
7.03.01	Each set of primary dewatering hydro-cyclone shall be sized to dewater the gypsum slurry produced by all the units operating at Design point with an additional 10% margin. The outlet water content in the gypsum shall be as per the requirement of the vacuum belt filters.																
7.03.02	Each set of primary hydro-cyclone shall be provided with 10% spare hydro-cyclones. The capacity defined in the previous clause shall be met with spare hydro-cyclones																
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 25 OF 52															

CLAUSE NO.	TECHNICAL REQUIREMENTS		एनटीपीसी NTPC	
	out of service.			
7.03.03	The primary hydro-cyclone shall be installed directly above the belt filters. The overflow of the hydro-cyclones shall be taken to Hydro-cyclone Waste Water tank via secondary hydro-cyclone feed tank and secondary waste water hydrocyclone as shown in the relevant tender drawing.			
7.03.04	Hydro-cyclones shall be of modular construction. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose.			
7.03.05	The hydro-cyclone shall be of proven design. The primary hydro-cyclone shall be made up of polyurethane or urethane materials. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose. The feed chamber shall be provided with a minimum rubber lining thickness of 12mm. The liners shall have a minimum wear life of not less than 7000 hrs.			
7.04.00	Vacuum Belt Filters			
7.04.01	Each vacuum belt filter shall be sized to meet the following requirements, all occurring together, with an inlet solid concentration of not more than 45% or outlet of hydro-cyclones whichever is minimum:			
	a. Capacity	110% of gypsum produced by Absorbers of all the units operating at Design point.		
	b. Outlet Moisture	10% max.		
	c. Gypsum Purity	90% (minimum)		
	d. Chloride content	< 100 ppm		
7.04.02	The vacuum belt filter shall be proven design in operation for similar capacities. The filter cloth shall be polyester or polypropylene as per the proven design of the supplier and shall be guaranteed for a minimum life of not less than 7000 hrs.			
7.04.03	The complete frame of the filter and all parts in contact with gypsum shall be made with corrosion resistant material.			
7.04.04	In case, the contractor offers a design with an underlying belt for carrying the filter cloth, the same shall be endless, factory vulcanized rubber belts. The belt shrouds and the sealing belts shall provide a leak tight arrangement to prevent overflow of gypsum slurry. The sealing belt shall have minimum life of not less than 7000 hrs.			
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 26 OF 52

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
7.04.05	The vacuum box shall ensure tight sealing with the belt/cloth and shall be of proven design.			
7.04.06	The belt filter shall have an automatic cloth tracking mechanism and shall be provided with all required instrumentation as per the supplier's proven practice. The belt filter shall have an automatic cloth tensioning mechanism.			
7.04.07	The filter shall be provided with minimum 2 stages of cake washing for removing impurities in the gypsum. For cake washing only clarified water shall be used. For this purpose, one (1) clarified water storage tank (minimum 1 hr storage) shall be provided along with 2x100 cake washing pumps for each Vacuum Belt Filter. One stage of cloth washing arrangement shall also be provided along with 2x100 cloth washing pumps for each Vacuum Belt Filter.			
7.04.08	The filtrate from gypsum slurry and from cake washing shall be taken to a common or separate vacuum receiver tank(s) as per the proven practice of the supplier. Each belt filter shall have an independent vacuum pump.			
7.04.09	Gypsum cake from each belt filter shall be discharged through a hopper onto belt conveyor being provided by the Contractor.			
7.04.10	A 2 m (min.) wide platform shall be provided around each belt filter for easy approach & maintenance. Handling facilities for replacement of heavy components of the belt shall also be provided.			
7.05.00	Vacuum System			
7.05.01	The filtrate from each belt filter, cake washing & cloth washing shall be taken to a common or separate receiver tank(s) as per the supplier's proven practice.			
7.05.02	Each belt filter shall be provided with an independent vacuum pump sized to meet the requirements of the belt filter operating at its maximum capacity. An additional margin of 10% (min.) over the above capacity shall be provided for each vacuum pump.			
7.05.03	The vacuum pump shall be of low speed liquid ring type of proven design. The design of the vacuum pumps shall avoid cavitations under all operating conditions. The seals shall be of proven design.			
7.05.04	Silencers shall be provided, if required, to limit the noise level to values stipulated elsewhere in this specification.			
7.05.05	The vacuum receiver and pump internals shall be suitably lined to protect against the corrosive environment. The material selected for vacuum pumps & vacuum receivers shall be proven for similar application.			
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 27 OF 52

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
7.05.06	Each vacuum receiver tank(s) shall be provided with slide plate type pneumatic vacuum breaker. The plate shall be stainless steel with a min. thickness of 3 mm.			
7.06.00	Filtrate System			
7.06.01	Water from vacuum receiver tank(s) and the secondary waste water hydrocyclone underflow shall be taken to a common filtrate tank for recirculation to the absorber tanks.			
7.06.02	2x100% horizontal centrifugal pumps shall be provided for recirculation of filtrate water to absorber. 2x100% horizontal centrifugal pumps shall be provided for wash water requirements of belt filter. Alternatively, wash water pump may take suction from the vacuums receiver tanks. Each pump shall be provided with 100% standby in such a case.			
7.06.03	The pump shall be capable of pumping of filtrate water with solid concentration of not less than 10% & particle lumps of 6-7mm. A 10% margin shall be provided in each of the pump.			
7.07.00	Waste Water System			
7.07.01	The overflow of the primary hydro-cyclones shall be taken to a secondary hydrocyclone feed tank for feeding the secondary waste water hydro-cyclones.			
7.07.02	The secondary hydrocyclone feed tank shall be sized to provide a minimum storage of 1 hr of primary hydro-cyclone overflow with all the units operating at Design Point and no outflow from the tank.			
7.07.03	2x100% horizontal centrifugal pumps shall be provided to feed the secondary hydro-cyclones.			
7.07.04	Each set of hydro-cyclone shall be sized to process the maximum discharge from the secondary hydro-cyclone feed pumps. A minimum 10% spare hydro-cyclones shall be provided in each set. Secondary Hydro-cyclones shall be of modular construction and of proven design. The secondary hydro-cyclone shall be made up of polyurethane or urethane materials. It shall be possible to remove and replace individual hydro-cyclone with the set in service. Individual isolation valve shall be provided for each hydro-cyclone for this purpose.			
7.07.05	The secondary waste water underflow shall be taken to the adequately sized filtrate tank, while the overflow shall be taken to a waste water tank. In case Bidder opts to provide additionally Lamella separator before the waste water tank and after the secondary hydro cyclone for removing impurities from the system, the solids concentration in waste water up to max 10% can be acceptable .However, the required moisture content in Gypsum & required Gypsum quality shall be complied.			
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 28 OF 52

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
7.07.06	1x100% Waste water tank shall be provided which shall be sized for 8 hrs storage of waste water with all the units operating at Design point and no out flow from the tank. The Waste water Tank shall be complete with Agitator, level transmitters etc. The waste water collection tank shall be of Steel construction with rubber lining. 2x100% horizontal centrifugal pumps shall be provided for pumping the waste water from waste water tank at required pressure to waste water terminal point as indicated in Sub-section IV, Part A, Section VI of the Technical Specification. The material of Casing and impeller shall be rubber lined Cast Iron (IS:210 Gr FG260). Shaft and Shaft Sleeves shall be Stainless Steel-410.			
7.07.07	All piping, valves & instrumentation upto the employer's terminal point shall be in the contractor's scope. Contractor shall provide the complete lime dosing system to correct the pH of the waste water by lime (83% purity) dosing shall be provided and after mixing of the effluent (using re-circulation system of the pumping system), the effluent shall be discharged once the waste water has been neutralized to desired pH. A pH monitor shall be provided at the discharge of the pumps for measurement and control. Complete lime storage, feeding & dosing system shall be in contractor scope. The complete waste water neutralization system shall be automated and controlled from the control room.			
7.07.08	Contractor shall provide 2x 100% Lime Neutralization tanks which shall be of minimum 8 hr capacity made of carbon steel with rubber lining along with 2x100% Lime storage silos. The tanks shall be provided with SS dissolving basket, Agitator of SS construction, drain, over flow and dosing connection, level transmitters, Agitators etc. The storage silos and hopper cones shall be fabricated of minimum 10 mm thick carbon steel with a SS lining of grade SS304 of minimum 4 mm thickness in the complete cones to ensure reliable discharge of material. The design of storage silos shall confirm to IS 9178 or any other proven international standards. The storage silo shall be capable of feeding the lime by motorized rotary feeding system to the Lime Neutralization tank.			
7.07.09	Contractor shall provide 2x 100% Lime Storage Silos for feeding lime to the Lime Neutralization tanks. The lime storage silo shall be of minimum 24 hr capacity equivalent to the requirements of FGD system of all the units at Design point and shall be complete with supporting steel structure, platforms, power operated outlet gates, level switches, air relief devices, etc. For dust free operation each silo should be provided with a covering arrangement and a self cleaning bag filter system of suitable capacity containing blower, automatic/on-load cleaning system, etc.			
7.07.10	Bucket conveyors shall be provided by the contractor to feed lime to each of the lime storage silos from ground level. The Bucket conveyors shall be sized to completely feed each lime silo within 2 hrs. Adequate storage and feeding system required for feeding the lime to the Bucket conveyors is also in the Contractor's scope.			
7.07.11	A storage room for storing minimum one (1) month requirement of lime for all the units shall also be provided by the contractor.			
7.08.00	Auxiliary Absorbent Tank			
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 29 OF 52

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
7.08.01	The Contractor shall provide an auxiliary absorbent tank, for the unit, sized to contain the complete slurry of one absorber tank at its maximum level equipped with all necessary pumps, valves, piping and controls to transfer the tank's contents back to the absorber to refill the absorber sump. It should be possible to discharge the each absorber into the Auxiliary Absorbent tank within 2 hours.			
7.08.02	The contractor shall provide 1 x100% pump to pump back the slurry from the sump back to the absorber in a maximum time of 8 hours.			
7.08.03	Agitation shall be provided to prevent settlement of slurry by side entry agitators with emergency flush start system. Sufficient number of agitators shall be provided in the tank by the contractor to prevent the solids from settling down.			
7.08.04	The Auxiliary Absorbent tank shall be made of minimum 7 mm thick carbon steel with minimum 4 mm thick rubber lining of best quality bromine butyl rubber and shall also be equipped with all necessary pumps, valves, piping and controls to transfer the tank's contents back to the absorber.			
7.08.05	The Auxiliary Absorbent tank shall be equipped with an opening to enable easy entry of a man with wheelbarrow.			
7.08.06	Suction screens shall be installed to protect the pump.			
8.00.00	SLURRY PUMPS			
8.01.00	This Clause covers the design, manufacture and erection of all slurry pumps for the FGD system including the Absorber slurry recirculation pumps, Gypsum bleed pumps, Limestone slurry feed pumps, Mill circuit pumps and any other pump handling slurries.			
8.02.00	The Contractor shall offer only proven design in successful operation in similar application at previous installations. The design, manufacture, installation and testing of the pumps shall follow the latest applicable Indian / International (ASME / EN / Japanese) Standards.			
8.03.00	The pumps shall be designed for continuous operation. The pump shall be single stage centrifugal type capable of delivering the rated flow at rated head with margins as specified in the respective clauses. The slurry concentration in the pump shall not exceed 30% by weight except for Mill circuit slurry pumps for which the slurry concentration in the pump shall not exceed 55% by weight.			
8.04.00	All the slurry pumps shall be provided with motorized suction and discharge valves. In addition, flushing water lines with motorized/ pneumatic valves shall be provided for each pump for automatic flushing of the pump after each shut down. The flushing water for the pumps shall be taken from the process water supply. The process water lines shall be provided with pneumatic/motorized valves as per the proven			
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 30 OF 52

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
8.05.00 8.06.00 8.07.00 8.08.00 8.09.00 8.10.00	practice of the Bidder.			
	In case of pump with rubber lined casing, the casing should be radially split to allow easy removal of impeller.			
	All the pump wear parts in contact with the slurry shall be provided with replaceable rubber/elastomer liners suitable for the fluid handled. The Bidder can also offer an hi chrome alloy line pump if the Bidder has previous experience of the same for similar applications. The material used by the contractor shall be proven in previous installations.			
	For absorber recirculation service a Silicon carbide/hi-chrome impeller and SiC lining for casing can also be accepted if the manufacturer has supplied a similar pump for a previous installation for similar service.			
	The material and thickness of the liners shall ensure a minimum service life of 2 years before replacement. All the wear parts of the pump shall be guaranteed for a minimum wear life of not less than 14000 hrs.			
	The design of the shaft shall ensure that the operating speed is at least 20% above the critical speed of the shaft.			
	The pump shall be provided with seals of proven type and shall be designed for minimization of seal water consumption. The shaft shall be supported on heavy duty ball/roller bearings.			
	9.00.00 VERTICAL SUMP PUMPS			
	9.01.00 Contractor shall provide sumps of adequate capacity in the each absorber area, limestone grinding area and gypsum dewatering area for containing the over flow from the respective systems. Acid resistant tiles or other suitable material of standard thickness as per bidders proven practice shall be provided as liner. Contractor shall make arrangements for pumping the drainage water back to the respective system with vertical sump pumps. Agitators shall also be provided to avoid settling of solids in the sump. Adequate redundancy in line with the standard practice adopted by the bidder shall be provided. This Clause covers the design, manufacture and erection of all vertical sump pumps for the FGD system.			
	9.02.00 The contractor shall offer only proven design in successful operation in similar application at previous installations. The design, manufacture, installation and testing of the pumps shall follow the latest applicable Indian / International (ASME / EN / Japanese) Standards.			
9.03.00	The pumps shall be designed for continuous operation. The pump shall be single stage centrifugal type with semi open or open impeller. The pump impeller shall be cantilever type and shall not be supported below the base plate for easy withdrawal.			
9.04.00	The pump shall deliver the rated flow at rated head with margins as specified in the			
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 31 OF 52

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	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

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	retardant.			
12.03.00	The isolation valves provided in all the slurry lines shall be of knife gate type/butterfly type unless specifically mentioned. Motorized actuators shall be provided for valves requiring frequent operation as indicated in the relevant scheme.			
12.04.00	The valves shall be of proven type and the contractor shall submit a detailed valve schedule for employer's approval. Reference list for previous installations for similar application shall also be furnished to the employer.			
12.05.00	Bidder shall provide all necessary arrangements for purging & flushing of all the process pipelines, equipments etc.			
13.00.00	PROCESS WATER STORAGE TANKS & PUMPS			
13.01.00	Two (2) Process water Storage tanks (each tank catering to the requirements of all the units operating at Design Point) along with two numbers of 2x100 % Booster water pumps, if required, (Each pump catering to the process water requirements of all the units operating at Design Point) along with all necessary piping, valves, control & instrumentation to feed the clarified water shall be provided by the Contractor. Process water Storage level shall be automatically controlled at operating level by controlling the water flow from the makeup water from terminal point. The process water storage tank shall be designed to store 15 minutes of total maximum water required for the entire FGD process (including absorber system and mist eliminator washing system, limestone grinding and slurry preparation system and gypsum dewatering system, etc.) for the units operating at Design point. All the process water storage tanks shall be designed, fabricated, erected and tested in accordance with the IS:803, latest edition. Additional Corrosion allowance of 1.50 mm on the minimum tank shell thickness as calculated by IS:803, latest edition shall be provided by the bidder. Tanks shall be made from IS:2062 quality mild steel plates of tested quality. The tank shall receive water supplied (as identified in Subsection titled "Terminal points" in Part-A of Technical Specification) by Employer. The Tanks shall be provided with drain, manholes, over flow & inlet level control valves etc.			
13.02.00	2x100% Process Water Pumps shall be provided for each unit connected to each of the Process water Storage tanks along with all necessary piping, valves, control & instrumentation. Each pump catering to process water requirement of one unit. The capacity of the pumps shall be such that it shall meet the maximum process water requirement of each unit. A further 10% margin shall be provided over the above capacity for all the above pumps.			
13.03.00	2x100% Mist Eliminator Wash Water Pump for each unit connected to each of the Process water Storage tanks along with all necessary piping, valves, control & instrumentation shall be provided by the Contractor. Alternatively, Contractor can use process water pumps for mist eliminator washing if it is the standard & proven			
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 34 OF 52

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
	practice of the Contractor or its Technology Collaborator. Each pump shall cater to maximum mist washing requirement of one unit. The capacity of the pumps shall be such that the total capacity of working pumps is sufficient to meet the maximum wash water requirements of mist eliminators of the absorber. A further 10% margin shall be provided over the above capacity for all the above pumps. 13.03.04 Two (2) clarified water Storage tanks along with two numbers of 2x100 % clarified Booster water pumps from terminal point shall be provided by the Contractor. The two tanks shall be interconnected with an isolation valve. 13.03.05 2x100% clarified water Pumps connected to each of the clarified water Storage tanks for each dewatering stream. Each pump catering to clarified water requirement of each dewatering stream. 13.03.06 The type of pumps shall be horizontal centrifugal type designed for continuous operation with semi open or closed impeller. Casing, Gland and Stuffing Box shall be of 2.5 Ni Cast Iron to IS:210 Grade FG 260 or equivalent. Impeller, Wearing rings (as applicable) shall be of Stainless Steel -316 grade and Shaft & Shaft sleeves shall be of SS-410 grade. Pump re-circulation line shall be provided for pumping system. Pumps shall be provided with accessories such as Y-type suction strainers, Coupling guard, drain plugs, vent valves etc. 13.03.07 All the Process water tanks (Process water Storage tanks, Clarified water tank, Emergency water storage 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 replacable chlorobuty/bromobutyl rubber lining of minimum 4 mm thickness or with vinly ester based flake glass lining of minimum 3 mm thickness or Epoxy lining minimum three coats of 150 micron thickness and the outside surface shall be coated with paint as approved by the Employer. The Tanks shall be provided with drain, manholes, over flow & inlet level control valves etc. 14.00.00 Approach and Handling Facilities 14.01.00 Proper approach shall be provided for access to all equipments during normal operation and maintenance. Unless otherwise specified, platforms, staircase and ladders shall follow the stipulations specified elsewhere in this specification. 14.02.00 Equipments requiring monitoring during regular operation shall be approachable from the ground floor through staircase. Staircase with minimum width of 1200 mm shall be provided for approach to elevated structures at 5m height from the nearest platform. Below this height a vertical ladder with minimum clear width of 600 mm may also be acceptable.			
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 35 OF 52	

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC		
14.03.00	Platform with a minimum clear width of 1000 mm shall be provided all around the lowest absorber spray levels and mist eliminators. Similar platforms shall be provided at subsequent elevations if they are more than 3000 mm apart from each other. An adequately sized manhole with platform (min. 2 sq. m) shall be provided above each spray level. Ladders/staircase shall be provided for the access to the platform.			
14.04.00	The absorber slurry recirculation pumps, gypsum bleed pumps and limestone feed pumps shall be mounted on the ground level. Suitable approach and platforms shall be provided for all the valves required during regular operation.			
14.05.00	A 1500 mm space shall be provided around all pumps, except absorber recirculation pumps, where a 2000 mm space shall be provided.			
14.06.00	Platform with a minimum width of 1500 mm shall be provided all around the pulverizers and feeders. Approach along with suitable platforms shall be provided for ball loading hoppers.			
14.07.00	A 1000 mm wide platform with suitable approach shall be provided around each hydro-cyclone.			
14.08.00	A 2000 mm wide floor/platform shall be provided all around each belt filter.			
14.09.00	Contractor shall provide motorized hoists and trolleys for all items requiring maintenance and weighing 500 kg or more. All auxiliary structures, monorails, runway beams for all lifting tackles, hoists etc., are included in Contractor's scope of supply. Access ladders with suitable platform shall also be provided for approach to all motorized hoists/trolleys mounted on their runway beams for the maintenance of hoists/trolleys. Items weighing more than 50 kg and required to be replaced for maintenance shall be provided with manual hoists/trolleys with runway beams/supporting structure etc.			
14.10.00	The regular basement floor is not acceptable in FGD area. Further local Pits/trenches shall be avoided as far as possible.			
14.11.00	Handling arrangement of milling system, Booster fans, Slurry recirculation pumps, oxidation blower, belt feeder system etc. complete with crane/monorail along with removal space for maintenance shall be provided by the Contractor.			
14.12.00	Approach for removal of equipment for maintenance shall be provided.			
14.13.00	All other safety requirements as per the Factories Act, National Electricity code shall be complied with while developing Layout.			
14.14.00	Cable trenches/slits, if unavoidable, shall be provided with adequate cushioning of sand and the same shall be covered with PCC.			
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 36 OF 52

CLAUSE NO.	TECHNICAL REQUIREMENTS			
14.15.00	Each Equipment room shall be provided with alternate exits in case of fire/accidents as per requirements of Factories Act and Statutory bodies/insurance companies.			
14.16.00	Minimum Headroom (free height) under all floors, ducts, walkways and stairs shall be 2.50 M.			
14.17.00	Inter-connecting pipes/cables between various facilities of FGD plant shall be routed on the steel trestles to be provided by the Contractor. The clear head room for the same shall be minimum 8 M.			
15.00.00	ELEVATORS			
15.01.00	Elevators shall be designed based on following criteria :			
	(i) Type of service	One (1) no. Passenger cum goods elevator per Absorber (higher than 20 m) & for Mill Building		
	(ii) Design/construction/installation codes	(a) Latest edition of IS:14665 (All parts) AND also meeting any additional requirements of IS:4666, IS:1860 and IS:3534. (b) Any other equivalent code, subject to Employer's approval. Load carrying capacity		
	(iii) Capacity	1000 kg (minimum).		
	(iv) Rated speed	1.0 m/s.		
	(v) Total Travel	As per FGD supplier's recommendations subject to Employer's approval.		
	(vi) Number of floors to be served	As per requirement and subject to Employer's approval		
	(vii) Entrance	As per requirement and subject to Employer's approval		
	(viii) Entrance and platform size	As per design/installation codes at (ii) above		
	(ix) Drive/motor	As per Electrical Specifications.		
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 37 OF 52



TITLE:

**2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
MISC. FGD TANKS**

SPECIFICATION No: PE-TS-468-167-A101

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
MISC. FGD TANKS**

SPECIFICATION No: PE-TS-468-167-A101

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			एनटीपीसी NTPC
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			
	p) IEEE standard q) JEC standard			
5.03.00	Other International/ National standards such as DIN, JIS, VDI, EN, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English.			
5.04.00	Not used.			
5.05.00	In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.			
5.06.00	Two (2) English language copies of all national and international codes and/or standards used in the design of the plant, equipment, civil, structural and architectural works shall be provided by the Contractor to the Employer within two calendar months from the date of the Notification of Award.			
5.07.00	In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect.			
5.08.00	A detailed list of standards apart from those mentioned in the respective detailed specifications in other parts of Section-VI to which all equipment/systems/civil works should conform as indicated in this Part C and elsewhere in the specification.			
6.00.00	EQUIPMENT FUNCTIONAL GUARANTEE			
6.01.00	The functional guarantees of the equipment under the scope of the Contract is given in Section-VI Part - A of Technical Specifications. These guarantees shall supplement the general functional guarantee provisions covered under Defect liabilities Section-IV, General Conditions of Contract.			
6.02.00	Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Contractor as specified elsewhere in this specification.			
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			एनटीपीसी NTPC
8.03.02	scope of the bidder civil calculation sheets including structural analysis and design alongwith output results.			
	xxvii) Underground facilities, levelling, sanitary, land scaping drawings.			
	xxviii) Geotechnical investigation and site survey reports (if and as applicable).			
	xxix) Model study reports wherever applicable.			
	xxx) Functional & guarantee test procedures and test reports.			
	xxxi) Documentation in respect of Quality Assurance System, and Documentation in respect of Commissioning, as listed out elsewhere in this specification.			
	xxxii) Maintenance schedule for Absorber & auxiliaries clearly indicating interval, duration if shutdown required, manhours required and tools & tackles required for maintenance.			
	The Contractor's while submitting the above documents/ drawings for approval/ reference as the case may be, shall mark on each copy of submission the reference letter alongwith the date vide which the submissions are made.			
	INSTRUCTION MANUALS			
	The Contractor shall make first submission of instruction manual for all the equipments covered under the Contract as per agreed engineering information schedule. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalisation and approval of the Employer the Instruction Manuals shall be submitted as indicated in Annexure-IV . The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals have been supplied to the Employer. The Instruction Manuals shall comprise of the following.			
A) ERECTION MANUALS				
The erection manuals shall be submitted atleast three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum.				
a) Erection strategy.				
b) Sequence of erection.				
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 9 OF 83

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS			एन टी पी सी NTPC
	c)Erection instructions. d)Critical checks and permissible deviation/tolerances. e)List of tool, tackles, heavy equipments like cranes, dozers, etc. f)Bill of Materials g)Procedure for erection and General Safety procedures to followed during erection/installation. h)Procedure for initial checking after erection. i)Procedure for testing and acceptance norms. j)Procedure / Check list for pre-commissioning activities. k)Procedure / Check list for commissioning of the system. l)Safety precautions to be followed in electrical supply distribution during erection. B)OPERATION & MAINTENANCE MANUALS a)The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the manufacturers shall be typewritten with a margin on the left hand side. b)The arrangement and contents of O & M manuals shall be as follows: 1)<u>Chapter 1 - Plant Description</u>: To contain the following sections specific to the equipment/system supplied (a)Description of operating principle of equipment / system with schematic drawing / layouts.			
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. 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 The Contractor shall submit a Project Completion Report at the time of handing over the plant.			
8.03.04	8.03.04 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. 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. 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			एनटीपीसी NTPC
	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	एनटीपीसी NTPC	
16.03.00	Such nameplates or labels shall be of white nonhygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back. The name plates shall be suitably fixed on both front and rear side.		
16.04.00	Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with enamel. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.		
16.05.00	Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support. Suitable scale shall also be provided to indicate load on support or hanger.		
16.06.00	Valves, steam traps and strainers shall be identified by Employer's tag number of a metal tap permanently attached to non pressure parts such as the yoke by a stainless steel wire. The direction of flow shall also be marked on the body.		
16.07.00	Safety and relief valves shall be provided with the following: a) Manufacturer's identification. b) Nominal inlet and outlet sizes in mm. c) Set pressure in Kg/cm ² (abs). d) Blowdown and accumulation as percentage of set pressure. e) Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.		
16.08.00	All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.		
16.09.00	All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.		
17.00.00	TOOLS AND TACKLES The Contractor shall supply with the equipment one complete set of all special tools and tackles and other instruments required and other instruments for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment,		
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	एनटीपीसी NTPC		
	checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder alongwith the offer. The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Contractor shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Contractor should bring his own tools and tackles. In case these tools and tackles are used by the Contractor during erection, commissioning or initial operation the same shall be refurbished repaired/replaced as required to the satisfaction of the Employer before handing over to the Employer. All the tools and tackles shall be of reputed make acceptable to the Employer.			
18.00.00	WELDING			
18.01.00	If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be per formed by others the requirements shall be submitted to the Employer in advance of commencement of erection work.			
19.00.00	COLOUR CODE FOR ALL EQUIPMENTS/ PIPINGS/ PIPE SERVICES			
19.01.00	All equipment/ piping/ pipe services are to be painted by the Contractor in accordance with Employer's standard colour coding scheme, which will be furnished to the Contractor during detailed engineering stage.			
20.00.00	PROTECTION AND PRESERVATIVE SHOP COATING			
20.01.00	PROTECTION All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or over ground environment as the case may be. The requirements for painting specification shall be complied with as detailed out in Part-A & B of the Technical Specification.			
20.02.00	PRESERVATIVE SHOP COATING All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the			
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	एनटीपीसी NTPC		
	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	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.			
22.09.00				
22.10.00				
22.11.00				
22.12.00				
22.13.00				
22.14.00				
22.15.00				
22.16.00				
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			
	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	एनटीपीसी NTPC		
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			
	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			
	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 		
26.03.00	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	एनटीपीसी NTPC		
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			एनटीपीसी NTPC								
	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><tr><td>1. Temperature</td><td>- Degree centigrade (deg C)</td></tr><tr><td>2. Pressure</td><td>- Kilograms per square centimetre (Kg/cm²). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.</td></tr><tr><td>3. Draught</td><td>- Millimetres of water column (mm wc).</td></tr><tr><td>4. Vacuum</td><td>- Millimeters of mercury gauge (mm Hg) or water column (mm Wcl).</td></tr></table>				1. Temperature	- Degree centigrade (deg C)	2. Pressure	- Kilograms per square centimetre (Kg/cm ²). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.	3. Draught	- Millimetres of water column (mm wc).	4. Vacuum	- Millimeters of mercury gauge (mm Hg) or water column (mm Wcl).
1. Temperature	- Degree centigrade (deg C)											
2. Pressure	- Kilograms per square centimetre (Kg/cm ²). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.											
3. Draught	- Millimetres of water column (mm wc).											
4. Vacuum	- Millimeters of mercury gauge (mm Hg) or water column (mm Wcl).											
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 		
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			एनटीपीसी NTPC
	LIST OF CODES AND STANDARDS			
	Indian Standards	Title	International and Internationally recognised standards	
	IS:277	Galvanised steel sheets (plain or corrugated)		
	IS:655	Specification for metal air duct		
	IS:800	Code of practice for use of structural steel in general building construction	BS 449:1969 BS 5950 ASA A57, 1-1952	
	IS:807	Code of practice for design, manufacture, erection and testing (Structural portion) of cranes and hoists 6588 (Issued by Standards Association of Australia). DIN 120:1936 (Sheet 1) DIN 120:1936 (Sheet 2) 327 part-I, 1951 BS 466 part-II, 1960 BS 644:1960 BS 1757:1951 BS 2573:part-I:1960	Draft Revision of A.S. NO. CS.2 SAA Crane and Hoist code Doc:No. BU/4 Rev	
	IS:875	Code of practice for design loads (other than earthquake) for buildings and structures Leading standards (issued by Canadian Standard) DIN-1055-1955 (Issued by ASA)	National Building code of Canada (1953)-Part-IV Design section 4.1	
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 		
	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- Atmospheric Water Cooling Equipment 23-1958 AMCA A-21C Test Code for air moving devices API:618 Reciprocating Compressor for general refinery services. HYDRAULIC INSTITUTE STANDARDS. HYDRANT SYSTEM MANUALS OF TAC. TAC MANUALS OF SPRAY SYSTEM NFPA USA/ NSC UK/ UL USA/ FM USA STANDARDS. INDIAN EXPLOSIVES ACT. INDIAN FACTORIES ACT. STANDARD OF TUBULAR EXCHANGER MANUFACTURER'S ASSOCIATION.		
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			एनटीपीसी NTPC
	(Part-II) IS: 1542 IS: 1566 IS: 1786 IS: 2062 IS: 2116 IS: 2386 (Parts-I to VIII) IS: 3150 IS: 3495 (Parts-I to IV) IS: 3812 IS: 4031 IS: 4032 IS: 4082 IS: 8112 IS: 8500 IS: 12269 IS: 12894 Cast-In-Situ Concrete and Allied Works IS: 280 IS: 456		Calcined clay based. Specification for sand for plaster. Specification for hard-drawn steel wire fabric for concrete reinforcement. Specification for high strength deformed bars for concrete reinforcement. Specification for steel for general structural purposes. Specification for sand for masonry mortars. Testing of aggregates for concrete. Hexagonal wire netting for general purpose. Methods of tests of burnt clay building bricks. Specification for fly ash, for use as pozzolana and admixture. Methods of physical tests for hydraulic cement. Methods of chemical analysis of hydraulic cement. Recommendations on stacking and storage of construction materials at site. Specification for 43 grade ordinary portland cement. Medium and high strength structural steel. 53 grade ordinary portland cement. Specification for Fly ash lime bricks. Specification for mild steel wire for general engineering purposes. 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			एनटीपीसी NTPC
	IS: 457	Code of practice for general construction of plain & reinforced concrete for dams & other massive structures.		
	IS: 516	Method of test for strength of concrete.		
	IS: 650	Specification for standard sand for testing of cement.		
	IS: 1199	Methods of sampling and analysis of concrete.		
	IS: 1791	General requirements for batch type concrete mixers.		
	IS: 1838 (Part-I)	Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type).		
	IS: 2204	Code of practice for construction of reinforced concrete shell roof.		
	IS: 2210	Criteria for the design of reinforced concrete shell structures and folded plates.		
	IS: 2438	Specification for roller pan mixer.		
	IS: 2502	Code of practice for bending and fixing of bars for concrete reinforcement.		
	IS: 2505	General requirements for concrete vibrators, immersion type.		
	IS: 2506	General requirements for concrete vibrators, screed board type.		
	IS: 2514	Specification for concrete vibrating tables.		
	IS: 2645	Specification for Integral cement water proofing compounds.		
	IS: 2722	Specification for portable swing weigh batches for concrete. (single and double bucket type)		
	IS: 2750	Specification for Steel scaffolding.		
	IS: 2751	Code of practice for welding of mild steel plain and deformed bars for reinforced concrete construction.		
	IS: 3025	Methods of sampling and test waste water.		
	IS: 3366	Specification for Pan vibrators.		
	IS: 3370	Code of practice for concrete structures for the storage of		
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		एनटीपीसी NTPC	
	(Part I to IV)	liquids.		
	IS: 3414	Code of practice for design and installation of joints in buildings.		
	IS: 3550	Methods of test for routine control for water used in industry.		
	IS: 3558 concrete.	Code of practice for use of immersion vibrators for consolidating concrete.		
	IS: 4014 (Parts I & II)	Code of practice for steel tubular scaffolding.		
	IS: 4326 of buildings.	Code of practice for earthquake resistant design and construction of buildings.		
	IS: 4461	Code of practice for joints in surface hydro-electric power stations.		
	IS: 4656	Specification for form vibrators for concrete.		
	IS: 4925	Specification for batching and mixing plant.		
	IS: 4990	Specification for plywood for concrete shuttering work.		
	IS: 4995 (Parts I & II)	Criteria for design of reinforced concrete bins for the storage of granular and powdery materials.		
	IS: 5256	Code or practice for sealing joints in concrete lining on canals.		
	IS: 5525 concrete work.	Recommendations for detailing of reinforcement in reinforced concrete work.		
	IS: 5624	Specification for foundation bolts.		
	IS: 6461	Glossary of terms relating to cement concrete.		
	IS: 6494	Code of practice for water proofing of underground water reservoirs and swimming pools.		
	IS: 6509	Code of practice for installation of joints in concrete pavements.		
	IS: 7861	Code of practice for extreme weather concreting. (Parts I & II)		
	IS: 9012	Recommended practice for shot concreting.		
	IS: 9103	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		एनटीपीसी NTPC	
	IS: 9417	Recommendations for welding cold worked steel bars for reinforced concrete construction.		
	IS: 10262	Recommended guidelines for concrete mix design.		
	IS: 11384	Code of practice for composite construction in structural steel and concrete.		
	IS: 11504	Criteria for structural design of reinforced concrete natural draught cooling towers.		
	IS: 12118	Specification for two-parts poly sulphide.		
	IS: 12200	Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams.		
	IS: 13311	Method of non-destructive testing of concrete.		
	Part-1	Ultrasonic pulse velocity.		
	Part-2	Rebound hammer.		
	SP:23	Handbook of concrete mixes		
	SP: 24	Explanatory Handbook on IS: 456-1978		
	SP: 34	Handbook on concrete reinforcement and detailing.		
	Precast Concrete Works			
	SP: 7(PartVI/	National Building Code- Structural design of prefabrication and Sec.7) systems building.		
	IS: 10297	Code of practice for design and construction of floors and roofs using precast reinforced/prestressed concrete ribbed or cored slab units.		
	IS: 10505	Code of practice for construction of floors and roofs using pre-cast reinforced concrete units.		
	Masonry and Allied Works			
	IS: 1905	Code of Practice for Structural Safety of Buildings-Masonry walls.		
	IS: 2212	Code of Practice for Brickwork.		
LOT-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			एनटीपीसी NTPC
	IS: 2250 Code of Practice for Preparation and use of Masonry Mortar. SP: 20 Explanatory hand book on masonry code. Sheeting Works IS:277 Galvanised steel sheets (plain or corrugated). IS: 459 Unreinforced corrugated and semi-corrugated asbestos cement sheets. IS: 513 Cold-rolled carbon steel sheets. IS: 730 Specification for fixing accessories for corrugated sheet roofing. IS: 1626 Specification for Asbestos cement building pipes and pipe fittings, gutters and gutter fittings and roofing fittings. IS: 2527 Code of practice for fixing rain water gutters and down pipe for roof drainage. IS: 3007 Code of practice for laying of asbestos cement sheets. IS: 5913 Methods of test for asbestos cement products. IS: 7178 Technical supply conditions for tapping screw. IS: 8183 Bonded mineral wool. IS: 8869 Washers for corrugated sheet roofing. IS: 12093 Code of practice for laying and fixing of sloped roof covering using plain and corrugated galvanised steel sheets. IS: 12866 Plastic translucent sheets made from thermosetting polyester 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			एनटीपीसी NTPC
	IS: 1608 IS: 1599 IS : 228 IS : 2595 IS : 1182 IS : 3664 IS : 3613 IS : 3658 IS : 5334	Method of Tensile Testing of Steel products other than sheets, strip, wire and tube. Method of Bend Tests for Steel products other than sheet, strip, wire and tube Methods of chemical Analysis of pig iron, cast iron and plain carbon and low alloy steel. Code of Practice for Radio graphic testing. Recommended practice for Radiographic Examination of fusion welded butt joints in steel plates. Code of practice for Ultra sonic Testing by pulse echo method. Acceptance tests for wire flux combination for submerged Arc Welding. Code of practice for Liquid penetrant Flaw Detection. 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			एनटीपीसी NTPC
	IS : 4441	Code of practice for use of silicate type chemical resistant mortars.		
	IS : 4443	Code of practice for use of resin type chemical resistant mortars.		
	IS : 4456	Method of test for chemical resistant tiles. (Part I & II)		
	IS : 4457	Specification for ceramic unglazed vitreous acid resistant tiles.		
	IS : 4832	Specification for chemical resistant mortars. Part I Silicate type Part II Resin type Part III Sulphur type		
	IS : 4860	Specification for acid resistant bricks.		
	IS : 9510	Specification for bitumasitc, Acid resisting grade.		
	Water Supply, Drainage and Sanitation			
	IS : 458	Specification for concrete pipes.		
	IS : 554	Dimensions for pipe threads, where pressure tight joints are made on thread.		
	IS : 651	Specification for salt glazed stoneware pipes.		
	IS : 774	Flushing cisterns for water closets and urinals.		
	IS : 775	Cast iron brackets and supports for wash basins and sinks.		
	IS : 778	Copper alloy gate, globe and check valves for water works purposes.		
	IS : 781	Cast copper alloy screw down bib taps and stop valves for water services.		
	IS : 782	Caulking lead.		
	IS : 783	Code of practice for laying of concrete pipes.		
LOT-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			एनटीपीसी NTPC
	IS : 1172	Basic requirements for water supply, drainage and sanitation.		
	IS : 1230	Cast iron rain water pipes and fittings.		
	IS : 1239	Mild steel tubes, tubulars and other wrought steel fittings.		
	IS : 1536	Centrifugally cast (Spun) iron pressure pipes for water, gas and sewage.		
	IS : 1537	Vertically cast iron pressure pipes for water, gas and sewage.		
	IS : 1538	Cast iron fittings for pressure pipe for water, gas and sewage.		
	IS : 1703	Ball valves (horizontal plunger type) including float for water supply purposes.		
	IS : 1726	Cast iron manhole covers and frames.		
	IS : 1729	Sand cast iron spigot and socket, soil, water and ventilating pipes, fittings and accessories.		
	IS : 1742	Code of practice for building drainage.		
	IS : 1795	Pillar taps for water supply purposes.		
	IS : 1879	Malleable cast iron pipe fittings.		
	IS : 2064	Code of practice for selection, installation and maintenance of sanitary appliances.		
	IS : 2065	Code of practice for water supply in building.		
	IS : 2326	Automatic flushing cisterns for urinals.		
	IS : 2470 (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		एनटीपीसी NTPC	
	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			एनटीपीसी NTPC
	IS : 10592 IS : 12592 IS : 12701 SP: 35 -	Industrial emergency showers, eye and face fountains and combination units. Specification for precast concrete manhole covers and frames. Rotational moulded polyethylene water storage tanks. 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 Part-I door Specification for timber panelled and glazed shutters- (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 (Part-II) Specification for wooden flush door shutters (solid core type); 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			एनटीपीसी NTPC
	IS:3067 Code of practice for general design details and preparatory work for damp proofing and water proofing of buildings. IS:3384 Specification for bitumen primer for use in water proofing and damp proofing. Floor Finishes and Allied Works IS:1237 Specification for cement concrete flooring tiles. IS:1443 Code of practice for laying and finishing of cement concrete flooring tiles. IS:2114 Code of practice for laying in-situ terrazzo floor finish. IS:2571 Code of practice for laying in-situ cement concrete flooring. IS:3462 Specification for unbacked flexible PVC flooring. IS:4971 Recommendations for selection of industrial floor finishes. IS:5318 Code of practice for laying of flexible PVC sheet and tile flooring. IS:8042 Specification for white portland cement. IS:13801 Specification for chequered cement concrete flooring tiles. Painting and Allied Works IS:162 Specification for fire resisting silicate type, brushing, for use on wood, colour as required. IS:1477 Code of practice for painting of ferrous metals in buildings. Part-I Pretreatment. Part-II Painting. IS:1650 Specification for colours for building and decorative finishes. IS:2074 Specification for red oxide-zinc chrome, priming, ready mixed paint air drying. IS:2338 Code of practice for finishing of wood and wood based materials. Part-I Operations and workmanship			
LOT-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			एनटीपीसी NTPC
	Part-II IS:2395 Part-I Part-II IS:2524 Part-I Part-II IS:2932 IS:2933 IS:4759 IS:5410 IS:5411 (Part-I) IS:6278 IS:10403 Piling and Foundation IS:1080 IS:1904 IS:2911 IS:2950 IS:2974 (Part-I TO V) IS:6403	Schedules Code of practice for painting concrete, masonry and plaster surfaces. Operations and workmanship. Schedule. Code of practice for painting of nonferrous metals in buildings. Pretreatment. Painting. Specification of synthetic enamel paint, exterior, under-coating and finishing. Specification enamel paint, under coating and finishing. Code of practice for hot dip zinc coating on structural steel and other allied products. Specification for cement paint Specification for plastic emulsion paint-for exterior use Code of practices for white washing and colour washing. Glossary of terms relating to building finishes. Piling and Foundation Code of practice for design and construction of simple spread foundations. Code of practice for design and construction of foundations in Soils; General Requirements. Code of practice for designs and construction of Pile foundations (Relevant Parts). Code of practice for designs and construction of Raft (Part-I) foundation. Code of practice for design and construction of machine foundations. Code of practice for determination of Allowable Bearing pressure on Shallow foundation.		
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			एनटीपीसी NTPC
	IS:8009 Part-I Part-II IS:12070 DIN:4024 VDI:2056 VDI:2060 Stop Log and Trash Rack IS:4622 IS:5620 IS:11388 IS:11855 Roads IRC:5 IRC:14 IRC:16 IRC:19 IRC:21 IRC:34 IRC:36 IRC:37 IRC:56 IRC:73 IRC:86	Code of practice for calculation of settlement of foundation subjected to symmetrical vertical loads. Shallow foundations. Deep foundations. Code of practice for design and construction of shallow foundations on rocks. Flexible supporting structures for machines with rotating machines. Criteria for assessing mechanical vibrations of machines. Criteria for assessing rotating imbalances in machines. Recommendations for fixed - wheel gates structural design. Recommendations for structural design criteria for low head slide gates. Recommendations for design of trash rack for intakes. General requirements for rubber seals for hydraulic gates. Standard specifications and Code of practice for road bridges, section-I general Features of Design. Recommended practice of 2cm thick bitumen and tar carpets. Specification for priming of base course with bituminous primers. Standard specifications and code of practice for water bound macadam. Standard specifications and Code of practice for road bridges, section-III - Cement concrete (plain and reinforced). Recommendations for road construction in waterlogged areas. Recommended practice for the construction of earth embankments for road works. Guidelines for the Design of flexible pavements. Recommended practice for treatment of embankment slopes for erosion control. Geometric design standards for rural (non-urban) highways. Geometric Design standards for urban roads in plains.		
LOT-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 Guidelines for the design of small bridges & culverts. IRC - Public- Ministry of Surface Transport (Roads Wing), Specifications ation for road and bridge works. IS:73 Specification for paving bitumen Loadings IS:875 Code of practice for design loads other than earthquake) for (Pt. I to V) buildings and structures. IS:1893 Criteria for earthquake resistant design of structures. IS:4091 Code of Practice for design and construction of foundation for transmission line towers & poles. IRC:6 Standard specifications & code of practice for road bridges, Section-II Loads and stresses. M.O.T. Deptt. of railways Bridge Rules. Safety IS:3696 Safety code for scaffolds and ladders. (Part I & II) IS:3764 Safety code for excavation work. IS:4081 Safety code for blasting and related drilling operations. IS:4130 Safety code for demolition of buildings. IS:5121 Safety code for piling and other deep foundations. IS:5916 Safety code for construction involving use of hot bituminous materials. IS:7205 Safety code for erection on structural steelwork. IS:7293 Safety code for working with construction machinery. IS:7969 Safety code for handling and storage of building materials IS:11769 Guidelines for safe use of products containing asbestos. - Indian Explosives Act. 1940 as updated. Architectural design of buildings SP:7 National Building Code of India SP:41 Hand book on functional requirements of buildings (other than industrial buildings)		
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 Creteria 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	

ANNEXURE-III

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

[illegible]

ANNEXURE-V

		Project : Contractor : Contractor No. : System :		Stage :		FIELD WELDING SCHEDULE (To be raised by the contractor) Welding Code:				DOC. NO.: REV. NO.: DATE : 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 Temp. Holding time	NDT method/Quantum	REF Spec. No. ACC Norm Ref.
NOTES:														
SIGNATURE														
FORMAT														
Engg. Div. / QA&I														

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS (Annexure-VI)			एनटीपीसी NTPC																																																																								
	<table><tr><th>S.No</th><th>Description of Drgs/Docs</th><th>No Prints</th><th>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></td><td>2</td></tr><tr><td>b) "As Built" Drawing/Documents (Directly to site)</td><td>6</td><td></td><td>2</td></tr><tr><td>c) Analysis reports of Equipments / piping /structures components/system employing software packages as detailed in the specifications.</td><td>2</td><td></td><td>2</td></tr><tr><td>2</td><td>Erection Manual (Directly to site)</td><td>4 sets</td><td></td><td>2</td></tr><tr><td rowspan="2">3</td><td>Operation & Maintenance manual</td><td rowspan="2">1 set</td><td rowspan="2"></td><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></td><td>2</td></tr><tr><td>4</td><td>Plant Hand Book</td><td rowspan="2">1</td><td rowspan="2"></td><td rowspan="2">1</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></td><td>2</td></tr></table>				S.No	Description of Drgs/Docs	No Prints	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 Prints	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																																																																								
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)			एनटीपीसी NTPC																																																
	<table><tr><th>S.No</th><th>Description of Drgs/Docs</th><th>No of Prints</th><th>No of CD ROMs/DVDs/Portable Hard Disk</th></tr><tr><td>6</td><td>Performance and Functional Guarantee Test Report i) First Submission</td><td>2 sets</td><td>—</td></tr><tr><td></td><td>ii) Approved Copies (Direct to Site)</td><td>4 sets</td><td>2</td></tr><tr><td>7</td><td>Project Completion Report (Directly to site)</td><td>6 sets</td><td>2</td></tr><tr><td>8</td><td>QA programme including Organisation for implementation and QA system manual(with revisions)</td><td>1</td><td>—</td></tr><tr><td>9</td><td>Vendor details in respect of proposed vendors including contractor's evaluation report.</td><td>2</td><td>—</td></tr><tr><td>10</td><td>Manufacturing QPs, Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc i) For review/comment</td><td>1</td><td>—</td></tr><tr><td></td><td>ii) Approved final copies of Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc (Direct to Site)</td><td>4</td><td>2</td></tr><tr><td>11</td><td>Welding Manual, Heat Treatment Manuals, Storage & preservation manuals i) For review/comment</td><td>1 set</td><td>—</td></tr><tr><td></td><td>ii) Approved copies (Direct to Site)</td><td>4 sets</td><td>2</td></tr><tr><td>12</td><td>QA Documentation Package for items / equipment manufactured and despatched to site</td><td>2 sets</td><td>2</td></tr><tr><td>13</td><td>QA Documentation Package for field activities on equipment/systems at site</td><td>2 sets</td><td>2</td></tr></table>				S.No	Description of Drgs/Docs	No of Prints	No of CD ROMs/DVDs/Portable Hard Disk	6	Performance and Functional Guarantee Test Report i) First Submission	2 sets	—		ii) Approved Copies (Direct to Site)	4 sets	2	7	Project Completion Report (Directly to site)	6 sets	2	8	QA programme including Organisation for implementation and QA system manual(with revisions)	1	—	9	Vendor details in respect of proposed vendors including contractor's evaluation report.	2	—	10	Manufacturing QPs, Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc i) For review/comment	1	—		ii) Approved final copies of Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc (Direct to Site)	4	2	11	Welding Manual, Heat Treatment Manuals, Storage & preservation manuals i) For review/comment	1 set	—		ii) Approved copies (Direct to Site)	4 sets	2	12	QA Documentation Package for items / equipment manufactured and despatched to site	2 sets	2	13	QA Documentation Package for field activities on equipment/systems at site	2 sets	2
S.No	Description of Drgs/Docs	No of Prints	No of CD ROMs/DVDs/Portable Hard Disk																																																	
6	Performance and Functional Guarantee Test Report i) First Submission	2 sets	—																																																	
	ii) Approved Copies (Direct to Site)	4 sets	2																																																	
7	Project Completion Report (Directly to site)	6 sets	2																																																	
8	QA programme including Organisation for implementation and QA system manual(with revisions)	1	—																																																	
9	Vendor details in respect of proposed vendors including contractor's evaluation report.	2	—																																																	
10	Manufacturing QPs, Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc i) For review/comment	1	—																																																	
	ii) Approved final copies of Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc (Direct to Site)	4	2																																																	
11	Welding Manual, Heat Treatment Manuals, Storage & preservation manuals i) For review/comment	1 set	—																																																	
	ii) Approved copies (Direct to Site)	4 sets	2																																																	
12	QA Documentation Package for items / equipment manufactured and despatched to site	2 sets	2																																																	
13	QA Documentation Package for field activities on equipment/systems at site	2 sets	2																																																	
LOT-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																																																

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT		
			
1.00.00	GENERAL		
1.01.00	The following provisions shall supplement the conditions already contained in the other parts of these specifications and documents and shall govern that portion of the work of this contract which is to be performed at site. The erection requirements and procedures not specified in these documents shall be in accordance with the recommendations of the equipment manufacturer, or as mutually agreed to between the Employer and the Contractor prior to commencement of erection work.		
1.02.00	The Contractor upon signing of the Contract shall, in addition to a Project Co-ordinator, nominate another responsible officer as his representative at Site suitably designated for the purpose of overall responsibility and co-ordination of the Works to be performed at Site. Such a person shall function from the Site office of the Contractor during the pendency of Contract.		
2.00.00	REGULATION OF LOCAL AUTHORITIES AND STATUTES		
2.01.00	In addition to the local laws and regulations, the Contractor shall also comply with the Minimum Wages Act and the Payment of Wages Act (both of the Government of India) and the rules made there under in respect of its labour and the labour of its sub-contractors currently employed on or connected with the contract.		
2.02.00	All registration and statutory inspection fees, if any, in respect of his work pursuant to this Contract shall be to the account of the Contractor. However, any registration, statutory inspection fees lawfully pay-able under the provisions of the Indian Boiler Regulations and any other statutory laws and its amendments from time to time during erection in respect of the plant equipment ultimately to be owned by the Employer, shall be to the account of the Employer. Should any such inspection or registration need to be re-arranged due to the fault of the Contractor or his Sub-Contractor, the additional fees for such inspection and/or registration shall be borne by the Contractor.		
3.00.00	WELDING OF PRESSURE PARTS AND HIGH PRESSURE PIPING		
	The welding of all pressure parts and high pressure piping shall be in accordance with the following requirements:		
3.01.00	Qualification of Weld Procedures		
	Only qualified welding procedures as per ASME Section IX shall be used by contractor at site. Procedure qualification records along with WPS shall be submitted to NTPC for review. Welding procedure shall indicate all essential and non-essential parameters as per ASME Section IX. Makes of welding consumables shall be subject to employer's approval.		
3.02.00	Welder's Qualification		
	Only welders who are qualified in accordance with the latest applicable requirements of the Indian Boiler Regulations, shall be permitted to perform any welding work on the pressure parts and its attachment welding. In addition to such statutory qualification requirements, the welders shall also undergo a satisfactory		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT PAGE 1 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT			एनटीपीसी NTPC
	pre-production qualification test to be conducted by the Contractor at site as per ASME Sec IX in presence of employer's representative(s), prior to performing work under these specifications. The services of an independent testing laboratory shall be retained by the Contractor to perform welder qualification tests for welders. All the welders carrying out welding at site shall carry an identification badge, which shall indicate the category and the grade of welding for which they have been tested and authorised to carry out welding.			
3.03.00	Records			
	Welders performance shall be monitored regularly and record of their performance shall be maintained by contractor in a manner acceptable to the employer. Contractor shall maintain such records including record of procedure qualification & welder qualification and hand-over to the employer at the end of work.			
3.04.00	MARKING			
	On completion of each welded joint, the welder shall mark his regularly assigned identification mark near the joint. The welder's identification numbers, inspection stamps or code symbol stamps and any other information shall not be directly stamped on any alloy steel piping. In alloy steel piping, all such information shall be stamped on separate marking plate which shall be tack welded on pipe near the weld.			
4.00.00	HEAT TREATMENT			
4.01.00	Pre-heating, post-heating and post-weld stress relief operations of all welds, shall be performed in accordance with the requirements of applicable code. Local post weld stress relieving heat treatments shall be adopted only in cases where it is normally impracticable to subject the entire assembly as such for stress relieving operations. Heating may be by means of electric induction coils or electric resistance coils. Oxy-acetylene flame heating or exothermic chemical heating methods will not be permitted. Complete recording of the temperatures through out the stress relieving cycle of the material and the weld subjected to heat treatment shall be made by means of a potentiometric recorder. Recorders other than those of potentiometric type shall not be used for such temperature recording during stress relieving operations. The contractor & employer's representative, at start and at the end of HT Cycle shall sign the time and temperature charts for heat-treatment.			
4.02.00	Not Used.			
4.03.00	After setting up the weld joint for heat treatment operation, the Employer's signature shall be obtained on the strips chart of the recorder prior to starting of heat treatment cycle. The right hand corner of the strip chart at the starting point of the heat treatment cycle shall contain details like the weld number, material, diameter and thickness, method of heating adopted, prescribed ranges of heat treatment temperatures, date of heat treatment, reference to item number of the Field welding Schedule (as specified at clause no 7.00.00- of this chapter) etc.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 2 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT			
5.00.00	WELD EDGE PREPARATION Preparation at site of weld joint shall be in accordance with details acceptable to the Employer. Wherever possible, machining or automatic flame cutting shall be used for edge preparation. Hand flame cutting will be permitted only where edge preparation otherwise is impractical. All slag shall be removed from cuts and all the hand cuts shall be ground smooth to the satisfaction of the Employer. Flame cutting of alloy steel pipe shall be avoided. Wherever such cutting is done, a 200mm length at the cut face shall be removed by machining. Pneumatic hand tools such as edge preparation, tube cutting machine can be used.			
6.00.00	CLEANING AND SERVICING			
6.01.00	The inside of all tubes, pipes, valves and fittings shall be free from dirt, and loose scales before being erected. All the pipelines shall be thoroughly blown and/or flushed. Each steam and water tubes shall be blown with compressed air and shall be subjected to 'ball test' before erection to ensure that no obstructions exist. A system for recording of all such operations shall be developed and maintained in a manner to ensure that no obstructions are left inside the tubes and no tubes are left uncleaned and untested.			
6.02.00	All valves and valve actuators, and dampers and damper actuators, if any, shall be thoroughly cleaned and serviced prior to pre-commissioning tests and/or Initial Operations of the plant. A system for recording of such servicing operation shall be developed and maintained in a manner acceptable to the Employer and to ensure that no valves or dampers including their actuators are left unserviced.			
6.03.00	All interior surfaces of the turbine shall be thoroughly cleaned prior to boxing - up to remove all traces of oil preservations.			
7.00.00	FIELD WELDING SCHEDULE The Contractor shall submit to the Employer, a certified and complete field welding schedule for all the field welding activities to be carried out in respect of the pressure parts involved in the equipment furnished and erected by him, at least 90 days prior to the scheduled start of erection work at site. Such schedule will be strictly followed by the Contractor during the process of erection. The above field-welding schedule to be issued by the Contractor shall contain the following: (a.) Drawing No (s) (b.) Location of the weld (c.) Size of the weld (outside diameter and thickness) (d.) Type of joints (e.) Material specifications (f.) Size of fillet on backing ring, when the type of joint is with backing ring (g.) Electrode/ filler metal specifications			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 3 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT	एनटीपीसी NTPC		
	(h.) Number of welds per unit (i.) Quantity of filler metal per weld (j.) Indication of required Non-destructive Examination (NDE) for each weld (k.) Pre-heat temperatures for welding (l.) Process of welding (m.) Post-welding heat treatment temperature ranges, duration, under as specified at clause no 4.00.00 of this chapter entitled "Heat Treatment". (n.) Qualification details of weld procedures to be adopted as specified at clause no 3.01.00 of this chapter entitled 'Qualification of Weld Procedures'.			
8.00.00	SITE RUN MISCELLANEOUS PIPING Sketches or diagrams of the proposed routings of all piping, not already indicated and routed on the shop drawings which were reviewed by the Employer, shall be submitted to the Employer for review, Employer's acceptance of such site routings shall be obtained before the piping is erected. All these site run piping shall be installed in such a manner as to present an orderly and neat installation. They shall be located as to avoid obstruction of access and passages. Valves, instruments or any other special items shall be located convenient for operation by the operating personnel. Pipe runs shall be plumb or level except where pitch for drainage is required. Pipe runs that are not parallel to the building structure, walls or column rows shall be avoided so that deflection of pipes between hangers does not exceed 6 mm. No miscellaneous pipe shall be routed and installed above or adjacent to electrical equipment.			
9.00.00	THERMAL EXPANSIONS All piping installation shall be such that no excessive or destructive expansion forces exist either in the cold condition or under condition of maximum temperature. All bends, expansion joints and any other special fittings, necessary to provide proper expansion, shall be incorporated. During installation of expansion joints and anchors, care must be taken to make sure that full design movement is available at all times for maximum to minimum temperature and vice-versa.			
10.00.00	PIPING SUPPORTS			
10.01.00	Hangers, supports and anchors shall be installed as required to obtain a safe, reliable and complete pipe installation. All supports shall be properly levelled and anchored when installed. The anchors shall be so placed that thermal expansion will be absorbed by bends without subjecting the valves or equipment to excessive strains.			
10.02.00	The hanger assemblies shall not be used for the attachment of rigging to hoist the pipe into place. Other means shall be used to securely hold the pipe in place till the pipe support is completely assembled and attached to the pipe and building			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 4 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT	एनटीपीसी NTPC		
	structures and spring support is set to accommodate the pipe way. All temporary rigging shall be removed in such a way that the pipe support is not subjected to any sudden load. All piping, having variable spring type supports, shall be held securely in place by temporary means during the hydraulic test of pipe system. Constant support type spring hangers used during hydraulic test shall be pinned or blocked solid during the test. After complete installation and insulation of the piping and filling of the piping with its normal operating medium, the pipe support springs shall be adjusted to the cold positions. If necessary, the spring support shall be re-adjusted to the hot positions after the line has been placed for service at its normal maximum operating temperature conditions. Electric arc welding only shall be used to weld all pipe supports to structural steel members that form part of the building supporting structure. The structural beams shall not be heated more than necessary during welding of supports and such welds shall run parallel to the axis of the span. All lugs or any other attachments welded to the piping shall be of the same material as the pipe.			
11.00.00	PRESSURE TESTING			
11.01.00	On completion of erection of pressure parts, a hydraulic test in accordance with the requirements of the Indian Boiler Regulations shall be performed by the Contractor.			
11.02.00	All the valves, high pressure pipes and inter-connected pipes connecting the pressure parts shall be tested along with pressure parts. All blank flanges or any removable plugs required for openings not closed by the valves, and piping provided, shall be furnished by the Contractor. The pressurization equipment including water piping from the supply, needed for the above test shall also be furnished by the Contractor. Any defects noticed during the testing are to be rectified and the unit re-tested. If any welding is done on the pressure parts after the Hydraulic test, the Hydraulic test for that portion of pressure parts shall be repeated. Water as required for such pressure testing shall be provided by the employer.			
11.03.00	Thy hydraulic test shall be considered successful only on certification to that effect by the concerned inspecting Authority as per the provisions of the Indian Boiler Regulations and the Employer.			
12.00.00	THERMOWELLS AND FLOW NOZZLES			
12.01.00	All the thermowells and flow nozzles in the equipment furnished under the technical specifications shall be installed as a part of this work.			
12.02.00	All thermowell connections incorporated in the steam service shall be plugged during the pressure testing and the blow out of steam piping systems. Upon completion of the blow out operation, all thermowells shall be installed and seam welded. Similarly, all flow nozzles in the steam lines shall also be installed only on completion of steam blowing operations unless otherwise agreed to by the Employer, depending upon the sequence of cleaning and purging operations to be adopted by the Contractor at the field.			
13.00.00	INSULATION, LAGGING AND CLADDING The provision of insulation, lagging and cladding of the various equipments and portion of the equipment covered under the Contract, shall be furnished by the			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9		PART-D ERECTION CONDITIONS OF CONTRACT PAGE 5 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT		
13.01.00	Contractor as specified elsewhere or agree to separately in writing. Welds required for holding insulation on pressure parts shall be carried out by IBR qualified welder. Piping, Pipe Fittings & Valves All piping insulation and metal cladding furnished with the equipment to be erected shall be applied as specified herein.		
13.01.01	Piping The insulation on piping shall be applied using wire loops on 150mm centres. These wire loops shall be thoroughly embedded into the outer insulation surface and all cracks, voids and depressions shall be filled with insulating cement suitable for the piping temperature so as to form a smooth base for application of cladding. The wires used for piping insulation shall be of 16 SWG. The surface shall be smooth and uniform before applying the outer covering. All piping insulation ends shall be terminated at a sufficient distance from flanges to facilitate removal of bolts.		
13.01.02	Flanges Insulation on flanges shall be by means of blocks of insulating material securely bound to the flange by wire loops. Such blocks of insulation shall be long enough to overlap the adjacent pipe insulation by an amount equal to the thickness of adjacent pipe insulation. Smooth finish shall be obtained by the application of insulating cement. Alternatively, sectional pipe insulation of proper diameter may be used. Insulation on flanges shall not be done until the pipe and equipment have been in service during the initial operation and till all the flange bolts have been retightened.		
13.01.03	Bends and Elbows Insulation on bends and elbows shall be cut into sections sufficiently short to form a reasonable smooth external surface. After the application of insulation material in place, it shall be smoothly coated with insulating cement. Elbows may be insulated as above or alternatively by means of specially moulded insulation enclosures.		
13.01.04	Cladding Cladding shall be of aluminium sheet of thickness as per details given in detail Technical Specification or will be provided during detail engineering shall be machine rolled and formed to accurately fit insulation curvatures. Cladding shall be secured using self-tapping screws. Screws shall be adequate number and so located as to produce tight joints. The spacing of screws shall be as far as possible uniform and on centres not exceeding 150 mm. For outside diameters less than 230 mm, spacing of screws shall be on centres not exceeding 100 mm. adequate number of screws shall be provided for fixing the cladding and be so placed in such locations, as to produce a smooth cladding finish without bellying'. Insulated elbows having insulated diameters less than 330 mm shall be provided with preformed smooth aluminium elbow jackets. Wherever possible, all joints should be lapped a minimum of 50 mm with joints facing downwards and so placed that they are obscured from normal points of vision. All the joints in the cladding shall be made with suitable provisions for expansions. All butt joints such as those at piping tees		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT PAGE 6 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT			
15.03.00	No electric cable in use by the other Contractor/Employer will be disturbed without permission. No weight of any description will be imposed on any such cable and ladder or similar equipment will rest against or to be attached with it.			
15.04.00	No reapir work shall be carried out on any live equipment. The equipment must be declared safe by the Employer and a permit to work issued before any work is carried out.			
15.05.00	The Contractor shall employ the necessary number of qualified, full time electricians to maintain his temporary electrical installation.			
16.00.00	REMOVAL OF MATERIAL No material brought to the Site shall be removed from the Site by the Contractor and/or his Sub-Contractors without the prior written approval of the Employer.			
17.00.00	INSPECTION, TESTING AND INSPECTION CERTIFICATES The provisions of the clause entitled Inspection, Testing and Inspection Certificates given in Part - C of the Technical Specification, shall also be applicable to the erection portion of the Works. The Employer shall have the right to re-inspect any equipment though previously inspected and approved by him at the Contractor's works, before and after the same are erected at Site. If by the above inspection, the Employer rejects any equipment, the Contractor shall make good for such rejections either by replacement or modification/ repairs as may be necessary to the satisfaction of the Employer. Such replacements will also include the replacements or re-execution of such of those works of other Contractors and/or agencies, which might have got damaged or affected by the replacements or re-work done to the Contractor's work.			
18.00.00	ACCESS TO SITE AND WORKS ON SITE			
18.01.00	Suitable access to site and permission to work at the Site shall be accorded to the Contractor by the Employer in reasonable time.			
18.02.00	In the execution of the Works, no person other than the Contractor or his duly appointed representative, Sub-Contractor and workmen, shall be allowed to do work on the Site, except by the special permission, in writing by the Employer or his representative.			
19.00.00	CONTRACTOR'S SITE OFFICE ESTABLISHMENT The Contractor shall establish a Office at the Site and keep posted an authorised representative for the purpose of the Contract. Any written order or instruction of the Employer or his duly authorised representative, shall be communicated to the said authorised resident representative of the Contractor and the same shall be deemed to have been communicated to the Contractor at his legal address.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 8 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT			
20.00.00	CO-OPERATION WITH OTHER CONTRACTORS			
20.01.00	Employer, who may be performing other works on behalf of the Employer and the workmen who may be employed by the Employer and doing work in the vicinity of the works under the Contract. The Contractor shall also arrange to perform his work as to minimise, to the maximum extent possible, interference with the work of other Contracts and their workmen. Any injury or damage that may be sustained by the employees of the other Contractors and the Employer, due to the Contractor's work shall promptly be made good at his own expense. The Employer shall determine the resolution of any difference or conflict that may arise between the Contractor and other Contractors or between the Contractor and the workmen of the Employer in regard to their work. If the work of the Contractor is delayed because of the any acts of omission of another Contractor, the Contractor shall have no claim against the Employer on that account other than an extension of time for completing his works. Employer shall have full access to visit the contractor's site at any time for inspection and surveillance checks.			
20.02.00	The Employer shall be notified promptly by the Contractor of any defects in the other Contractor's works that could affect the Contractor's Works. The Employer shall determine the corrective measures if any, required to rectify this situation after inspection of the works and such decisions by the Employer shall be binding on the Contractor.			
21.00.00	DISCIPLINE OF WORKMEN			
	The Contractor shall adhere to the disciplinary procedure set by the Employer in respect of his employees and workmen at Site. The Employer shall be at liberty to object to the presence of any representative or employee of the Contractor at the Site, if in the opinion of the Employer such employee has misconducted himself or is incompetent, negligent or otherwise undesirable then the Contractor shall remove such a person objected to and provide in his place a competent replacement.			
22.00.00	CONTRACTOR'S FIELD OPERATION			
22.01.00	The Contractor shall keep the Employer informed in advance regarding his field activity plans and schedules for carrying out each part of the works. Any review of such plan or schedule or method of work by the Employer shall not relieve the Contractor of any of his responsibilities towards the field activities. Such reviews shall also not be considered as an assumption of any risk or liability by the Employer or any of his representatives and no claim of the Contractor will be entertained because of the failure or inefficiency of any such plan or schedule or method of work reviewed. The Contractor shall be solely responsible for the safety, adequacy and efficiency of plant and equipment and his erection methods.			
22.02.00	The Contractor shall have the complete responsibility for the conditions of the Work-Site including the safety of all persons employed by him or his Sub-Contractor and all the properties under his custody during the performance of the work. This requirement shall apply continuously till the completion of the Contract and shall not be limited to normal working hours. The construction review by the Employer is not intended to include review of Contractor's safety measures in, on or near the Work-Site, and their adequacy or otherwise.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 9 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT	एनटीपीसी NTPC		
23.00.00	PHOTOGRAPHS AND PROGRESS REPORT			
23.01.00	The Contractor shall furnish three (3) prints each to the Employer of progress photographs of the work done at Site. Photographs shall be taken as and when indicated by the Employer or his representative. Photographs shall be adequate in size and number to indicate various stages of erection. Each photograph shall contain the date, the name of the Contractor and the title of the photograph.			
23.02.00	The above photographs shall accompany the monthly progress report detailing out the progress achieved on all erection activities as compared to the schedules. The report shall also indicate the reasons for the variance between the scheduled and actual progress and the action proposed for corrective measures, wherever necessary.			
23.03.00	The Contractor shall submit the progress of work in soft and hard form (as decided by employer) quarterly highlighting the progress and constraints at site.			
24.00.00	MAN-POWER REPORT			
24.01.00	The Contractor shall submit to the Employer, on the first day of every month, a man hour schedule for the month, detailing the man hours scheduled for the month, skill-wise and area-wise.			
24.02.00	The Contractor shall also submit to the Employer on the first day of every month, a man power report of the previous month detailing the number of persons scheduled to have been employed and actually employed, skill- wise and the areas of employment of such labour.			
25.00.00	PROTECTION OF WORK The Contractor shall have total responsibility for protecting his works till it is finally taken over by the Employer. No claim will be entertained by the Employer or the representative of the Employer for any damage or loss to the Contractor's works and the Contractor shall be responsible for complete restoration of the damaged works to original conditions to comply with the specification and drawings. Should any such damage to the Contractor's Works occur because of other party not being under his supervision or control, the Contractor shall make his claim directly with the party concerned. If disagreement or conflict or dispute develops between the Contractor and the other party or parties concerned regarding the responsibility for damage to the Contractor's Works the same shall be resolved as per the provisions of the as specified at clause no 21.00.00 of this chapter entitled "Co-operation with other Contractors." The Contractor shall not cause any delay in the repair of such damaged Works because of any delay in the resolution of such disputes. The Contractor shall proceed to repair the Work immediately and no cause thereof will be assigned pending resolution of such disputes.			
26.00.00	EMPLOYMENT OF LABOUR			
26.01.00	In addition to all local laws and regulations pertaining to the employment of labour to be complied with by the Contractor pursuant to GCC, the Contractor will be expected to employ on the work only his regular skilled employees with experience of the			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9		PART-D ERECTION CONDITIONS OF CONTRACT PAGE 10 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT	एनटीपीसी NTPC		
	particular work. No female labour shall be employed after darkness. No person below the age of eighteen years shall be employed.			
26.02.00	All travelling expenses including provisions of all necessary transport to and from Site, lodging allowances and other payments to the Contractor's employees shall be the sole responsibility of the Contractor.			
26.03.00	The hours of work on the Site shall be decided by the Employer and the Contractor shall adhere to it. Working hours will normally be eight (8) hours per day - Monday through Saturday.			
26.04.00	Contractor's employees shall wear identification badges while on work at Site.			
26.05.00	In case the Employer becomes liable to pay any wages or dues to the labour or any Government agency under any of the provisions of the Minimum Wages Act, Workmen Compensation Act, Contract Labour Regulation Abolition Act or any other law due to act of omission of the Contractor, the Employer may make such payments and shall recover the same from the Contractor's Bills.			
27.00.00	FACILITIES TO BE PROVIDED BY THE EMPLOYER			
27.01.00	Electricity			
	Refer clause 1.14.00 (Construction Power) Sub-Section III-B, Part-A, Section VI of Technical Specification.			
27.02.00	Water			
	Contractor shall make all arrangements himself for the supply of construction water as well as potable water for labour and other personnel at the worksite/colony. However, drawl of construction/potable water from bore-well shall be permitted if found suitable. Any statutory clearance required shall be obtained by the contractor. Assistance, if required shall be provided by the owner.			
27.03.00	Communication			
	The Employer will extend the telephone facilities, if available at Site, for purposes of Contract. The Contractor shall be charged at actuals for such facilities.			
27.04.00	Railway Siding			
	Railway siding shall be provided by owner (up to plant entry point) for coal transportation to site. However the same may not be available to the bidder for material/supplies transport etc. Bidder has to plan its own arrangement for movement of ODC consignment to plant site.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 11 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT		
28.00.00 28.01.00 28.02.00 28.03.00 28.04.00 28.05.00 28.05.01 28.05.02 28.06.00 28.06.01 28.06.02 29.00.00	FACILITIES TO BE PROVIDED BY THE CONTRACTOR Contractor's site office Establishment The Contractor shall establish a site office at the site and keep posted an authorized representative for the purpose of the contract, pursuant to GCC. The site office will include one conference meeting room for site meetings between the Contractor and the Employer. Tools, tackles and scaffoldings The Contractor shall provide all the construction equipments, tools, tackles and scaffoldings required for pre-assembly, installation, testing, commissioning and conducting Guarantee tests of the equipments covered under the Contract. He shall submit a list of all such materials to the Employer before the commencement of pre-assembly at Site. These tools and tackles shall not be removed from the Site without the written permission of the Employer. The Contractor shall arrange Dozer, Hydra, Cranes, Trailer, etc. for the purpose of fabrication, erection and commissioning. Testing Equipment and Facilities: The contractor shall provide the necessary testing, equipment and facilities. Site laboratory for civil works: Contractor shall provide and maintain a site laboratory for the testing of construction material under the direction and general supervision of employer. First-aid The Contractor shall provide necessary first-aid facilities for all his employees, representatives and workmen working at the Site. Enough number of Contractor's personnel shall be trained in administering first-aid. The Employer will provide the Contractor, in case of any emergency, the services of an ambulance for transportation to the nearest hospital. Cleanliness The Contractor shall be responsible for keeping the entire area allotted to him clean and free from rubbish, debris etc. during the period of Contract. The Contractor shall employ enough number of special personnel to thoroughly clean his work-area at least once in a day. All such rubbish and scrap material shall be stacked or disposed in a place to be identified by the Employer. Materials and stores shall be so arranged to permit easy cleaning of the area. In areas where equipment might drip oil and cause damage to the floor surface, a suitable protective cover of a flame resistant, oil proof sheet shall be provided to protect the floor from such damage. Similarly the offices shall be kept clean and neat to the entire satisfaction of the Employer. Proper sanitary arrangements shall be provided by the Contractor, in the work-areas and office areas of the Contractor. LINES AND GRADES		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 12 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT	एनटीपीसी NTPC		
	All the Works shall be performed to the lines, grades and elevations indicated on the drawings. The Contractor shall be responsible to locate and layout the Works. Basic horizontal and vertical control points will be established and marked by the Employer at Site at suitable points. These points shall be used as datum for the works under the Contract. The Contractor shall inform the Employer well in advance of the times and places at which he wishes to do work in the area allotted to him so that suitable datum points may be established and checked by the Employer to enable the Contractor to proceed with his works. Any work done without being properly located may be removed and/or dismantled by the Employer at Contractor's expense. 30.00.00 FIRE PROTECTION 30.01.00 The work procedures that are to be used during the erection shall be those which minimise fire hazards to the extent practicable. Combustible materials, combustible waste and rubbish shall be collected and removed from the Site at least once each day. Fuels, oils and volatile or flammable materials shall be stored away from the construction and equipment and materials storage areas in safe containers. Untreated canvas, paper, plastic or other flammable flexible materials shall not at all be used at Site for any other purpose unless otherwise specified. If any such materials are received with the equipment at the Site, the same shall be removed and replaced with acceptable material before moving into the construction or storage area. 30.02.00 Similarly corrugated paper fabricated cartons etc. will not be permitted in the construction area either for storage or for handling of materials. All such materials used shall be of water proof and flame resistant type. All the other materials such as working drawings, plans etc. which are combustible but are essential for the works to be executed shall be protected against combustion resulting from welding sparks, cutting flames and other similar fire sources. 30.03.00 All the Contractor's supervisory personnel and sufficient number of workers shall be trained for fire-fighting and shall be assigned specific fire protection duties. Enough of such trained personnel must be available at the Site during the entire period of the Contract. 30.04.00 The Contractor shall provide enough fire protection equipment of the types and number for the warehouses, office, temporary structures, labour colony area etc. Access to such fire protection equipment, shall be easy and kept open at all time. 31.00.00 SECURITY The Contractor shall have total responsibility for all equipment and materials in his custody stores, loose, semi-assembled and/or erected by him at Site. The Contractor shall make suitable security arrangements including employment of security personnel to ensure the protection of all materials, equipment and works from theft, fire, pilferage and any other damages and loss. All materials of the Contractor shall enter and leave the Employer Site only with the written permission of the Employer in the prescribed manner.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 13 OF 53	

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT	एनटीपीसी NTPC		
32.00.00	CONTRACTOR'S AREA LIMITS The Employer will mark-out the boundary limits of access roads, parking spaces, storage and construction areas for the Contractor and the Contractor shall not trespass the areas not so marked out for him. The Contractor shall be responsible to ensure that none of his personnel move out of the areas marked out for his operations. In case of such a need for the Contractor's personnel to work out of the areas marked out for him the same shall be done only with the written permission of the Employer.			
33.00.00	CONTRACTOR'S CO-OPERATION WITH THE EMPLOYER In case where the performance of the erection work by the Contractor affects the operation of the system facilities of the Employer, such erection work of the Contractor shall be scheduled to be performed only in the manner stipulated by the Employer and the same shall be acceptable at all times to the Contractor. The Employer may impose such restrictions on the facilities provided to the Contractor such as electricity, etc. as he may think fit in the interest of the Employer and the Contractor shall strictly adhere to such restrictions and co-operate with the Employer. It will be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and operation of the equipment systems which are erected by him. The Contractor shall also be responsible for flushing and initial filling of all the oil and lubricants required for the equipment furnished and installed by him, so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in documents and specifications.			
34.00.00	PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES			
34.01.00	GENERAL			
34.01.01	The Contractor upon completion of installation of equipments and systems, shall conduct pre-commissioning and commissioning activities, to make the equipment/systems ready for safe, reliable and efficient operation on sustained basis. All pre-commissioning/commissioning activities considered essential for such readiness of the equipment/systems including those mutually agreed and included in the Contractor's quality assurance programme as well as those indicated in clauses elsewhere in the technical specifications shall be performed by the contractor.			
34.01.02	The pre-commissioning and commissioning activities including Guarantee/ demonstration/ acceptability tests, checks and trial operations of the equipment/systems furnished and installed by the contractor shall be the responsibility of the Contractor as detailed in relevant clauses in Technical Specification. The Contractor shall provide, in addition, test instruments, calibrating devices etc. and labour required for successful performance of these operations. If it is anticipated that the above test may prolong for a long time, the Contractor's workmen required for the above test shall always be present at site during such operations.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 14 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT	एनटीपीसी NTPC		
34.01.03	The following activities shall be carried out by the contractor, 18 month prior to schedule date of commissioning of the equipment/systems installed by him. (a.) The contractor shall furnish the organization chart of his operation and commissioning engineers for the acceptance of employer. Adequate number of operation and commissioning engineers shall be deployed by the contractor to effectively meet the requirement of round the clock operation in shifts also, till the plant is taken over by the employer. (b.) The contractor shall submit the bio-data containing the details of experience of his operation and commissioning engineers for the acceptance of employer. (c.) The contractor shall furnish the deployment schedule of his operation and commissioning engineers for the acceptance of the employer. (d.) Apart from above, contractor shall ensure deployment of sufficient skilled/semi-skilled/unskilled manpower during pre-commissioning and commissioning activities.			
34.01.04	It shall be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and initial operation of the equipment/systems which are installed by him.			
34.01.05	The Contractor shall also be responsible for flushing and initial filling of all oils and lubricants required for the equipment furnished and installed by him so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in these specifications and documents.			
34.02.00	COMMISSIONING DOCUMENTATION			
34.02.01	The contractor shall submit the commissioning documentation, comprising of Standard checklists, pre-commissioning procedures, testing schedules, commissioning schedules and commissioning networks for various equipment/systems covered under the contract, for the approval of employer.			
34.02.02	Standard checklist, as the name suggests, shall be a fairly general documents, containing the list of all checks required to be carried out for similar and repetitive type of equipment to ensure consistent and thorough checking. An indicative list of such equipment is enclosed as Annexure I.			
34.02.03	The testing schedule is a document, designed for safe and systematic commissioning of individual equipment/sub-system (for example compressor etc.) Commissioning schedule is a document envisaged for commissioning of a system (for example Compressed Air system, Unit commissioning etc.). The testing/Commissioning schedule shall have a standard format in order to maintain consistency of presentation, content and reporting. A brief write up on the contents of the Testing Schedule/Commissioning Schedule is enclosed as Annexure-II.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 15 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT			एनटीपीसी NTPC
34.02.04	The contractor shall submit the list of commissioning documentation to be submitted by him, along with their submission schedule for various equipment/systems covered under the contract, with in 6(six) month from the date of award of contract, for the acceptance of employer.			
34.02.05	The Contractor shall submit the commissioning documentation, for various equipment/covered under the contract, for the approval of employer, at least 18 months before the scheduled date of commissioning of the equipment/systems.			
34.03.00	COMMISSIONING ACTIVITIES			
34.03.01	Upon completion of pre-commissioning activities/tests, the contractor shall initiate commissioning of facilities. During commissioning the Contractor shall carry out system checking and reliability trials on various parts of the facilities.			
34.03.02	Contractor shall carry out the checks/tests at site to prove to the Employer that each equipment of the supply complies with requirements stipulated and is installed in accordance with requirements specified.			
34.03.03	Before the plant is put into initial operation the Contractor shall be required to conduct test to demonstrate to the Employer that each item of the plant is capable of correctly performing the functions for which it was specified and its performance, parameters etc. are as per the specified/approved values. These tests may be conducted concurrently with those required under commissioning sequence.			
34.03.04	The Contractor shall also demonstrate the performance of all C&I equipment, the tests on main equipment of prior to that as the case may be.			
34.03.05	Other tests shall be conducted, if required by the Employer, to establish that the plant equipment are in accordance with requirements of the specifications.			
34.03.06	The Contractor shall conduct all the commissioning tests and undertake commissioning activities pertaining to all other auxiliaries and equipments including all electrical and C&I equipment/systems not specifically brought out above but are within the scope of work and facilities being supplied and installed by the Contractor and follow the guidelines indicated above or elsewhere in these technical specifications.			
34.05.00	Initial Operation			
	Upon completion of system checking/Tests as above and as a part of commissioning of facilities, complete plant/facilities shall be put on initial operation as stipulated in General Technical Requirements.			
35.00.00	MATERIALS HANDLING AND STORAGE			
35.01.00	All the equipments furnished under the Contract and arriving at Site shall be promptly received, unloaded and transported and stored in the storage spaces by the Contractor.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 16 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT			
35.02.00	Contractor shall be responsible for examining all the shipment and notify the Employer immediately of any damage, shortage, discrepancy etc. for the purpose of Employer's information only. The Contractor shall submit to the Employer every week a report detailing all the receipts during the week. However, the Contractor shall be solely responsible for any shortages or damage in transit, handling and / or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.			
35.03.00	The Contractor shall maintain an accurate and exhaustive record detailing out the list of all equipment received by him for the purpose of erection and keep such record open for the inspection of the Employer.			
35.04.00	All equipment shall be handled very carefully to prevent any damage or loss. No bare wire ropes, slings, etc. shall be used for unloading and/or handling of the equipment without the specific written permission of the Employer. The equipment stored shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the store shall be moved to the actual location at the appropriate time so as to avoid damage of such equipment at Site.			
35.05.00	All electrical panels, controls gear, motors and such other devices shall be properly dried by heating before they are installed and energised. Motor bearings, slip rings, commutators and other exposed parts shall be protected against moisture ingress and corrosion during storage and periodically inspected. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion due to prolonged storage.			
35.06.00	All the electrical equipment such as motors, etc. shall be tested for insulation resistance at least once in three months from the date of receipt till the date of commissioning and a record of such measured insulation values maintained by the Contractor. Such records shall be open for inspection by the Employer.			
35.07.00	The Contractor shall ensure that all the packing materials and protection devices used for the various equipments during transit and storage are removed before the equipment are installed.			
35.08.00	The consumables and other supplies likely to deteriorate due to storage must be thoroughly protected and stored in a suitable manner to prevent damage or deterioration in quality by storage.			
35.09.00	All the materials stored in the open or dusty location must be covered with suitable weatherproof and flame-proof covering material wherever applicable.			
35.10.00	If the materials belonging to the Contractor are stored in areas other than those earmarked for him, the Employer will have the right to get it moved to the area earmarked for the Contractor at the Contractor's cost.			
35.11.00	The Contractor shall be responsible for making suitable indoor storage facilities to store all equipment which require indoor storage. Normally, all the electrical equipments such as motors, control gear, generators, exciters and consumables like			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 17 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT			
36.00.00 36.01.00 36.02.00 36.03.00 36.04.00 36.05.00 a)	electrodes, lubricants etc. shall be stored in the closed storage space. The Employer, in addition, may direct the Contractor to move certain other materials, which in his opinion will require indoor storage, to indoor storage areas which the Contractor shall strictly comply with. CONSTRUCTION MANAGEMENT The field activities of the Contractors working at Site, will be coordinated by the Employer and the Employer decision shall be final in resolving any disputes or conflicts between the Contractor and other Contractors and tradesmen of the Employer regarding scheduling and co- ordination of work. Such decision by the Employer shall not be a cause for extra compensation or extension of time for the Contractor. The Employer shall hold weekly meetings of all the Contractors working at Site, at a time and place to be designated by the Employer. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Employer and shall strictly adhere to those decisions in performing his Works. In addition to the above weekly meeting, the Employer may call for other meeting either with individual Contractors or with selected number of Contractors and in such a case the Contractor if called, will also attend such meetings. Time is the essence of the Contract and the Contractor shall be responsible for performance of his works in accordance with the specified construction schedule. If at any time, the Contractor is falling behind the schedule, he shall take necessary action to make good for such delays by increasing his work force or by working overtime or otherwise accelerate the progress of the work to comply with the schedule and shall communicate such actions in writing to the Employer, satisfying that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action. The Employer shall however not be responsible for provision of additional labour and/or materials or supply or any other services to the Contractor except for the co- ordination work between various Contractors as set out earlier. Site management during construction phase till handing over of plant Bidder shall ensure that the plant site within the plant boundary is managed in a coordinated and professional way all through the construction phase till handing over of plant, ensuring safe, easy & unhindered working conditions and a healthy & hygienic working environment at site. He shall ensure the following measures at site while executing the project. Proper housekeeping by systematic and proper disposal of earth from excavations (separately for usable & surplus earth), muck (from pile bores or otherwise), wastes (from dismantling of pile tops, concrete works etc), packing & insulation wastes, steel scrap, cable wastes etc generated during construction / erection works. Suitable disposal sites for each of above shall be identified in the layout and at site in the beginning of the project itself. It shall be ensured that all agencies engaged by the bidder follow the discipline to dispose off of earth spoils and wastes at the			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 18 OF 53	

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT	एनटीपीसी NTPC		
	designated places. Preferably once in a week suitable time slot will be identified for housekeeping by all agencies and suitable instructions shall be issued in this regard. Bidder may engage a separate agency or identify a gang for collection of wastes and disposal to designated places. Suitable arrangement / tieup will also be made for periodic disposal of wastes/ scrap from the designated places. b) All fabrication areas shall be suitably hard crusted to provide a water free and proper working platforms. Suitable sheds preferably pre engineered structures to be provided for paint shops, fabrication workshops etc for ensuring all weather work conditions for onsite structural works. For the main plant and auxiliary buildings, bidder should preferably plan the works in such a way that structural fabrication is done in suppliers' offsite works / workshops and onsite fabrication works are avoided / kept minimum. c) Suitable onsite maintenance workshop for day to day breakdown maintenance heavy plant and equipment like batching plants, cranes, earth moving equipment, poclains, welding equipment etc. The workshop shall have stock of frequently needed spares and suitable repair facilities with experienced technicians/mechanics. A central test laboratory equipped with test equipment for routine tests like tests on soil, concrete, bricks, aggregates, welds etc with experienced staff shall be established at the start of the project itself. d) All office and covered store buildings of the bidder and its agencies shall be of prefab/ pre-engineered / porta cabin construction. Shabby semi finished constructions in brickwork/ GI / asbestos roof etc shall not be permitted. e) First aid facilities and amenities like rest rooms, suitable pre engineered toilets (separate for men and women), drinking water fountains/tanks, canteen, crèche for women workers shall be planned and established at the beginning of the project itself. These facilities shall be located distributed over the plant area to enable easy access by the construction workers and staff and shall be marked on the plant layout. Suitable treatment for toilet discharge, like bio digesters etc shall be planned and conventional septic tanks / soak pits etc shall be avoided. f) Proper lighting of all construction / erection areas. Bidder shall erect adequate number of high lighting masts in main plant, offsite, office and store areas for lighting during night. DG sets of adequate capacity shall be provided for emergency backup. The street lighting along the roads shall also be priortised along with road construction. The construction power ring main shall be planned and erected immediately after the award. g) Well planned and coordinated storage and movement of plant, equipment and construction materials. System wise / agency wise storage / laydown areas shall be planned and marked on the plant layout at the beginning itself. Bidder shall ensure that all its agencies comply to the areas allocated to them and follow the designated storage and movement plans. Adequate covered storage shall be constructed for storage of critical equipments like switchgears, MCCs, insulation etc. h) Proper access control for construction workers, staff and visitors. Bidder shall ensure that suitable electronic based gate pass system is in place from start of project itself			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 19 OF 53	

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT	एनटीपीसी NTPC		
37.00.00	to keep record and track of all workers, staff and visitors entering/exiting the plant premises shift wise on daily basis. i) Compliance to all safety requirements as specified elsewhere in the tender documents. Bidders shall establish a safety centre at the start of the project itself. It shall have a 24X7 manned safety control room in addition to a permanent safety equipment display room, separate training / lecture hall with AV facilities for safety training, store room with adequate stock of specified safety equipment, a first aid room and other amenities. Bidder shall install CCTV cameras at all strategic locations in the plant area which shall be linked to the safety control room. j) Compliance to all environment and other conditions stipulated by the concerned statutory authorities while according clearance / NOC to the project. Bidder shall ensure adequate sprinkling of water by deploying water tankers to prevent the fugitive dust nuisance during construction. k) Development of suitable landscape & green belt areas and rainwater harvesting within the plant premises. Bidder shall plan to develop the landscape & green belt areas and rainwater harvesting from the start of the project itself. The landscape and rainwater harvesting plan shall be finalized immediately after award of work and suitable work plan with priority and schedule shall also be finalized thereafter. Top soil before excavation shall be suitably preserved and stacked for landscape and green belt development. l) Provision of adequate shelters, water supply, sanitation and lighting in construction workers and staff camps. No camps for workers and staff shall be permitted within the plant premises and Bidder shall make separate arrangement outside the plant premises for locating and development of camps for construction workers and staff. The designated areas shall be suitably developed with infrastructure like roads, drains, water supply and sewerage and shall be free from water logging. Suitable low cost shelters will be provided for the workers. Complete area shall be secured by fencing and shall be provided adequate area lighting. Suitable waste disposal, shopping and recreation facilities will be developed in these camps. Contractor shall ensure that due importance is given to site management as discussed above and a detailed work plan considering the above aspects is finalized immediately after the award. A senior level executive shall be identified who shall be responsible for implementation of the work plan. Suitable format for progress reporting on site management plan shall be developed and made part of the project progress report. The progress on implementation of above work plan shall be reviewed along with project progress in the monthly project review meetings with owner. In case the progress on site management plan is unsatisfactory, Engineer-in Charge may withhold upto 1% of the monthly running bill (for civil and site erection works) till such time the required progress is demonstrated. In case in the opinion of Engineer-in-charge, bidder's actions on site management aspects is not adequate, Engineer-in-charge may get the relevant work executed through a separate agency and deduct the expenses incurred from Bidder's bill along with overheads @10 %. FIELD OFFICE RECORDS			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 20 OF 53	

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT 		
	The Contractor shall maintain at his Site Office up-to- date copies of all drawings, specifications and other Contract Documents and any other supplementary data complete with all the latest revisions thereto. The Contractor shall also maintain in addition the continuous record of all changes to the above Contract Documents, drawings, specifications, supplementary data, etc. effected at the field and on completion of his total assignment under the Contract shall incorporate all such changes on the drawings and other Engineering data to indicate as installed conditions of the equipment furnished and erected under the Contract. Such drawings and Engineering data shall be submitted to the Employer in required number of copies.		
38.00.00	CONTRACTOR'S MATERIALS BROUGHT ON TO SITE		
38.01.00	The Contractor shall bring to Site all equipment, components, parts, materials, including construction equipment, tools and tackles for the purpose of the Works under intimation to the Employer. All such goods shall, from the time of their being brought vest in the Employer, but may be used for the purpose of the Works only and shall not on any account be removed or taken away by the Contractor without the written permission of the Employer. The Contractor shall nevertheless be solely liable and responsible for any loss or destruction thereof and damage thereto.		
38.02.00	The Employer shall have a lien on such goods for any sum or sums which may at any time be due or owing to him by the Contractor, under, in respect of or by reasons of the Contract. After giving a fifteen (15) days notice in writing of his intention to do so, the Employer shall be at liberty to sell and dispose off any such goods, in such manner as he shall think fit including public auction or private treaty and to apply the proceeds in or towards the satisfaction of such sum or sums due as aforesaid.		
38.03.00	After the completion of the Works, the Contractor shall remove from the Site under the direction of the Employer the materials such as construction equipment, erection tools and tackles, scaffolding etc. with the written permission of the Employer. If the Contractor fails to remove such materials, within fifteen (15) days of issue of a notice by the Employer to do so then the Employer shall have the liberty to dispose off such materials as detailed under as specified at clause no 39.02.00 of this chapter and credit the proceeds thereto to the account of the Contractor.		
39.00.00	PROTECTION OF PROPERTY AND CONTRACTOR'S LIABILITY		
39.01.00	The Contractor shall be responsible for any damage resulting from his operations. He shall also be responsible for protection of all persons including members of public and employees of the Employer and the employees of other Contractors and Sub- Contractors and all public and private property including structures, building, other plants and equipments and utilities either above or below the ground.		
39.02.00	The Contractor will ensure provision of necessary safety equipment such as barriers, sign - boards, warning lights and alarms, etc. to provide adequate protection to persons and property. The Contractor shall be responsible to give reasonable notice to the Employer and the Employers of public or private property and utilities when such property and utilities are likely to get damaged or injured during the performance of his Works and shall make all necessary arrangements with such		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT PAGE 21 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT		
40.00.00	Employers, related to removal and/or replacement or protection of such property and utilities. PAINTING For painting refer Part-A, sub section-III, Section VI of Technical specification. Painting for structures shall conform to the painting specification specified in Part-B under Civil. Painting for Electrical equipments/systems shall conform to the painting specification given in Electrical portion of Part-A and Part-B of technical specifications.		
41.00.00	INSURANCE		
41.01.00	In addition to the conditions covered under the Clause entitled "Insurance" in Section General Conditions of Contract (GCC), the following provisions will also apply to the portion of works to be done beyond the Contractor's own or his Sub-Contractor's manufacturing Works.		
41.02.00	Workmen's Compensation Insurance		
	This insurance shall protect the Contractor against all claims applicable under the Workmen's Compensation Act, 1948 (Government of India). This policy shall also cover the Contractor against claims for injury, disability disease or death of his or his Sub-Contractor's employees, which for any reason are not covered under the Workmen's Compensation Act, 1948. The liabilities shall not be less than the following:		
	Workmen's Compensation - As per Statutory Provisions		
	Employee's Liability - As per Statutory Provisions		
41.03.00	Comprehensive Automobile Insurance		
	This insurance shall be in such a form to protect the Contractor against all claims for injuries, disability, disease and death to members of public including the Employer's men and damage to the property of other arising from the use of motor vehicles during on or off the Site operations, irrespective of the Ownership of such vehicles. The liability covered shall be as herein indicated :		
	Fatal Injury : Rs.100,000 each person		
	: Rs.200,000 each occurrence		
	Property Damage : Rs.100,000 each occurrence		
41.04.00	Comprehensive General Liability Insurance		
41.04.01	The insurance shall protect the Contractor against all claims arising from injuries, disabilities, disease or death of members of public or damage to property of others,		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 22 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT			
	due to any act or omission on the part of the Contractor, his agents, his employees, his representatives and Sub-Contractors or from riots, strikes and civil commotion. This insurance shall also cover all the liabilities of the Contractor arising out of the Clause entitled "Defence of Suits" in Section General Conditions of Contract (GCC).			
41.04.02	The hazards to be covered will pertain to all the Works and areas where the Contractor, his Sub-Contractors, his agents and his employees have to perform work pursuant to the Contract.			
41.05.00	The above are only illustrative list of insurance covers normally required and it will be the responsibility of the Contractor to maintain all necessary insurance coverage to the extent both in time and amount to take care of all his liabilities either direct or indirect, in pursuance of the Contract.			
42.00.00	UNFAVOURABLE WORKING CONDITIONS The Contractor shall confine all his field operations to those works which can be performed without subjecting the equipment and materials to adverse effects during inclement weather conditions, like monsoon, storms, etc. and during other unfavourable construction conditions. No field activities shall be performed by the Contractor under conditions which might adversely affect the quality and efficiency thereof, unless special precautions or measures are taken by the Contractor in a proper and satisfactory manner in the performance of such Works and with the concurrence of the Employer. Such unfavourable construction conditions will in no way relieve the Contractor of his responsibility to perform the Works as per the schedule.			
43.00.00	PROTECTION OF MONUMENTS AND REFERENCE POINTS The Contractor shall ensure that any finds such as relic, antiquity, coins, fossils, etc. which he may come across during the course of performance of his Works either during excavation or elsewhere, are properly protected and handed over to the Employer. Similarly the Contractor shall ensure that the bench marks, reference points, etc., which are marked either with the help of Employer or by the Employer shall not be disturbed in any way during the performance of his Works. If, any work is to be preformed which disturb such reference, the same shall be done only after these are transferred to other suitable locations under the direction of the Employer. The Contractor shall provide all necessary materials and assistance for such relocation of reference points etc.			
44.00.00	WORK & SAFETY REGULATIONS			
44.01.00	General i) The contractor shall comply with all the requirements of "The Building and Other Construction Workers (Regulation of Employment & Conditions of Service) Act," 1996 and its Central Rule 1998 / State Rules and any other statutory requirements as applicable.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 23 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT			
	ii) The Contractor shall follow NTPC Safety Rules as issued from time to time with respect to safety in construction & erection. iii) The contractor shall have the approved Safety, Health and Environment (SHE) Policy in respect of Safety and health of Building Workers and it shall be circulated widely and displayed at conspicuous place in Hindi and local language understood by the majority of the workers. A copy of the safety policy should be submitted to Engineer in charge. iv) The contractor shall submit the safety plan comprising of methods to implement the Safety Policy/ Rules, Risk assessment and ensuring Safety at work areas, Safety audits, inspections and its compliance, Supervision and responsibility to ensure Safety at various levels, Safety training to employees, review of Safety and accident analysis, ensure Health and Safety Procedures to prevent accidents to Engineer I/c for approval as per the format of Safety plan as annexed at Annexure - III. v) The Contractors shall ensure proper safety of all the workmen, materials, plant and equipment belonging to him or to the Employer or to others, working at the Site. vi) All equipments used in construction and erection by the contractor shall meet BIS / International Standards and where such standards do not exist, the Contractor shall ensure these to be absolutely safe. All equipments shall be strictly operated and maintained by the contractor in accordance with manufacturer's operation manual. The contractor should also follow Guidelines / Rules of the Employer in this regard. vii) The Contractors shall provide suitable latest Personal Protective Equipments of prescribed standard to all their employees and workmen according to the need. The Engineer I/c shall have the right to examine these safety equipments to determine their suitability, reliability, acceptability and adaptability. The contractor should also ensure these before their use at worksite. viii) The Contractor shall provide safe working conditions to all workmen and employees at his workplace including safe means of access, railings, stairs, and ladders, scaffolding, work platforms, toe boards etc. The scaffoldings shall be erected under the control and supervision of an experienced and competent person. For erection of scaffolds, access, work platforms etc. shall be good and the contractor shall use standard quality of material. ix) The Contractor shall follow and comply with all the Safety Rules, standards, code of practices of NTPC and relevant provisions of applicable laws pertaining to the safety of workmen, employees, plant and equipment as may be prescribed from time to time without any protest or contest or reservation. In case of any unconformity between statutory requirement and the Safety Rules of the Employer referred above, the latter shall be binding on the Contractor unless the statutory provisions are more stringent. As and when required he can refer / obtain copy of NTPC safety documents as stated above.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 24 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT	एनटीपीसी NTPC		
	required to be complied for use, handling, storing or transportation of explosives under the rules framed under the Explosives Act, 1884.			
44.02.00	Fencing of Machinery The contractor shall provide suitable fencing or guard to all dangerous and moving parts of machinery. The contractor shall not allow any of the employees to clean, lubricate, repair, adjust or examine during machinery in motion, which may cause injury to the person.			
44.03.00	Carrying of Excessive Weight by a Worker The worker shall not be allowed to lift by hand or carry over his head, back or shoulder more than the maximum limit set by the prescribed rules for the construction Workers.			
44.04.00	Dangerous and Harmful Gases / Equipment The contractor shall ensure that the workers are not exposed to any harmful gases during any construction activity including excavation, tunneling, confined spaces etc. The contractor should not allow any worker to go into the confined space unless it is certified by Engineer (I/c) to be safe and fit for the entry to such work place. Proper record and work permits should be followed to carry out such works.			
44.05.00	Overhead Protection The contractor shall ensure that any area exposed to risk of falling materials, articles or objects is roped off or cordoned off or otherwise suitably guarded from inadvertent entry of any person. Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards.			
44.06.00	Working at Heights All working platforms, ways and other places of construction work shall be free from accumulations of debris or any other material causing obstructions and tripping. Wherever workers are exposed to the hazard of falling into water, the contractor shall provide adequate equipment for saving the employees from drowning and rescuing from such hazards. The contractor shall provide boat or launch equipped with sufficient number of life buoys, life jackets etc. manned with trained personnel at the site of such work. Every opening at elevation from ground level through which a building worker, vehicle, material equipment etc. may fall at a construction work shall be covered and/or guarded suitably by the contractor to prevent such falls.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9		PART-D ERECTION CONDITIONS OF CONTRACT PAGE 26 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT 		
44.07.00	Wherever the workers are exposed to the hazards of falling from height, the contractor shall provide full harness safety belts fitted with fall arresting systems to all the employees working at higher elevations and life line of 8 mm diameter wire rope with turn buckles for anchoring the safety belts while working or moving at higher elevations. Safety nets shall also be provided for saving them from fall from heights and such equipment should be in accordance with BIS standards. Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards. The contractor shall provide standard prefabricated ladders on the columns where the workers are required to use them as an access for higher elevations till permanent staircase is provided. The workers shall be provided with safety belts fitted with suitable fall arresting system (Fall arrestors) for climbing/getting down through ladders to prevent fall from height.		
	Handling of Hazardous Chemicals The Contractor will notify well in advance to the Engineer I/c of his intention to bring to the Site any container filled with liquid or gaseous fuel or explosive or petroleum substance or such chemicals which may involve hazards. NTPC shall have the right to prescribe the conditions, under which such container is to be stored, handled and used during the performance of the works and the Contract shall strictly adhere to and comply with such instructions. The Engineer I/c shall have the right at his sole discretion to inspect any such container or such construction plant / equipment for which material in the container is required to be used and if in his opinion, its use is not safe, he may forbid its use. No claim due to such prohibition shall be entertained by NTPC and NTPC shall not entertain any claim of the Contractor towards additional safety provisions / conditions to be provided for / constructed. Further, any such decision of the Engineer I/c shall not, in any way, absolve the Contractor of his responsibilities and in case, use of such a container or entry thereof into the Site area is forbidden by NTPC, the Contractor shall use alternative methods with the approval of the NTPC without any cost implication to the NTPC or extension of work schedule. Where it is necessary to provide and / or store petroleum products or petroleum mixtures and explosives, the Contractor shall be responsible for carrying-out such provision and / or storage in accordance with the rules and regulations laid down in Petroleum Act 1934, Explosives Act 1948, and Petroleum and Carbide of Calcium Manual published by the Chief Inspector of Explosives of India. All such storage shall have prior approval of the Engineer I/c. In case any approvals are necessary from the Chief Inspector (Explosives) or any statutory authorities, the Contractor shall be responsible for obtaining the same. The Contractor shall be fully responsible for the safe storage of his and his Sub-contractor's radio-active sources in accordance with BARC/DAE (Bhabha Atomic Research Centre/ Department of Atomic Energy, Govt. of India) Rules and other applicable provisions. All precautionary measures stipulated by BARC/DAE in		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 27 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT	एनटीपीसी NTPC		
44.08.00	connection with use, the contractor would take storage and handling of such material.			
	The contractor shall provide suitable personal protective equipments to the workers who are handling the hazardous and corrosive substances including alkalis and acids.			
	As a precautionary measure the contractor should keep the bottles filled with distilled water in cupboard / Boxes near work place for emergency eye wash by worker exposed to such hazardous chemicals.			
	Eye Protection The contractor shall provide suitable personal protective equipment to his workmen depending upon the nature of hazards and ensure their usage by the workers engaged in operations like welding, cutting, chipping, grinding or similar operations which may cause injuries to his eyes.			
44.09.00	Excavation The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding material or article from any bank or side of such excavation which is more than one and a half meter above his footing by providing adequate piling, shoring, bracing etc. against such bank or sides.			
44.10.00	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.			
	Electrical Hazards The contractor should ensure that all electrical installations at the construction work comply with the requirements of latest electricity acts / rules. The contractor shall take all adequate measures to prevent any worker from coming into physical contact with any electrical equipment or apparatus, machines or live electrical circuits which may cause electrical hazards during the construction work. The contractor shall provide the sufficient ELCBs / RCCBs for all the portable equipments, electrical switchboards, distribution panels etc. to prevent electrical shocks.			
	The contractor should ensure use of single / double insulated hand tools or low voltage i.e., 110 volts hand tools.			
44.11.00	The contractor should also ensure that all temporary electrical installations at the construction works are provided with earth leakage circuit breakers.			
	Vehicular Traffic The contractor should employ vehicle drivers who hold a valid driving license under the Motor Vehicles Act, 1988.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 28 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT			एनटीपीसी NTPC
44.12.00	Lifting Appliances, Tools & Tackles, Lifting Gear And Pressure Plant & Equipment etc. The contractor shall ensure all the lifting appliances, tools & tackles including cranes etc., lifting gear including fixed or movable and any plant or gear, hoists, Pressure Plant and equipment etc. are in good condition and shall be examined by competent person and only certified shall be used at sites. Periodical Examination and the tests for all lifting / hoisting equipment & tackles shall be carried out. A register of such examinations and tests shall be properly maintained by the Contractor and will be promptly produced as and when desired by the Engineer I/c or by the person authorized by him.			
44.13.00	Excessive Noise, Vibration The contractor shall take adequate measures to protect the workers against the harmful effect of excessive noise or vibration. The noise should not exceed the limits prescribed under the concerned rules, Noise Pollution (Regulation and Control) Rules, 2000.			
44.14.00	Electrical Installations			
44.14.01	The Contractor shall not interfere or disturb electric fuses, wiring and other electrical equipment belonging to the Employer or other contractors under any circumstances, whatsoever, unless expressly permitted in writing by the Engineer I/c to handle such fuses, wiring or electrical equipment. Before the Contractor connects any electrical appliances to any plug or socket belonging to the other contractor or the NTPC, he shall i) Satisfy the Engineer I/C that the appliance is in good working condition; ii) Inform the Engineer I/C of the maximum current rating, voltage and phases of the appliances; iii) Obtain permission of the Engineer I/C detailing the sockets to which the appliances may be connected. The Engineer I/C will not grant permission to connect until he is satisfied that: The appliance is in good condition and is fitted with suitable plug; having earth connection with the body. Wherever armored / metallic sheathed multi core cable is used, the same armored / sheathed should be connected to earth. iv) No repair work shall be carried out on any live equipment. The Engineer I/c must declare the equipment safe and a permit to work shall be issued by the NTPC / contractor as the case may be to carry out any repair / maintenance work. While working on electric lines / equipments whether live or dead, suitable type and sufficient quantity of tools will have to be provided by the contractor to electricians / workmen / Officers.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 29 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT			
	v) The contractor shall employ necessary number of qualified, full time Electricians / Electrical Supervisors to maintain his temporary electrical installation. The installations are provided with suitable ELCBs and RCCBs wherever required.			
44.15.00	Safety Organisation			
44.15.01	The contractor employing more than 250 workmen whether temporary, casual, probationary, regular or permanent shall employ at least one full time safety officer exclusively to supervise safety aspects of the equipments and workmen, who will coordinate with the NTPC Safety Officer. Further requirement of safety officers, if any, shall be guided by Rule 209 of The Building and Other Construction Worker (Regulation of Employment and Conditions of Service) Central Rule 1998. In case the work is being carried out through subcontractor, the employees / workmen of the sub contractor shall also be considered as the contractor's employees/workmen for the above purpose. In case of contractor deploying less than 250 workmen he should designate one of his Engr / supervisor or the contractor himself (if he is directly supervising the work) as safety officer in addition to his existing responsibilities. The Engr./ supervisor should get atleast 2days safety training from any reputed organization or from NTPC before resuming the work. If already trained in past the declaration along with trg. certificate to be furnished to NTPC safety officer.			
44.15.02	The name and address of such Safety Officer of the Contractor will be promptly informed in writing to the EIC with a copy to the Project Safety Officer before he starts work or immediately after any change of the incumbent is made during currency of the Contract.			
44.16.00	Reporting of Accident and Investigation In case any accident occurs during the construction / erection or other associated activities undertaken by the Contractor thereby causing any near miss, minor or major or fatal injury to his employees due to any reason, whatsoever, it shall be the responsibility of the Contractor to promptly inform the same to the Engineer I/C, NTPC Safety Officer with a copy to NTPC Head of Project in the prescribed form and also to all the authorities envisaged under the applicable laws.			
44.17.00	Right to stop Work			
44.17.01	The Engineer I/C shall have the right at his sole discretion to stop the work, if in his opinion the work is being carried out in such a way that it may cause accidents and endanger the safety of the persons and / or property, and / or equipments. In such cases, the contractor shall be informed in writing about the nature of hazards and possible injury / accident and he shall comply to remove shortcomings promptly. The Contractor after stopping the specific work can, if felt necessary appeal against the order of stoppage of work to the Project Manager within 3 days of such stoppage			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9		PART-D ERECTION CONDITIONS OF CONTRACT PAGE 30 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT			
44.17.02	of work and decision of the Project Manager in this respect shall be conclusive and binding on the Contractor. The Contractor shall not be entitled for any damages / compensation for stoppage of work, {Sub-Clause XVIII (I)} due to safety reasons and the period of such stoppage of work shall not be taken as an extension of time for Completion of the Facilities and will not be the ground for waiver of levy of liquidated damages. Fire Protection The contractor shall provide sufficient fire extinguishers at place /s of work. The fire extinguishers shall be properly maintained as per relevant BIS Standards. The employees shall be trained to operate the fire extinguishers / equipment. Penalties I If the Contractor fails in providing safe working environment as per the Safety Rules of NTPC or continues the work even after being instructed to stop the work by the Engineer I/C as provided in Clause XVIII (1) above, the Contractor shall be penalized at the rate of Rs. 25,000/- per day or part thereof till the instructions are complied with and so certified by the Engineer I/C. However, in case of accident, the provisions contained in Sub-Clause XX (II) below shall also apply in addition to the penalties mentioned in this sub-clause. II If the Contractor does not take all safety precautions and / or fails to comply with the Safety Rules as prescribed by the Employer or under the applicable law for the safety of the plant and equipment and for the safety of personnel and the contractor does not prevent hazardous conditions which cause injury to this own employees or employees of other contractors, or NTPC's employees or any other person who are at the Site or adjacent thereto, the Contractor shall be responsible for payment of penalty to NTPC as per the following schedule:- a) Fatal injury or accident causing death: Penalty @10% of contract value or Rs. 5,00,000/- per person, which ever is less. b) Major injuries or accident causing 25% or more permanent disablement to workmen or employees: Penalty @2.5% of contract value or Rs. 1,00,000/- per person which ever is less Permanent disablement shall have the same meaning as indicated in The Workmen's Compensation Act' 1923. The penalty mentioned above shall be in addition to the compensation payable to the workmen / employees under the relevant provisions of the Workmen's Compensation Act' 1923 and rules framed there under or any other applicable laws as applicable from time to time.			
44.18.00				
44.19.00				
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 31 OF 53	

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT			एनटीपीसी NTPC
	III If any contractor worker found working without using the safety equipment like safety helmet, safety shoes, safety belts, etc. or without anchoring the safety belts while working at height the Engineer I/c / Safety Officer of NTPC shall have the right to penalize the contractor for Rs. 200/- per person per day and such worker shall be sent out of the workplace immediately and shall not be allowed to work on that day. Engineer I/c / Safety Officer of NTPC will also issue a notice in this regard to the contractor. IV If two or more fatal accidents occur at same NTPC site under the control of contractor during the period of contract and he has (1) not complied with keeping adequate PPEs in stock or (2) defaulted in providing PPEs to his workmen (3) not followed statutory requirements / NTPC safety rules (4) been issued warning notice/s by NTPC head of the project on non observance of safety norms (5) not provided safety training to all his workmen, the contractor can be debarred from getting tender documents in NTPC for two years from the date of last accident. The safety performance will also be one of the overriding criteria for evaluation of overall performance of the contractors by NTPC. The contractor shall submit the accident data including fatal / non-fatal accidents for the last 3 years where he has undertaken the construction activities Projects-wise along with the tender documents. This will also be considered for evolution of tender documents. If the information given by the contractor found incorrect, his contract will be liable to be terminated.			
44.20.00	The Contractor will make available minimum quantity of all safety equipments and safety personal protection equipments (PPEs) of required specifications as per suggestive list included bidding documents as a part of "List of minimum T & P". Further Contractor will ensure availability of additional requirement for individual worker and safety equipment as per site requirement during execution of the contract till its completion.			
44.21.00	Award If the Contractor's performance on safety front is found satisfactory i.e. without any fatal/reportable accident in the year of consideration; he may be considered for suitable award "ACCIDENT FREE SAFETY MERITORIOUS AWARD" as per scheme of the employer.			
44.22.00	The Contractor shall abide by the following during Construction and Erection activities: I. Chain pulley block shall not be used for loads more than 2 (Two) tonne.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 32 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT	एनटीपीसी NTPC		
	II. Hydra shall not be used for material transport. III. Cage shall necessarily be provided to Monkey ladders of height more than 4 m. IV. Fencing shall be provided to all Electrical Distribution boards and transformers etc.			
45.00.00	FOREIGN PERSONNEL			
45.01.00	The Contractor shall submit to the Employer data on all personnel he proposes to bring into India from abroad for the performance of the Works under the Contract, at least sixty (60) days prior to their departure to India. Such data will include for each person the name, his present address, his assignment and responsibility in connection with the works, and a short resume of his qualification, experience etc. in relation to the work to be performed by him.			
45.02.00	Any person unsuitable and unacceptable to the Employer shall not be brought to India. Any person brought to India, if found unsuitable or unacceptable by the Employer, the Contractor shall within a reasonable time make alternate arrangements for providing a suitable replacement and repatriation of such unsuitable personnel.			
45.03.00	No person brought to India for the purposes of the works shall be repatriated without the consent of the Employer in writing, based on a written request from the Contractor for such repatriation giving reasons for such an action to the Employer. The Employer may give permission for such repatriation provided he is satisfied that the progress of work will not suffer due to such repatriation.			
45.04.00	The cost of passports, visas and all other travel expenses to and from India, incurred by the Contractor shall be to his account. The Employer will not provide any residential accommodation and/or furniture for any of the Contractor's personnel including foreign personnel and Contractor shall make his own arrangements for such facilities in the area allotted at Site, to him by the Employer for that purpose.			
45.05.00	The Contractor and his expatriate personnel shall respect all Indian Acts, Laws, rules and regulations and shall not in any way interfere with Indian political and religious affairs and shall conform to any other rules and regulations which the Government of India and the Employer may establish from time to time, on them. The Contractor's expatriate personnel shall work and live in close co-operation and coordination with their co-workers and the community and shall not engage themselves in any other employment neither part-time nor full-time nor shall they take part in any local politics.			
45.06.00	The Employer shall assist the Contractor, to the extent possible, in obtaining necessary permits to travel to India and back, by issue of necessary certificates and other information needed by the Government agencies.			
46.00.00	FOUNDATION DRESSING & GROUTING FOR EQUIPMENT/ EQUIPMENT BASES			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9		PART-D ERECTION CONDITIONS OF CONTRACT PAGE 33 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT			एनटीपीसी NTPC
46.01.00	The surfaces of foundations shall be dressed to bring the top surface of the foundations to the required level, prior to placement of equipment/equipment bases on the foundations.			
46.02.00	All the equipment/ equipment bases, shall be grouted and finished by bidder as per these specifications unless otherwise recommended by the equipment manufacturer.			
46.03.00	The concrete foundation surfaces shall be properly prepared by bidder by chipping, grinding as required to bring the top of such foundation to the required level, to provide the necessary roughness for bondage and to assure enough bearing strength.			
46.04.00	Grout The grout for equipment foundation shall be high strength grout having a minimum characteristic compressive strength of 60 N/mm² at 28 days. The grout shall be ready mix non-shrink, chloride - free, cement based, free flowing, non-metallic grout as recommended by equipment manufacturer. The ready mix grout shall be of reputed make as approved by the Employer. The Grout shall have good flowability even at very low water/ grout powder ratio. The Grout shall have characteristics of controlled expansion to be able to occupy its original volume to fill the voids and to compensate for shrinkage. Grout shall be of pre-mix variety so that only water needs to be added before use. The mixing of the Grout shall conform to the recommendations of the manufacturer of the Grout.			
46.05.00	Placing of Grout			
46.05.01	After the base has been prepared, its alignment and level has been checked and approved and before actually placing the grout, a low dam shall be set around the base at a distance that will permit pouring and manipulation of the grout. The height of such dam shall be at least 25mm above the bottom of the base. Suitable size and number of chains shall be introduced under the base before placing the grout, so that such chains can be moved back & forth to push the grout into every part of the space under the base.			
46.05.02	The grout shall be poured either through grout holes if provided or shall be poured at one side or at two adjacent sides to make the grout move in a solid mass under the base and out in the opposite side. Pouring shall be continued until the entire space below the base is thoroughly filled and the grout stands at least 25 mm higher all around than the bottom of the base. Enough care should be taken to avoid any air or water pockets beneath the bases.			
46.05.03	In addition to the above, recommendations of Grout manufacturer shall also be followed.			
46.06.00	Finishing of the Edges of the Grout			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 34 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT	एनटीपीसी NTPC		
	The poured grout should be allowed to stand undisturbed until it is well set. Immediately thereafter, the dam shall be removed and grout which extends beyond the edges of the structural or equipment base plates shall be cut off, flushed and removed. The edges of the grout shall then be pointed and finished with 1:2 cement mortar pressed firmly to bond with the body of the grout and smoothened with a tool to present a smooth vertical surface. The work shall be done in a clean and scientific manner and the adjacent floor spaces, exposed edges of the foundations, and structural steel and equipment base plates shall be thoroughly cleaned of any spillage of the grout.			
46.07.00	Checking of Equipment After Grouting After the grout is set and cured, the Contractor shall check and verify the alignment of equipments, alignment of shafts of rotating machinery, the slopes of all bearing pedestals, centering of rotors with respect to their sealing bores, couplings, etc. as applicable and the like items to ensure that no displacement had taken place during grouting. The values recorded prior to grouting shall be used during such post grouting check- up and verifications. Such pre and post grout records of alignment details shall be maintained by the Contractor in a manner acceptable to the Employer.			
47.00.00	SHAFT ALIGNMENTS All the shafts of rotating equipment shall be properly aligned to those of the matching equipments to as perfect an accuracy as practicable. The equipment shall be free from excessive vibration so as to avoid overheating of bearings or other conditions which may tend to shorten the life of the equipment. The vibration level of rotating equipments measured at bearing housing shall conform to Zone A of ISO 10816. All bearings, shafts and other rotating parts shall be thoroughly cleaned and suitably lubricated before starting.			
48.00.00	DOWELLING All the motors and other equipment shall be suitably doweled after alignment of shafts with tapered machined dowels as per the direction of the Employer.			
49.00.00	CHECK OUT OF CONTROL SYSTEMS After completion of wiring, cabling furnished under separate specification and laid and terminated by the Employer, the Contractor shall check out the operation of all control systems for the equipment furnished and installed under these specifications and documents.			
50.00.00	COMMISSIONING SPARES			
50.01.00	It will be the responsibility of the Contractor to provide all commissioning spares including consumable spares required for initial operation till the Completion of Facilities. The Contractor shall furnish a list of all commissioning spares within 60 days from the date of Notification of Award and such list shall be reviewed by the Employer and mutually agreed to. However. such review and agreement will not			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9		PART-D ERECTION CONDITIONS OF CONTRACT PAGE 35 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT	एनटीपीसी NTPC		
	absolve the Contractor of his responsibilities to supply all commissioning spares so that initial operation do not suffer for want of commissioning spares. All commissioning spares shall be deemed to be included in the scope of the Contract at no extra cost to the Employer.			
50.02.00	These spare will be received and stored by the Contractor atleast 3 months prior to the schedule date of commencement of initial operation of the respective equipment and utilised as and when required. The unutilised spares and replaced parts, if any, at the end of successful completion of guarantee tests shall be the property of the Contractor and he will be allowed to take these parts back at his own cost with the permission of Employer.			
51.00.00	CABLING			
51.01.00	All cables shall be supported by conduits or cable tray run in air or in cable channels. These shall be installed in exposed runs parallel or perpendicular to dominant surfaces with right angle turn made of symmetrical bends or fittings. When cables are run on cable trays, they shall be clamped at a minimum intervals of 2000mm or otherwise as directed by the Employer.			
51.02.00	Each cable, whether power or control, shall be provided with a metallic or plastic tag of an approved type, bearing a cable reference number indicated in the cable and conduit list (prepared by the Contractor), at every 5 meter run or part thereof and at both ends of the cable adjacent to the terminations. Cable routing is to be done in such a way that cables are accessible for any maintenance and for easy identification.			
51.03.00	Sharp bending and kinking of cables shall be avoided. The minimum radii for PVC insulated cables 1100 V grade shall be 15 D where D is the overall diameter of the cable. Installation of other cables like high voltage, coaxial, screened, compensating, mineral insulated shall be in accordance with the cable manufacturer's recommendations. Wherever cables cross roads and water, oil, sewage or gaslines, special care should be taken for the protection of the cables in designing the cable channels.			
51.04.00	In each cable run some extra length shall be kept at a suitable point to enable one or two straight through joints to be made, should the cable develop fault at a later date.			
51.05.00	Control cable terminations shall be made in accordance with wiring diagrams, using identifying codes subject to the Employer's approval. Multicore control cable jackets shall be removed as required to train and terminate the conductors. The cable jacket shall be left on the cable, as far as possible, to the point of the first conductor branch. The insulated conductors from which the jacket is removed shall be neatly twined in bundles and terminated. The bundles shall be firmly but not tightly tied utilising plastic or nylon ties or specifically treated fungus protected cord made for this purpose. Control cable conductor insulation shall be securely and evenly cut.			
51.06.00	The connectors for control cables shall be covered with a transparent insulating sleeve so as to prevent accidental contact with ground or adjacent terminals and shall preferably terminate in Elmex terminals and washers. The insulating sleeve shall be fire resistant and shall be long enough to over pass the conductor insulation.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 36 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT			एनटीपीसी NTPC
	(b.) Equipment shall be packed with suitable desiccants, sealed in water proof vapour-proof wrapping and packed in lumber of plywood enclosures, suitably braced, tied and skidded. Lumber enclosures shall be solid, not slatted. (c.) Desiccants shall be either silica gel or calcium sulphate, sufficiently ground to provide the required surface area and activated prior to placing in the packaging. Calcium sulphate desiccants shall be of a chemical nature to absorb moisture. In any case, the desiccant shall not be of a type that will absorb enough moisture to go into solution. Desiccants shall be packed in porous containers, strong enough to withstand handling encountered during normal shipment. Enough desiccant shall be used for the volumes enclosed in wrapping. (d.) Review by the Employer of the Contractor's proposed packaging methods shall not relieve the Contractor of responsibility for damage or deterioration to the equipment and materials specified. (e.) All accessory items shall be shipped with the equipment. ; Boxes and crates containing accessory items shall be marked so that they are identified with the main equipment. The contents of each box and crates shall be indicated by markings on the exterior. (f.) All boxes, crates, cases bundles, loose pieces, etc. shall be marked consecutively from No.1 upward throughout all shipments from a given port to completion of the order without repeating the same number. (g.) An itemized list of contents shall be enclosed inside each case and one other copy securely fastened to the outside of the case in a tin or light weight sheet metal envelope or pocket. The lists shall be plainly marked and placed in accessible locations to facilitate receipt and inspection. The packing list shall indicate whether shipment is partial or complete and shall incorporate the following information on each container, etc., according to its individual shipping number: a) Export case markings b) Case number c) Gross weight and net weight in Kilograms d) Dimensions in centimeters e) Complete description of material (h.) Packaging or shipping units shall be designed within the limitations of unloading facilities and the equipment which will be used for transport. Complications involved with ocean shipment and the limitations of ports, railways and roads shall be considered. It shall be the Contractor's responsibility to investigate these limitations and to provide suitable packaging to permit safe handling during transit and at the job site.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 38 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT 		
52.03.00	(i.) Electrical equipment, control and instrumentation shall be protected against moisture and water damage. All external gasket surfaces and flange faces, couplings, motor pump shafts, bearing and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection. (j.) Equipment having antifriction or sleeve bearings shall be protected by weather tight enclosures. (k.) Coated surfaces shall be protected against impact, abrasion, discolouration and other damage. Surfaces which are damaged shall be repaired. (l.) All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors. All female threaded openings shall be closed with forged steel plugs. All pipings, tubing, and conduit equipment and other equipment openings shall be sealed with metallic or other rough usage covers and tapped to seal the interior of the equipment piping, tubing, or conduit. (m.) Provisions shall be made to ensure that water does not enter any equipment during shipment or in storage at the plant site. (n.) Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense. (o.) While packaging the material, care shall be taken for the limitation from the point of view of availability of railway wagon sizes in India.		
	Factory Assembly (a.) Instrument enclosures shall be supplied and erected completely in the factory with instrument, air supply and blow down piping with necessary valves, fittings, etc. and also all electrical wiring between the instruments and the enclosure terminal blocks. Control panel and cubicles shall also be fully wired in the factory. Control panel mounted equipments are to be dismounted from the panels before shipment and individually packed for shipment. Electronic control modules of the plug-in type are to be removed from equipment racks after factory checkout are individually packed for shipment. Other equipment shall be fully assembled at the factory, except for necessary shipping splits in panels. (b.) All separately packaged accessories items and parts shall be shipped with the equipment. Containers for separately packaged items shall be marked so that they are identified with the main equipment. An itemized packing slip, indicating what is in that carton only, shall be attached to the outside and inside of each container used for packing. A master packing slip covering all accessories items for a given piece of equipment which are shipped in separate containers, shall be attached to one container.		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT PAGE 39 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT 		
52.04.00	Equipment Installation (a.) General Requirements (1.) The Contractor shall furnish all construction materials, tools and equipment and shall perform all work required for complete installation of all control and instrument equipment furnished under this specification. (2.) Contractor shall prepare detailed installation drawings for each equipment furnished under this specification for Employer's approval. Installation of all equipment/systems furnished by this specification shall be as per Employer's approval. (3.) Erection procedures not specified herein shall be in accordance with the recommendations of the equipment manufacturers. The procedures shall be acceptable to the Employer. (4.) The Contractor shall coordinate his work with other suppliers where their instruments and devices are to be installed under specifications. (b.) Installation Materials All materials required for installation, testing and commissioning of the equipment shall be furnished by the Contractor. (c.) Regulatory Requirements All installation procedures shall confirm with the accepted good engineering practice and with all applicable governmental laws, regulations and codes. (d.) Cleaning All equipment shall be cleaned of all sand, dirt and other foreign materials immediately after removal from storage and before the equipment is brought inside the power plant building or to other installation sites. All piping and tubes shall be air blown. (e.) Equipment Assembly Equipment installed under these specifications shall be assembled if shipped unassembled. The equipment shall be dismantled and reassembled as required to perform the installation and commissioning work described in these specifications. (f.) Equipment Setting Field mounted instruments and accessories shall be bracket or sub panel mounted on the nearest suitable firm steel work or masonry. The brackets,		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT PAGE 40 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT 		
	stands, supports and other miscellaneous hardware required for mounting instruments and accessories such as receiver gauge, air set, valve manifold, purge-meter etc. shall be furnished and installed. No field mounted instruments shall be installed such that it depends for support or rigidity on the impulse piping or on electrical connection to it. Indicating type field mounted instruments shall be installed in such a way that centre of indicating dial shall be about 1600-1800mm from operating floor level. Non-indicating type field instruments shall be installed such that operating handle of manifold block / isolating cock comes within 1600 mm from operating floor level. (g.) Free-Standing Equipment Free-standing Cabinets shall be attached to the floor, concrete equipment bases or supporting steel as indicated on the manufacturer's drawings and the Employer's Plant Arrangement Drawings. The cabinets shall be shimmed for proper alignment before bolting them to the floor. Adjacent enclosures shall be shimmed to maintain mutually level appearance before they are attached to floor. Vibration dampening mounts shall be installed between supporting structures and panels when specified. (h.) Non-free Standing Equipment (1.) Non-free standing local enclosures and cabinets shall be mounted in accessible locations on columns, walls, or stands in locations as indicated on the Employer's Plant Arrangement Drawings. Bracket and stands shall be fabricated as required to install the local enclosures and cabinets in a workman like manner. (2.) Rough edges and welds on all fabricated supports shall be ground smooth. The supports shall be finished with two coats of primer and two coats of paint as specified in this part. (i.) Equipment Location (1.) All individual items of equipment not located in cabinets or on panels and racks are located approximately according to the floor elevation and the nearest building column designated by the Employer. (2.) Solenoid valves not located in enclosures or mounted on valves shall be mounted in easily accessible protected locations near the components with which they are associated. (3.) All brackets, stands, supports and other miscellaneous hardware required for mounting devices shall be furnished and installed. (4.) Thermometers shall be installed in the process lines and ducts as required and adjusted for ease in reading.		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 41 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT			
	(5.) Permanent temperature wells on the main steam, hot reheat and cold reheat piping shall not be installed until steam blowing has been completed. Temporary temperature wells shall be installed in the main and reheat steam piping during steam blow and discarded after completion. (6.) Any required adapting hardware such as pipe bushings, nipples, drilled caps and the like shall be provided for complete installation of control devices into process connections. For location of C&I related equipment/devices, the requirement specified elsewhere in the technical specification may be referred. (j.) Installation of Field Mounted Instruments and Devices The Contractor shall submit installation drawings for all field mounted equipment furnished under this specification for Employer's approval. These drawings shall meet the requirements of this specification, installation drawings, applicable codes and standards and recommendations of manufacturers of instruments/devices. All installation work under this specification shall be strictly as per installation drawings approved by the Employer during detailed engineering stage. In addition to above relevant Portion as specified elsewhere in technical specification may be referred. (k.) Piping Connections (1.) All equipment having piping connections shall be levelled, aligned and wedged in place but shall not be grouted or bolted prior to the initial fitting and alignment of connecting piping. All equipment shall, however, be grouted or bolted to its foundation prior to final bolting or welding of the connection piping. (2.) All flanged joints shall be checked and retightened after approximately 10 days of operation at normal operating temperature. (l.) Equipment Checkout (1.) All equipment shall be cleaned after installation. Equipment subject to pressure differentials shall be checked for leakage. (2.) After erection, all equipment having moving parts, having electrical apparatus, or subject to pressure differentials shall be trial-operated. (m.) Defects (1.) All defects in erection shall be corrected to the satisfaction of the Employer and the Project Manager. The dismantling and reassembly of Contractor furnished equipment to remove defective parts, replace			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 42 OF 53	

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT			एनटीपीसी NTPC
	parts, or make adjustments shall be included as a part of the work under these specifications. (2.) The removal of control and instrument equipment in order to allow bench calibration, if required, and the re-installation of the said equipment after calibration shall also be included as a part of the work under these specifications. (n.) Equipment Protection (1.) All equipment to be erected under these specifications shall be protected from damage of any kind from the time of contract award until commissioning of each unit. (2.) The equipment shall be protected during storage as described herein. (3.) Equipment shall be protected from weld spatter during construction. (4.) Suitable guards shall be provided for protection of personnel on all exposed rotating or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy removal and maintenance. (5.) Equipment having glass components such as gauges, or equipment having other easily breakable components, shall be protected during the construction period with plywood enclosures or other suitable means. Broken, stolen, or lost components shall be replaced by the Contractor. (6.) Machine finished surfaces, polished surfaces, or other bare metal surfaces which are not to be painted, such as machinery shafts and couplings shall be provided temporary protection during storage and constructional periods by a coating of a suitable non- drying, oily type, rust preventive compound.			
53.00.00	WELDING - SPECIAL REQUIREMENTS If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be performed under separate specifications, the requirements shall be submitted to the Project Manager in advance of commencement of erection work.			
54.00.00	DEVIATIONS DISPOSITIONING: Any deviation to the contract and employer approved documents shall be properly recorded in the format prescribed by NTPC. All the deviations shall be brought to the knowledge of employer's representative for suitable dispositioning.			
55.00.00	NON-DESTRUCTIVE TESTING (NDT):			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 43 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT 		
56.00.00	The contractor shall record results of NDTs carried out at site in the format acceptable to employer. All the radiographs & its report duly signed & correlated to the job shall be handed over to the employer. Sensitivity of all the test equipment shall be compatible to the job & acceptance norms agreed. TESTING EQUIPMENT & FACILITIES: Contractor shall provide the testing equipment and facilities necessary to carry out tests & inspections.		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 44 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT		
	ANNEXURE-I <u>STANDARD CHECKLIST</u> This is an indicative list of items. The actual list shall depend on the Equipment / System being supplied by the contractor. <u>MECHANICAL</u> <u>VALVES</u> 1. Manually Operated Valve 2. Electrically Operated Valve 3. Pneumatically Actuated Valve 4. Hydraulically Actuated Valve 5. Safety Valve 6. Electromatic Relief Valve 7. Steam Trap 8. Non Return Valve (including Hydraulic/ Pneumatic QCNRVS) 9. Control Valve 10. Relief Valve 11. Differential Pressure Regulating Valve 12. Pinch valve <u>TANKS & PRESSURE VESSELS</u> 1. Limestone silos 2. Gypsum storage silos 3. Limestone slurry tanks 4. Filtrate tank 5. Waste water tank		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 45 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT 		
	6. Secondary hydrocyclone feed tank 7. Lime dosing tank 8. Process water tank 9. Absorber 10. Auxiliary absorbent tank 11. Mill circuit tank 12. Any other tank not covered above 13. Vacuum tanks 14. Air Receiver(if any) <u>PUMPS</u> 1. Slurry recirculation pumps 2. Gypsum bleed pumps 3. Limestone slurry pumps 4. Process water pumps 5. All other slurry pumps 6. Vacuum pumps 7. Sump pumps <u>PIPE WORK SYSTEM</u> 1. Steam services 2. Water services 3. Slurry services 4. Air services 5. Constant load support 6. Spring supports 7. Hangers and other Supports		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 46 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT	एनटीपीसी NTPC		
	<u>STRAINER AND FILTER</u> 1. Strainer / Filter Basket Type 2. Strainer Rotary (Low Pressure) 3. Filter & Strainers Centrifugal Separators 4. Filter & Strainer Y-Type 5. Filter & Strainer (Plate Type) 6. Purifier 7. Filter – Compressed Air Line <u>FANS & COMPRESSORS</u> 1. Booster Fans (if provided) – Axial Flow pressure Lubricated 2. Oxidation Blowers/Compressors-General <u>DAMPERS & GATES</u> 1. Manually Operated Damper 2. Pneumatically Operated Damper 3. Electrically Operated Damper 4. Manually Operated Gates 5. Pneumatically Operated Gate 6. Electrically Operated Gate <u>DUCT WORK</u> 1. Flue Gas Ducting 2. Expansion Joints 3. Observation & Access Door <u>CRANES AND ELEVATORS</u> 1. Crane 2. Hoists			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 47 OF 53	

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT 		
	3. Passenger cum goods elevator <u>POWER TRANSMISSION</u> 1. Power Transmission Gear Box 2. Bearings 3. Couplings <u>FGD & AUX.SYSTEM</u> 1. Agitators 2. Air Motor 3. Process trustle 4. Limestone feeder 5. Vacuum belt filter 6. Limestone ball mill 7. Limestone Hydrocyclones 8. Primary Hydrocyclones 9. Secondary Hydrocyclones 10. Absorber internals 11. Absorber Auxiliaries <u>ELELCTRICAL</u> 1. D.C. Motor 2. HV Squirrel Cage Induction Motor 3. 415 V Squirrel Cage Induction Motor 4. Motor Operated Actuators 5. Soot Blower (GGH) 6. Aux. Control and Relay Panel Desk 7. SWITCHGEARS/MCC		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 48 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT	एनटीपीसी NTPC	
	(I.) STANDARD CHECLISTS FOR ALL TYPES OF RELAYS USED IN SWITCHGEARS PROTECTION SYSTEM (II.) PT CARRIAGE AND CUBICLES (III.) CABLE/BUS DUCT/BUS BARS (IV.) CONTRACTOR MODULE (V.) SWITCH FUSE MODULE (VI.) MASTER PANEL OF LUBE OIL PANEL (VII.) FEEDER PANEL OF LUBE OIL PANEL (VIII.) SFACE HEATER AND CABLE MODULE (IX.) HT CIRCUIT BREAKER (X.) 415 V CIRCUIT BREAKER POWER CABLE AUXILIARY CABLE D.C. CABLE EXPLOSION PROOF ELECTRICAL EQUIPMENT JUNCTION BOX CONTROL TRANSFORMER MODULE BRUSH GEAR ASSEMBLY AUX. CONTROL AND RELAY PANEL DESK INDICATING INSTRUMENT RECORDING INSTRUMENT INTEGRATING INSTRUMENT <u>CONTROL & INSTRUMENTATION</u> 1. Conductivity Measuring Equipment Including Test Procedures 2. pH Analyser Including Test procedure		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 49 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT	एनटीपीसी NTPC		
	3. Silica Analyser 4. Level Switch (Float Actuated) 5. Level Switch (Electrode Type) 6. Level Switch (Displacer Actuated) 7. Transmitter (Float Operated Pneumatic Output including Testing procedures) 8. Level indicator (Float/Pulley Type) 9. Local Temperature Indicator Including Test Procedure 10. Resistance Thermometer Element Including Test procedure 11. Thermocouple Element and Connecting Cable 12. Thermocouple and Resistance Thermometer Convertor/Transmitter Including Test Procedures 13. Temperature Switch Including Test Procedure 14. Cold Junction Boxes 15. O₂Analyser 16. SO₂ analyzer 17. O₂ in Hydrogen including Test procedures 18. Pressure and Vacuum Gauge 19. Pressure and Vacuum Switch Including Test procedures 20. Differential Pressure Transmitter including Test Procedures 21. Differential pressure switch including Test procedures 22. Flow indicator (Variable Area) 23. Orifice plate 24. Flow Switch 25. Nozzle 26. Flow Integrator (pneumatic input) including test procedure			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 50 OF 53	

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT	एनडीपीसी NTPC		
	27. Flow indicator (Float Operated) Including Test Procedure 28. Venturi (Fluid) 29. Flow Switch (Magnetic Type) 30. Limit Switches 31. Turbine Supervisory Measuring System 32. Position Measurement & Indication Including Test procedures 33. Vibration Measurement 34. Digital Indicator 35. Moving Coil Indicator Including Test Procedures 36. Recorder Including Test procedure 37. Flame Scanner 38. Electrical Auto Manual Control Station 39. Push Button Module 40. Test Procedure for Electronic Modules of DDCMIS 41. Alarm Annunciator Equipment Including Test Procedure 42. Test procedure for Adjustment of Modulating Controller-PID Term 43. Test Procedure Indicating Controller-Electrical Input & Pneumatic Output 44. Density monitors Note: The items which are not part of this specification may be considered as not applicable.			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 51 OF 53	

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT 		
	ANNEXURE-II BRIEF WRITE UP ON THE CONTENTS OF TESTING SCHEDULE / COMMISSIONING SCHEDULE Testing Schedules should be designed to ensure that the plant area, equipment or apparatus are tested and commissioned and will operate as per the employer's specifications and good engineering practices. Testing Schedule/Commissioning Schedule is required to be of a standard format in order to maintain consistency of presentation, content and reporting. Testing Schedule/Commissioning Schedule should contain the following sections to make the document a self contained one: 1. Plant Details/Design data 2. Testing Objective/Proposals 3. State of the Plant a) Erection Status with respect to Mech. Elect and C&I b) Availability of the services required c) Safety requirements as per Manufacturer's 4. Test method including completion/acceptance criteria 5. Results 6. Appendix a) Testing Programme b) Mech/Elect/C&I -Plant item completing list c) List of Drawing/documents required for carrying out the testing.		
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 52 OF 53

CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT			
	ANNEXURE - III SAFETY PLAN 01. Safety Policy of the Contractor to be enclosed: 02. When was the Safety Policy last reviewed: 03. Details of implementation procedure / methods to implement Safety Policy / Safety Rules: 04. Name, Qualification, experience of Safety Officer 05. Review of Accidents Analysis Method, Methods to ensure Safety and Health: 06. Unit executive responsible to ensure Safety at various levels in work area: 07. List of employees trained in safety employed before execution of the job. Give the details of training: 08. Safety Training Targets, Schedules, methods Adopting to providing safety training to all employees: 09. Details of checklist for different jobs / work and responsible person to ensure compliance (copy of checklist to be enclosed): 10. Regular Safety Inspection Methods and Periodicity and list of members to be enclosed: 11. Risk Assessment, Safety Audit by Professional Agencies, Periodicity: 12. Implementation of Recommendations of Audit / Inspections. Procedures for implementation and follow up: 13. Provision for treatment of injured persons at work site: 14. Review of overall safety by top Management and Periodicity: 15. System for Implementation of Statutory legislations: 16. Issue of PPEs to employees, Periodicity / stock on hand etc: Signature Head of the Organisation with date & stamp			
LOT-2 PROJECTS FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO. CS-0011-109(2)-9	PART-D ERECTION CONDITIONS OF CONTRACT	PAGE 53 OF 53	



TITLE:

2 X 250 MW BHILAI FGD

**TECHNICAL SPECIFICATION FOR
MISC. FGD TANKS**

SPECIFICATION No: PE-TS-468-167-A101

SECTION-I, SUB-SECTION-C2B

REV. 00

Date: April, 2020

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

CUSTOMER SPECIFICATION: QUALITY ASSURANCE

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

LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN						ANNEXURE- V			
								PROJECT:			
								PACKAGE:			
								CONTRACT NO.			
Sl. No	Activity and operation	Characteristics / Instruments	Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks	
								8	9		
1	2	3	4	5	6	7	8	9	10		
5.01.03		Dye Penetration Test (DPT)	B	Physical	25% weld length of tension member of crane girder- For crane girder 5% of Weld length with min. 300mm at each location - Except Crane Girder, for all other Fillet Welds	As per technical specifications and construction drawings		SR	√		
5.02	Butt Welds										
5.02.01		Visual	B	Visual	Random in each shift	As per technical specifications and construction drawings		SR			
5.02.02		Dye Penetration Test	B	Physical	100% DPT after back gouging on all butt welds except for coal bunker bins 10% DPT after back gouging-For coal bunker bins	As per technical specifications and construction drawings		SR		All butt welds to be back gouged before DPT	
5.02.03		Mechanical testing on production test coupons	A	Physical	Min. one joint per built up beams, columns and crane girder.	As per technical specifications and construction drawings		SR	√	Test on production test coupons	
5.02.04		Radiography Test (RT)	A	Physical	100% RT on butt welds of tension flange (bottom flange) of crane girders 5% spot RT on butt welds / at inaccessible locations UT on butt welds- For coal bunker bins 10% RT weld length of each welder on butt welds, except for crane girders and coal bunk	As per technical specifications and construction drawings		SR	√	In case of failure of any welds in SPOT/RT or UT the % of retesting shall be doubled at that particular location. Acceptance criteria of NDT on welds shall be as per AWS D1.1. Wherever RT is not feasible UT to be carried out with the approval of the Engineer	
5.03	Full Penetration Welds (Other than butt welds)										

LOGO	Sl. No	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN						ANNEXURE- V			
			ITEM : STRUCTURAL STEEL WORK			PROJECT:			FLUE GAS DESULPHURISATION SYSTEM PACKAGE			
			SUB-SYSTEM : FABRICATION & ERECTION			PACKAGE:			CONTRACT NO.			
5.03.01	2	Activity and operation	Characteristics / instruments	Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks	
									8	9		
1				4	5	6	7			10		
5.03.01			3	A	Physical	100% UT on the web to flange joint of crane girder 10% UT on other full penetration joints	As per technical specifications and construction drawings		IR	✓	In case of failure of any welds in SPOT/RT or UT the % of retesting shall be doubled at that particular location. Acceptance criteria of NDT on welds shall be as per AWS D1.1.	
5.04												
i			Visual examination	B	Visual	100%	As per technical specifications and construction drawings, IS 822, AWS D 1.1		SR	✓	As per requirement of NTPC Engineer	
ii			DPT	B	Physical	100%	As per technical specifications and construction drawings, IS 822, AWS D 1.1		IR	✓		
iii			RT	A	Physical	10% FOR SHOP BUTT WELD AND 15% FOR SITE BUTT WELDS	As per technical specifications and construction drawings, IS 822, AWS D 1.1					
6.00												
6.01			Dimensions and levels	B	Physical/ Measurement	Each Foundation	Tech Specs and Const. Drawings		SR	✓	Shape, lines (including diagonal checks)	
6.02			Foundation Bolts and Embedments	B	Physical/ Measurement	Each Foundation	Tech Specs and Const. Drawings		SR	✓	Measurement of Verticality, Levels, pitch distance	
7.00												
7.01			Punch Erection marks and match marks on members	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings				Markings for - Assembly designation, Part number, Weight, Any other important identifications.	
7.02			Pre-assembly as per match mark	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings					
7.03			Camber, sweep and total length after trial assembly of structure.	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings		SR	✓		
7.04			Control assembly check at shop	B	Visual/ Physical	Every first and tenth set of identical structure	Tech Specs and Const. Drawings					
8.00												
8.01			Alignment, slopes, level, tolerances of erected member	B	Measurement	Each structural member	Tech Specs and Const. Drawings		SR	✓		
8.02			Tightening of bolts including foundation bolts with lock nuts	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings		SR	✓		

LOGO	Sl. No	Activity and operation	INDICATIVE FIELD QUALITY PLAN										ANNEXURE- V				
			ITEM : STRUCTURAL STEEL WORK				PROJECT:		FLUE GAS DESULPHURISATION SYSTEM PACKAGE								
			SUB-SYSTEM : FABRICATION & ERECTION				PACKAGE:		CONTRACT NO.								
			SUB-SYSTEM : FABRICATION & ERECTION				DATE :		MAIN CONTRACTOR								
			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						
8.03			Acceptance of erected structure	B	Visual/ Physical	Each erected structure	Tech Specs and Const. Drawings, IS 7215 and IS 12843	IS	SR	✓							
9.00																	
i			Submission of Installation/ Erection Scheme/ methodology for all structures	B	Approval	Once prior to erection of each structure	Approved drawings and Specifications	Technical	SR	✓							
ii			Check for Erection Marks	B	Visual	100%	Approved drawings and Technical Specifications	Technical	SR								
iii			Check for Installation of Steel Liners	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications	Technical	SR								
iv			Check for Site Joints	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications	Technical	SR								
v			Check for Installation of Inlet Transition Ducts	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications	Technical	SR								
vi			Check for Installation of Insulations and Expansion Compensators	B	Visual, Physical, Acceptance	100%	Approved drawings and Technical Specifications	Technical	SR		Each layer of expansion Compensator to be checked at shop for thickness, unit weight, tensile strength & elongation along with temp. withstandability for composite joints						
vii			Ensure the Erection of all steel structures along with permissible tolerances and their acceptance	B	Visual/ Acceptance	100%	Approved drawings and Specifications	Technical	SR								
viii			Check and approval for Dismantling, Modification and Re-erection, if required for any reason	B	Visual/ Acceptance	100%	Approved drawings and Specifications	Technical	SR								
10.00		PAINTING SYSTEM															
10.01			Painting Materials and accessories	A	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings	SR/MTC	✓		Mfr.'s T.C. shall be correlated with the consignment received.						
10.02			Surface preparation	B	Physical /visual	Random in each shift	Tech Specs and Const. Drawings, Relevant code/ standards	SR	✓								
10.03			DFT of paint - Over steel surface	B	Physical	Each surface at random	Tech Specs and Const. Drawings	SR	✓								
10.04			Acceptance of painted surfaces	B	Physical	Each surface at random	Tech Specs and Const. Drawings	SR									
11.00		PERMANENT BOLTS AND NUTS AND WASHERS															
11.01			Material	A	Physical and MTC Review	Once for each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	✓		Permanent mild steel Bolts, mild steel Nuts, Mild steel Washers, High strength structural Bolts, Washers-Dimensions, properties, storage along with MTC						
11.02			Contact surfaces before bolting	B	Physical	Random before assembly for bolting	Tech Specs and Const. Drawings, IS 4000	SR									



TITLE:

**2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
MISC. FGD TANKS**

SPECIFICATION No: PE-TS-468-167-A101

SECTION-I, SUB-SECTION-C2C

REV. 00

Date: April, 2020

SECTION-I, SUB-SECTION-C2C

CUSTOMER SPECIFICATION: PAINTING SPECIFICATION

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

1. FANS

1	Axial Fan tool & fixtures (Clause 20.03.00 of Part- C Section VI)	55 000	Power Tool Cleaning to st3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	40	100
2	Booster Fan foundation material	55 081		Temporary rust preventive fluid application as per PRQA 523 DFT- 20µ				
			All Threaded and other surfaces of foundation bolt and its materials shall be coated with temporary rust preventive fluid. During execution of civil works the dried film of coating will be removed using Organic Solvents.					
3	Booster Fan Handrails & Insert (Clause 31.06.00 of Sec.VI, Part-B, Subsection- IV-D)	55 082	Blast cleaning to Sa 2½/ Acid pickling	Hand rails, Gratings- Hot dip galvanizing to 610gms/sq.m (minimum) and to a coating thickness of 87µm (min).				
4	Booster Fan Handrails & Insert- Structural items other than the above (Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)	55 082	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
5	Axial booster cooling/ seal fan (Clause 1.04.00 of Part- A Section VI)	55 084	Blast cleaning to Sa 2½	Primer: Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat	100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ	75	300

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
				Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/TiO2 DFT- 100µ	100	Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	25	
6	Booster fan canopy for motor (Clause 1.04.00 of Part- A Section VI)	55 089	Blast cleaning to Sa 2½	Primer: Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/TiO2 DFT- 100µ	100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300
7	Axial booster fan rotor (Clause 20.03.00 of Part- C Section VI)	55 287	Power Tool Cleaning to St3 (SSPC-SP3)	Two coats of Epoxy based Zinc phosphate primer (Two pack system) to IS 13238; DFT- 30µ/coat	60	NIL	--	60
8	Axial booster fan stator (Clause 20.03.00 of Part- C Section VI)	55 587	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	40	100
9	Axial booster fan coupling (Clause 1.04.00 of Part- A Section VI)	55 880	Blast cleaning to Sa 2½	Primer: Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/TiO2 DFT- 100µ	100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
10	Booster fan LOS with lubricant (Clause 1.04.00 of Part- A Section VI)	55 980	Blast cleaning to Sa 2½	Primer: Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/TiO2 DFT- 100µ	100	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	300
11	Booster fan actuator (Clause 1.04.00 of Part- A Section VI)	55 983	Blast cleaning to Sa 2½	Primer: Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/TiO2 DFT- 100µ	100	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	25	300

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

2. FGD SYSTEM

1	Slurry recirculation pump System (Referred from cl. 7.05.00 of Section-VI, Part-B, Sub section-I-M5)	FW 212	Power Tool Cleaning to St3 (SSPC-SP3)	Primer: Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) Intermediate: One coat of Synthetic Enamel intermediate coat to IS 2932; DFT- 50µ	60 50	Two coats of Synthetic Enamel to IS 2932, DFT- 50µ/ coat Shade: Light blue RAL 5012	100	210
2	Absorber System Internals – Structural items (Clause 1.04.00 of Part- A Section VI)	FW 213	Blast cleaning to Sa 2½	Primer: Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/TiO2 DFT- 100µ	100 100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300
3	Mist eliminator and accessories, Absorber baffle grating support, Mist eliminator support& Absorber Spray pipe support - Structural items (Clause 1.04.00 of Part- A Section VI)	FW 215 FW 216 FW 217 FW 218	Blast cleaning to Sa 2½	Primer: Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/TiO2 DFT- 100µ	100 100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300
4	Absorber System- Base (Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)	FW 219	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition	70	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat	70	240

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
			conforming to ISO 8501-1	and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	100	Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)		
5	Absorber system structures, Absorber shear plate, Duct supports, Structures for RC pump house& Hook up duct structure (Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)	FW 220 FW 231 FW 232 FW 233 FW 234 FW 236 FW 238	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
6	Absorber system casing bottom- Outside surfaces (Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)	FW 221	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ	70	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM	70	240

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
	Inside surfaces are of C276 cladded sheets, hence no paint is envisaged.			Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	100	D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)		
7	Absorber system casing top-Outside surfaces (Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)	FW 222	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
8	Absorber system accessories (Clause 20.03.00 of Part- C Section VI)	FW 223	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	40	100
9	Emergency Quench water tank- Outside surfaces (Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)	FW 226	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ	70	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002	70	240

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
				Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	100	With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)		
10	Emergency Quench water tank- Inside surfaces	FW 226	Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50µm	Primer: Two coats of Red Oxide Zinc phosphate primer, DFT-30µ/coat; Total-60µ (Primer is only envisaged as lining is given in inside surfaces of the tank)				
11	Emergency quench system, Handling Equipment RC pump (Clause 20.03.00 of Part- C Section VI)	FW 227 FW 249	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	60	120
12	Air oxidation system, Viewing ports (Without glass) (Clause 20.03.00 of Part- C Section VI)	FW 230 FW 239	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	40	100
13	Absorber W/D interface, W/D wash system, Slurry distribution system, Oxidation Air distribution system (Clause 1.04.00 of Part- A Section VI)	FW 228 FW 229 FW 243 FW 244	Blast cleaning to Sa 2½	Primer: Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/TiO2 DFT- 100µ	100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
14	Expansion joint between bypass (Clause 20.03.00 of Part- C Section VI)	FW 251	Flue gas swept surface	Power Tool Cleaning to St3 (SSPC-SP3)	60	--	--	60
			Insulated surfaces	Power Tool Cleaning to St3 (SSPC-SP3)	40	NIL	--	40
15	Expansion joint (Clause 20.03.00 of Part- C Section VI)	FW 252	Flue gas swept surface	Power Tool Cleaning to St3 (SSPC-SP3)	60	NIL	--	60
			Insulated surfaces	Power Tool Cleaning to St3 (SSPC-SP3)	40	NIL	--	40
16	Ducts between bypass duct inlet& booster fan (Clause 20.03.00 of Part- C Section VI)	FW 255	Flue gas swept surface	Power Tool Cleaning to St3 (SSPC-SP3)	60	NIL	--	60
			Insulated surfaces	Power Tool Cleaning to St3 (SSPC-SP3)	40	NIL	--	40
17	Ducts between Booster fan& Absorber (Clause 20.03.00 of Part- C Section VI)	FW 256	Flue gas swept surface	Power Tool Cleaning to St3 (SSPC-SP3)	60	NIL	--	60
			Insulated surfaces	Power Tool Cleaning to St3 (SSPC-SP3)	40	NIL	--	40

SI No	SURFACE LOCATION		PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
					PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
18	Ducts between Absorber& Stack	Flue gas swept surface	FW 257	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	NIL	--	60
	(Clause 20.03.00 of Part- C Section VI)	Insulated surfaces		Power Tool Cleaning to St3 (SSPC-SP3)	HR Aluminium paint to IS 13183 Gr.II (upto 400 deg C)	40	NIL	--	40
19	Duct structure between bypass duct& Booster fan (Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)	FW 260	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ	70	100	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
				Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ					
20	Duct structure between Booster fan& Absorber (Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)	FW 261	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ	70	100	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs	70	240
				Intermediate: One coat of Two component polyamide cured epoxy					

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

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
22	Foundation material for duct structures, Absorber, Elevator, RC pump shed, tanks, Silo Structure, pipe racks	FW 280 FW 281 FW 282 FW 283 FW 740 FW 760 FW 762 FW 763		Temporary rust preventive fluid application as per PRQA 523 DFT- 20µ All Threaded and other surfaces of foundation bolt and its materials shall be coated with temporary rust preventive fluid. During execution of civil works the dried film of coating will be removed using Organic Solvents.				
23	Structures for Emergency Quench water tank Structures for Elevator (Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)	FW 285 FW 292	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
24	Elevator and accessories (Clause 20.03.00 of Part- C Section VI)	FW 293 FW 716	Power Tool Cleaning to st3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	60	120

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
25	Structures for booster fan handling (Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)	FW 310	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
26	Galleries and railings for Stairs, Absorber, Dampers, Ducts, Tanks (Clause 31.06.00 of Sec.VI, Part-B, Subsection- IV-D)	FW 237 FW 610 FW 612 FW 613 FW 722	Blast cleaning to Sa 2½/ Acid pickling	Hand rails, Gratings- Hot dip galvanizing to 610gms/sq.m (minimum) and to a coating thickness of 87µm (minimum)				
27	Galleries and railings for Stairs, Absorber, Dampers, Ducts, Tanks – Structures other than the above (Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)	FW 237 FW 610 FW 612 FW 613 FW 722	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ	70	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002	70	240

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
				Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	100	With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)		
28	Slurry pumps & accessories, Water pumps (Referred from cl. 7.05.00 of Section-VI, Part-B, Sub section-I-M5)	FW 701 FW 702	Power Tool Cleaning to St3 (SSPC-SP3)	Primer: Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) Intermediate: One coat of Synthetic Enamel intermediate coat to IS 2932; DFT- 50µ	60 50	Two coats of Synthetic Enamel to IS 2932, DFT- 50µ/ coat Shade: Light blue RAL 5012	100	210
29	Monorail for hoist & cranes (Clause 31.03.00 of Sec. VI, Part-B, Subsection- IV-D)	FW 710	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
30	Handling Equipment- Hoists& Man hole door (Clause 20.03.00 of Part-C Section VI)	FW 713 FW 714 FW 717	Power Tool Cleaning to st3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) Idle roller shall be applied with two coats of 70 microns at shop	70	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	60	130
31	Agitator support (Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)	FW 721	Blast cleaning to Sa 2½ (Near white metal) with surface	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume	70	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane	70	240

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
			profile 40-60µm conforming to ISO 8501-1	minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	100	paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)		
32	Limestone silo structures Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)	FW 730	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
33	Limestone Silo- Outside surfaces Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)	FW 731	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ	70	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002	70	240

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
				Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	100	With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)		
34	Lime stone Silo- Inside surfaces (Conical portion)	FW 731	Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50µm conforming to ISO 8501-1	Primer: Two coats of Red Oxide Zinc phosphate primer to IS: 12744 (SS lining is inside the Limestone silo conical portion, hence primer is only envisaged; SS lining will be done at shops itself)	60	NIL	--	60
35	Lime stone Silo- Inside surfaces (Cylindrical portion)	FW 731	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer Coat: One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 70 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00	70	--	--	70
36	Air cannon silo, Bag filter & Fan assy, Nozzles& Flanges (Clause 20.03.00 of Part-C Section VI)	FW 723 FW 724 FW 725	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	40	100
37	Limestone silo approach platform, Platform for Pipe racks& Sub pipe racks (Clause 31.06.00 of Sec.VI, Part-B, Subsection- IV-D)	FW 733 FW 766 FW 767	Blast cleaning to Sa 2½/ Acid pickling	Hand rails, Ladders, Gratings- Hot dip galvanizing to 610gms/sq. m (minimum) and to a coating thickness of 87µm (minimum)				

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
38	Limestone silo approach platform, Pipe racks, Sub pipe racks platform- Structures other than the above (Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)	FW 733 FW 766 FW 767	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
39	Limestone Mill – Outside surfaces (Clause 1.04.00 of Part- A Section VI)	FW 735	Blast cleaning to Sa 2½	Primer: Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/TiO2 DFT- 100µ	100 100	Finish: One coat of Epoxy based finish paint to IS 14209; DFT- 75µ Finish: One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300
40	Lime stone mill- Inside surfaces	FW 735	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer Coat: One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 70 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00	70	--	--	70

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
41	Gypsum belt filter and accessories Structural items (Clause 1.04.00 of Part- A Section VI)	FW 738	Blast cleaning to Sa 2½	Primer: Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100	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	300
42	Lime stone slurry storage tank, Auxiliary absorber tank, Filtrate tank, Wastage water tank, Hydro cyclone waste water tank, Neutralization tank, Process Water tank, Belt filter washing tank, Primary hydro cyclone feed tank, Clarified water tank Outside surfaces (Clause 31.03.00 of Sec. VI, Part-B, Subsection- IV-D)	FW 742 FW 743 FW 744 FW 745 FW 747 FW 748 FW 785 FW 786 FW 800 FW 802	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
43	Lime stone slurry storage tank, Auxiliary absorber tank, Filtrate tank, Wastage water tank, Hydrocyclone waste water tank, Neutralization tank,	FW 742 FW 743 FW 744 FW 745 FW 747 FW 748 FW 749	Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50µm	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) (Liner is inside the tank, hence primer is only envisaged; Protection till erection only)	60	NIL	--	60

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
	Process Water tank, Belt filter washing tank, Primary Hydrocyclone feed tank, Clarified water tank, Tank internal structure Inside surfaces	FW 800 FW 802						
44	Process water pipe accessories, Cooling pipe accessories (Referred from cl. 7.05.00 of Section-VI, Part-B, Sub section-I-M5)	FW 751 FW 752	Power Tool Cleaning to St3 (SSPC-SP3)	Primer: Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) Intermediate: One coat of Synthetic Enamel intermediate coat to IS 2932; DFT- 50µ	60 50	Two coats of Synthetic Enamel to IS 2932, DFT- 50µ/ coat Shade: Grey white RAL 9002 Identification Tag: Sea Green Shade no: 217 as per IS 5	100	210
45	Slurry pipe accessories (Referred from cl. 7.05.00 of Section-VI, Part-B, Sub section-I-M5)	FW 753	Power Tool Cleaning to St3 (SSPC-SP3)	Primer: Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) Intermediate: One coat of Synthetic Enamel intermediate coat to IS 2932; DFT- 50µ	60 50	Two coats of Synthetic Enamel to IS 2932, DFT- 50µ/ coat Shade: Grey white RAL 9002 Identification Tag: Sea Green Shade no: 217 as per IS 5	100	210
46	Service Air pipe accessories (Referred from cl. 10.00.00 of Section-VI, Part-B, Sub section-I-M3)	FW 754	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coat)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- 30µ/ coat Identification Tag: Sky Blue Shade no: 101 as per IS 5	60	120
47	Instrument air pipe accessories (Referred from cl. 10.00.00 of Section-VI, Part-B, Sub section-I-M3)	FW 755	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coat)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- 30µ/ coat	60	120

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

							Identification Tag: Sky Blue Shade no: 101 as per IS 5		
48	All valves (Temp <95 deg C) (Clause 20.03.00 of Part-C Section VI)	FW 815 to FW 851	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- 30µ/ coat	60	120	
49	Structure for Pipe racks, Sub pipe racks Trestle for pipe racks, Structures inside Gypsum dewatering building & Ball mill building (Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)	FW 761 FW 765 FW 768 FW 769 FW 787	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240	
50	Supports for cable trays, Air receivers, commissioning& Mandatory spares, Tools & tackles (Clause 20.03.00 of Part-C Section VI)	FW 779 FW 798 FW 988 FW 996	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	40	100	

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

3. GATES & DAMPERS

01	Gates & Dampers > 95° C Insulated Surfaces& Uninsulated surfaces	57 540 57 550 57 583	Power Tool Cleaning to St3 (SSPC-SP3)	HR Aluminium paint to IS 13183 Gr.II (upto 400 deg C)	40	--	--	40
02	Seal air piping	57 141	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coat)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- 30µ/ coat Identification Tag: Sky Blue Shade no: 101 as per IS 5	60	120
03	Blower with Motor Knife Gate valve Mounting bracket Mandatory spares	57 491 57 497 57 209	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	40	100
04	Ladder, Cage for Ladder Toe Guard Plate Floor Grill, Hand Rails, Hand Rail Post Clause 31.06.00 of Sec.VI, Part-B, Subsection- IV-D	57 466 57 566	Blast cleaning to Sa 2½/ Acid Pickling	Hot Dip Galvanizing to 610 gm per sq. Meter (minimum) and to a coating thickness of 87 µm (minimum)				
05	Other Structural Items- Other than sl.no. 3 of above (Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)	57 466 57 566	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40- 60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition	70	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat	70	240

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (μm min.)
				PAINT	DFT (μm min.)	PAINT	DFT (μm min.)	
				and properties shall be as per Type II as per ASTM D520-00 DFT- 70μ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%$\pm$2) DFT- 100μ	100	Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)		

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

4. PAINTING OF DAMAGED AREAS

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

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

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

GENERAL NOTES

1. No painting is required for Galvanized, non-ferrous & stainless steel items, except as indicated above.
2. Machined items are to be applied with coat of temporary rust preventive oil
3. PGMAs covered in sub-supplier (ie., Purchased) items viz., Agitator/ slide bearing and other sub-delivery components etc., are not indicated in the above list. However, the Painting Schedule for all items supplied by all sub-suppliers and BOI under the scope of BHEL shall be same as for main equipment covered in this document.
4. In sub-assy, wherever plates / sheets of thickness less than or equal to 5mm and rods are used, very minor items like clamps, small items etc - Power Tool or Hand Tool Cleaning to SSPC - SP 3 / SP 2 shall be followed and painting under SI no:01 of Fans shall be followed.
5. 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.
6. All components covered under different PGMAs are to be painted. In case any component is left out, the same shall be deemed to be included under the relevant section.
7. All threaded and other surfaces of foundation bolts and its materials, insulation pins, Anchor channels, Sleeves shall be coated with temporary rust preventive fluid and during execution of civil works; the dried film of coating shall be removed using organic solvents.
8. Painting requirement for all electrical equipment shall be as per the details identified in specification for the respective equipment.
9. All steel structures shall be provided with painting as given in the specification. Further, painting system shall also meet the requirements of corrosivity category C3 (durability high) as per ISO 12944.
10. Finish coat to be applied after an interval of min 10 hrs and within 6 months (after completion of intermediate coat).
11. Primer coat on steel shall be applied in shop immediately after blast cleaning by airless spray technique.
12. For the portion of steel surfaces embedded in concrete, the surface shall be prepared by Manual cleaning and provided with Primer coat of Chlorinated Rubber based Zinc Phosphate Primer of Minimum 50 Micron DFT.

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

PAINTING SCHEME- DETAILS OF PROCUREMENT & APPLICATION PROCESSES

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

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

PGMA DETAILS

SNO	PGMA	PGMA DESCRIPTION	PGMA DETAILS
01	FW 212	Slurry recirculation pump system	RC Pumps incl Shaft seal Common Base Plate Coupling and Guard Gear Box Expansion Bellow Anchor Bolts & Fasteners Special Tools
02	FW 219	Absorber system base	Absorber tank bottom plate
03	FW 220	Absorber system structures	Absorber tank structure Absorber tower structure Spray headers structure
04	FW 221	Absorber system casing bottom	Absorber tank wall casing- bottom
05	FW 222	Absorber system casing top	Absorber Tank wall casing –Top Mist Eliminator supports Spray pipe supports Internal Beam Shim plates in Absorber area Internal Struts
06	FW 223	Absorber system accessories	Nozzles and flanges Inspection doors & Man holes Viewing ports Antifoam dosing equipment Suction strainers- FRP
07	FW 226	Emergency Quench water tank	Base Plate & its supports Roof, Shell
08	FW 227	Emergency Quench System	Emergency Quenching Spray Pipe Nozzle for Emergency Pipe Fasteners Gaskets
09	FW 230	Air oxidation System	Oxidation Blowers Common Base Plate Coupling and Guard Anchor Bolts & Fasteners Expansion Bellow Suction & Discharge Silencers Acoustic Enclosure Water Injection cooling system

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

				Pipe, Valves & Instruments Special Tools				
--	--	--	--	---	--	--	--	--

SNO	PGMA	PGMA DESCRIPTION	PGMA DETAILS					
10	FW 244	Oxidation air distribution System	Pipe & Fittings Flanges					
11	FW 251	Expansion joint between bypass	Pipe Hanger, Bottom Elbow, Bottom sliding supports					
12	FW 252	Expansion joint between scrubbers	Expansion joints Seal Plates & Fasteners					
13	FW 255	Ducts between bypass duct inlet & booster fan	Fabric & its fixing fasteners Sleeves & Flanges Gaskets					
14	FW 256	Ducts between Booster fan & Absorber	Plates & Stiffeners Guide Vanes					
15	FW 257	Ducts between Absorber & stack	Plates & Stiffeners Guide Vanes					
16	FW 260	Duct structure between bypass duct& Booster fan	Duct Supports Gusset Plate Divider plate Internal Struts Support bearings					
17	FW 261 FW 262	Duct structure between booster fan& absorber & Absorber and Stack	Duct Supports Gusset Plate Divider plate Internal Struts Support bearings					
18	FW 292	Structures for Elevator	Columns Seal Plate Bracings Enclosure (Purlin& sheeting)					
19	FW 293	Elevator and accessories	Base Frame Buffer Spring Mast Section Cage Control Panel & AC Mandatory Spares					

SI No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
SNO	PGMA	PGMA DESCRIPTION	PGMA DETAILS					
20	FW 310	Structures for booster fan handling	Columns Beams Bracings Seal plate					
21	FW 610 FW 722	Galleries & railings for Scrubbers, Tank	Stairs Handrail Step treads Floor grills Ladders Foundation bolts Fasteners					
22	FW 701	Slurry pumps & accessories	Slurry Pumps incl Shaft seal Common Base Plate Coupling and Guard Belt & Pulley Expansion Bellow Anchor Bolts & Fasteners Motor & accessories Sump Pumps incl Shaft seal Common Base Plate Coupling and Guard Belt & Pulley Anchor Bolts & Fasteners Motor & accessories					
23	FW 710	Monorail for hoist& cranes	Insert Plate Stiffener plate Monorail beam					
24	FW 721	Agitator support	Channels & Beams					
25	FW 730	Limestone silo structures	Columns Beams Bracings Seal plate Angles, channels					

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

PGMA DETAILS								
26	FW 731	PGMA	PGMA DESCRIPTION	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
MISC. FGD TANKS**

SPECIFICATION No: PE-TS-468-167-A101

SECTION-I, SUB-SECTION-D

REV. 00

Date: April, 2020

SECTION-I, SUB-SECTION-D

ANNEXURE-I

LIST OF MAKES



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS TANKS
SUB-VENDOR LIST
ANNEXURE-I**

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

VOLUME II-B

SECTION 'E'

REVISION 01

DATE: 07/07/2015

PAGE 2 of 5

SUB-VENDORS - MISCELLANEOUS TANKS

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



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS TANKS
SUB-VENDOR LIST
ANNEXURE-I**

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

VOLUME II-B

SECTION 'E'

REVISION 01

DATE: 07/07/2015

PAGE 3 of 5

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



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS TANKS
SUB-VENDOR LIST
ANNEXURE-I**

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

VOLUME II-B

SECTION 'E'

REVISION 01

DATE: 07/07/2015

PAGE 4 of 5

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

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

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



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS TANKS
SUB-VENDOR LIST
ANNEXURE-I**

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

VOLUME II-B

SECTION 'E'

REVISION 01

DATE: 07/07/2015

PAGE 5 of 5

- a) Documentation to show that the equipment /system has been supplied for a plant of similar or higher capacity.
- b) Documentation in the form of certificate that the equipment/system has been operating satisfactorily for two years as on the scheduled date of bid opening.

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

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

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

QUALIFYING REQUIREMENTS FOR RUBBER LINING & VINYL ESTER GLASS FLAKE FOR SLURRY TANKS

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



TITLE:

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

SPECIFICATION No: PE-TS-468-167-A101

SECTION-I, SUB-SECTION- D

REV. 00

Date: April, 2020

SECTION-I, SUB-SECTION- D

ANNEXURE-II

QUALITY PLANS

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

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

Page 251 of 338

LEGENDS:

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

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

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

MA: MAJOR, MI: MINOR, CR: CRITICAL

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

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

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

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

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

	MANUFACTURER/BIDDER/ SUPPLIER NAME & ADDRESS		QUALITY PLAN		SPEC. NO : PE-TS-XXX-167-A001	DATE: XX.XX.XX
	CUSTOMER :				QP NO.: PE-QAP-XXX-167-A001(P1)	DATE: 11.02.2020
	PROJECT:				PO NO.: LATER	DATE: XX.XX.XX
	ITEM: PIPE FITTINGS , FLANGES & ACCESSORIES		SYSTEM: MISC.TANKS (SITE FABRICATED)		SECTION:	

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

NOTES:

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

LEGENDS:

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

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

CONTRACTOR'S NAME & ADDRESS		MANUFACTURING QUALITY PLAN					PROJECT					
ITEM : RUBBER LINING OF PIPING CONFORMING TO BHEL Customer No. : 7374,7391 & 7392		REFERENCE DOCUMENT		ACCEPTANCE NORMS	FORMAT OF RECORDS	D*	AGENCY		REMARKS			
S.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	7	8	9	10	11	12	
1.0	RAW MATERIAL											
1.1	Rubber Mix	a. Tensile Strength b. % Elongation c. Specific Gravity d. Hardness e. Thickness of Sheet	Major	Verification	1 sample/lot	As per Tech Spec./Relevant IS, Material Spec.		TC	✓	P	-	
		f. Resistance to Bleeding #	Major	Chemical	1 sample/lot	Immersion for 24 hours @40 deg C in 10% of H2SO4 and 10% of HNO3	No discoloration and Weight change -0% +4%	TC	✓	P	-	
2.0	INPROCESS INSPECTION											
2.1	Surface Preparation	Cleanliness & Uniformity	Major	Visual	100%	IS 4682 Part I, Sa 2.5 Grade Surface Finish		TC	-	P	-	
2.2	Continuity of Lining at Uncured stage	Spark test	Major	Visual	100%	IS 4682 Part I		TC	-	P	-	
2.3	Curing of Rubber Lining	Control of Pressure, Temperature & Time	Major	Visual	100%	IS 4682 Part I and Manufacturer's Procedure		Log Book	-	P	-	
3.0	FINAL INSPECTION											
3.1	Complete Lining	a. Surface Defects b. Shore Hardness c. Spark Test d. Rubber lining Thickness e. Adhesion Test	Major Major Critical Major Critical	Visual Measurement Visual Measurement Peel-Off test	100% Random 100% Random One sample per Vule. Lot	IS 4682 Part I IS 4682 Part I IS 4682 Part I IS 4682 Part I IS 4682 Part I		IR IR IR IR IR	✓ ✓ ✓ ✓ ✓	P P P P P	- - - - -	
4.0	Documentation	Review of Reports	Major	Verification	100%	All reports required as per QP.				P	V	-
SIGNATURE		APPROVED BY		APPROVED BY		APPROVED BY		APPROVED BY		APPROVED BY		
PREPARED BY		MAIN-SUPPLIER		PAGE 01 OF 02		FOR NTPC USE:		REVIEWED BY		APPROVAL SEAL		
J. N. S. R.		D. K. S. R.		LEGEND:		RECORDS, IDENTIFIED WITH 'TICK' (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.		DOC. NO. 6130-109-8m-012 Rev 01		CAT...		
						* RECORDS, IDENTIFIED WITH 'TICK' (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.						
						** M.MANUFACTURER/SUB-SUPPLIER C: BHEL/BHEL AUTHORIZED AGENCY.						
						N: NTPC, P: PERFORM W: WITNESS AND V: VERIFICATION						
						CUP: NTPC SHALL IDENTIFY IN COLUMN 'N' AS 'W'						

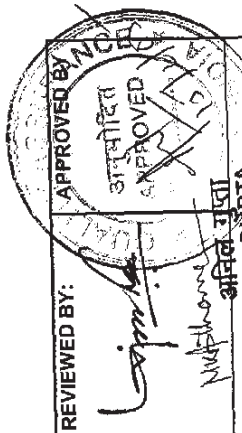
		CONTRACTOR'S NAME & ADDRESS /		MANUFACTURING QUALITY PLAN						PROJECT : PACKAGE CONTRACT No.: MAIN-SUPPLIER											
				ITEM : RUBBER LINING OF PIPING CONFORMING TO IS 4682 PART I.		Q.P.No:7374QPC01 REV-01		ACCEPTANCE NORMS				FORMAT OF RECORDS		D*		AGENCY M C N		REMARKS			
COMPONENT & OPERATIONS		CHARACTERISTICS		CLASS		TYPE OF CHECK		QUANTUM OF CHECK		REFERENCE DOCUMENT		8		9		10		11		12	
S.No		3		4		5		6		7		8		9		10		11		12	
1																					

NOTES:

1. **Rubber Lining Vendor's Name & Address.
 a. M/s Lebracs Rubber Linings Private Limited ; Works Address : No16, Sedrapet, Puducherry-605111
 b. M/s Jasmine Polymertech Pvt Ltd ; Works Address : L-61, MIDC Industrial Area, Talaja, Dist-Raigad, Maharashtra -410208
2. NTPC Inspection Category : Cat III
3. Repair, if any, should be carried out by same as per original rubber.
4. Adhesion test coupon shall be as prepared as per governing code.
5. NTPC Surveillance check may be carried out, if required.

PREPARED BY 		LEGEND: * RECORDS, IDENTIFIED WITH 'TICK' (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: MANUFACTURER/SUB-SUPPLIER, C: BHEL / BHEL AUTHORISED AGENCY, N: NTPC, P: PERFORM W: WITNESS AND V: VERIFICATION	
APPROVED BY 		DOC.NO. 6130-09-BVM-8-012 CAT... Buro1.	
MAIN-SUPPLIER SIGNATURE		REVIEWED BY APPROVED BY APPROVAL SEAL	

PAGE 02 OF 02



REVIEWED BY: *[Signature]*
APPROVED BY: *[Signature]*
ANIL GUPTA
Addl. General Manager (QA)
एन टी पी सी लि. / NTPC LTD.

QIP NO.: 0000-999-QOM - I-001
Rev. No. 0 Date 15-02-2005
Page 1 Of 1
VALID UPTO: 14-02-2008

STANDARD FIELD QUALITY PLAN
CONFORMING TO CODE: IS:803-1976

SYSTEM EQUIPMENT

Misc. Tanks



SL. NO	ACTIVITY AND OPERATION	CHARACTERISTICS / INSTRUMENTS	CLASS # OF CHECK	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD
1.	2.	3.	4.	5.	6.	7.	8.	9. D
1	RAW MATERIAL INSPECTION							
1.1	MS Plates	Mechanical & Chemical	B	Mechanical & Chemical	1 sample per Heat	Appd Drg./ Data Sheet	Relevant Specs	TC
		Surface Defects	B	Visual	100%	No Pitting/ Corrosion	Damaged Plates not to be used	IR
		Thickness	B	Measure	100%	Appd Drg.	Appd Drg.	IR
2	IN PROCESS INSPECTION							
2.1	Welding	WPS/PQR/WQR	A	Qualification / Verification	100%	ASME Sec-IX	ASME Sec-IX	WPS/ PQR
		Marking, Cutting, Rolling, Joint Set-up	C	Visual & Measure	100%	Appd Drg.	Appd Drg.	IR
		NDT on Back Gauging	B	DPT	100%	ASTM E-165	No Indications	IR
		NDT on Root Run	B	DPT	100%	ASTM E-165	No Indications	IR
		NDT on Finished Welds	A	Vacuum Testing	100%	IS:803	No Leakage	IR
3	FINAL INSPECTION							
3.1	Finished Tank	Finish, Orientation	B	Visual	100%	IS:803 & Appd. Drg.	IS:803 & Appd. Drg.	IR
		Dimensions including Verticality, Ovality	B	Visual & Measure	100%	IS:803 & Appd. Drg.	IS:803 & Appd. Drg.	IR
		NDT on Final Welding	A	DPT	100%	ASTM E-165	No Indications	IR
		Leak Proof ness	A	Water Fill Test	100%	IS:803 & Appd. Drg.	No Leakage	IR
		Surface Preparation	B	Visual	100%	IS:803, Appd. Drg., NTPC Specs	IS:803, Appd. Drg., NTPC Specs	IR
3.2	Painting	Coating Thickness, Colour	B	Visual & DFT	100%	IS:803, Appd. Drg., NTPC Specs	IS:803, Appd. Drg., NTPC Specs	IR
Note :- 1. Only Qualified Welders are to be used. IF Welders qualified by NTPC/ BHEL/ LRQA/ BVQI are available & continuously doing the job, then re-qualification is not necessary. 2. NDT on Finished weld shall also include Spot RT (10%), if Joint efficiency is taken as 0.85, in line with requirements of Code.								

LEGEND: * RECORDS, 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)

ENGG. DIV./QA&I

1/1

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



TITLE:

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

SPECIFICATION No: PE-TS-468-167-A101

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

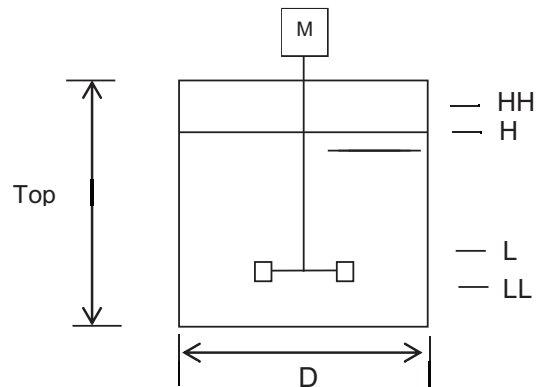
LL – Pump LL level m

L – LL + 0.2 m

H – Effective height m

HH – H + 0.2 m

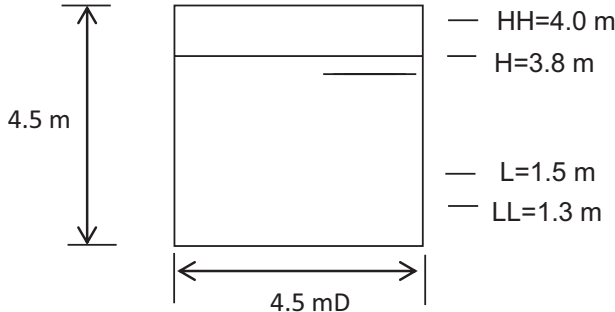
Top – HH + 0.5 m(If tank Ht. <10m)
 – HH + 0.8 m(If tank Ht. >10m)



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

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

H/D ratio = 1-1.2

S. No	Item No	Service	Design Spec	Process Parameter	Design Basis
1	00HTQ0 0BB001/ 002	Process Water Tank	4500 mmD X 4500 mmH Quantity = 2 nos.	Process Capacity	146.2 m3/h (Refer Mass Flow Balance (Design Point) data stream no. (<801> + <802> + <803> + <804> + <805>/2 + <806>) x units).
				Retention Time	0.25 hr
				Required volume	146.2 m3/h x 0.25 hr = 36.55 m3
				Tank Level is designated as follows	
				Top	4.5
				HH	4.0
				H	3.8
				L	1.5
				LL	1.3*
				Effective volume = 4.5 m Φ ^ 2 / 4 x π x (3.8-1.5) m = 36.58 m3 > 36.55 m3 Hold Volume = 4.5 m Φ ^ 2 / 4 x π x 4.0 m = 63.62 m3	

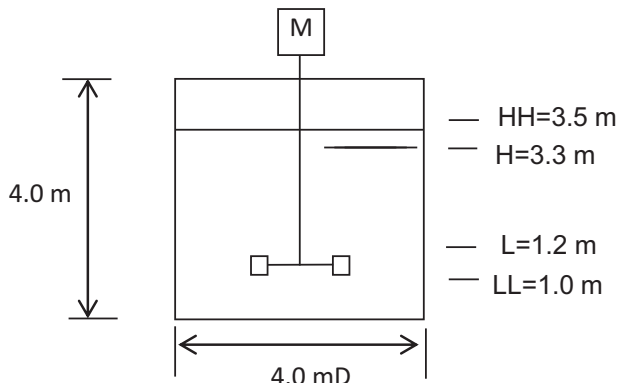
* LL level will be finalized by vendor's information of Process water pump.

S. No	Item No	Service	Design Spec	Process Parameter	Design Basis
2	00HTQ01BB001/002	Cake wash (Clarified water) Tank	3000 mmD X 3000 mmH Quantity = 2 nos.	Process Capacity for each tank	5.724 m3/h (Refer Mass Flow Balance Design Point data stream no.(805 /2) x 2 units
				Retention Time	1 hr
				Required volume	5.724 m3/h x 1.0hr = 5.724 m3
				</	

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

S. No	Item No	Service	Design Spec	Process Parameter	Design Basis
3	00HTM0 1BB001	Belt Filter Wash Tank	3000 mmD X 3000 mmH Quantity = 2 nos.	Process Capacity for each tank	5.724 m3/h (Refer Mass Flow Balance Design Point data stream no.($\frac{805}{2}$) x 2 units
				Retention Time	1 hr
				Required volume	5.724 m3/h x 1.0hr = 5.724 m3

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

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
				Tank Level is designated as follows	
				Top	4.0
				HH	3.5
				H	3.3
				L	1.2*
				LL	1.0*
				Circular Tank	
				Effective volume = 4.0 m $\Phi^2 / 4 \times \pi \times (3.5-1.2)$ m = 28.9 m3>24.221 m3	
				Hold Volume = 4.0 m $\Phi^2 / 4 \times \pi \times 3.5$ m = 43.98m3	

*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

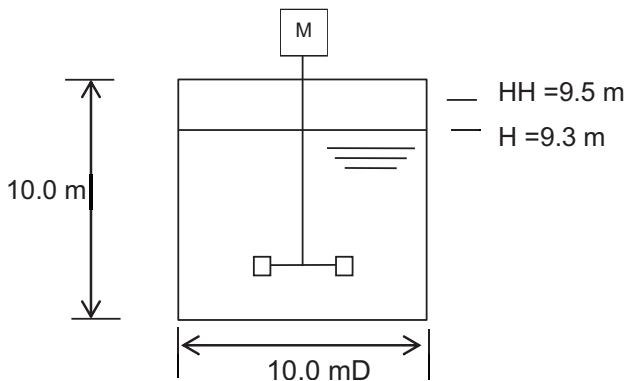
*L and LL level is finalized by vendor's information of hydro cyclone feed pump and agitator.

S. No	Item No	Service	Design Spec	Process Parameter	Design Basis
7	00HTM 05BB0 01	Waste water storage Tank	5500 mmD X 5500mmH- Quantity = 1 no.	Process Capacity	9.8 m3/h (Stream No: <205> x 2 Units)
				Retention Time	8.0 Hours
				Required volume	9.8 m3/h x 8.0 hr = 78.4 m3
				M </	

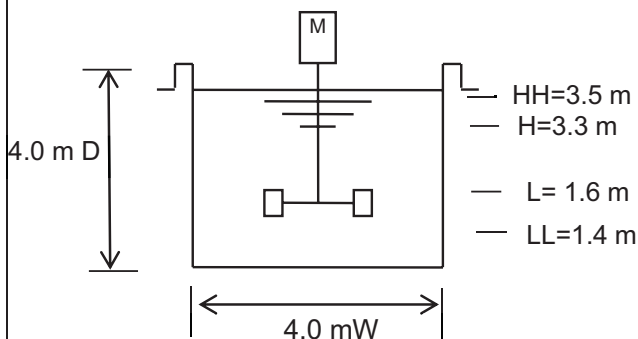
*L and LL level is finalized by vendor's information of Waste water pump and agitator.

S. No	Item No	Service	Design Spec	Process Parameter	Design Basis						
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*										
<											

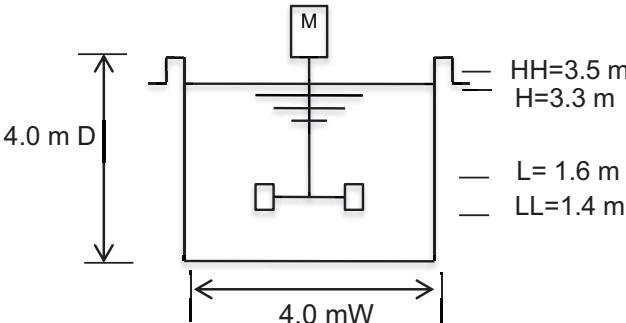
*L and LL level is finalized by vendor's information of Limestone slurry Feed pump and agitator.

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	
					Tank Level is designated to be empty during normal operation. Therefore the volume from bottom to H is considered as effective volume of tank.	
					Top	10.0
					HH	9.5
					H	9.3
					L	1.2*
					LL	1.0*
<u>Circular Tank</u>						
Effective volume						
$= 10.0 \text{ m } \Phi ^ 2 / 4 \times \pi \times 9.3 \text{ m}$						
$= 730.4 \text{ m}^3>724.8 \text{ m}^3$						
Hold Volume						
$= 10.0 \text{ m } \Phi ^ 2 / 4 \times \pi \times 9.5 \text{ m}$						
$= 746.13 \text{ m}^3$						

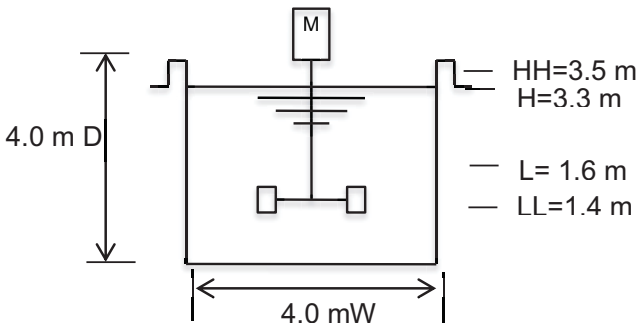
*L and LL level is finalized by vendor's information of Auxiliary Absorbent tank pump and agitator.

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 <table><tr><td>Top</td><td>4.0</td></tr><tr><td>HH</td><td>3.5</td></tr><tr><td>H</td><td>3.3</td></tr><tr><td>L</td><td>1.6*</td></tr><tr><td>LL</td><td>1.4*</td></tr></table> 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		Top	4.0	HH	3.5	H	3.3	L
Top	4.0														
HH	3.5														
H	3.3														
L	1.6*														
LL	1.4*														

*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.

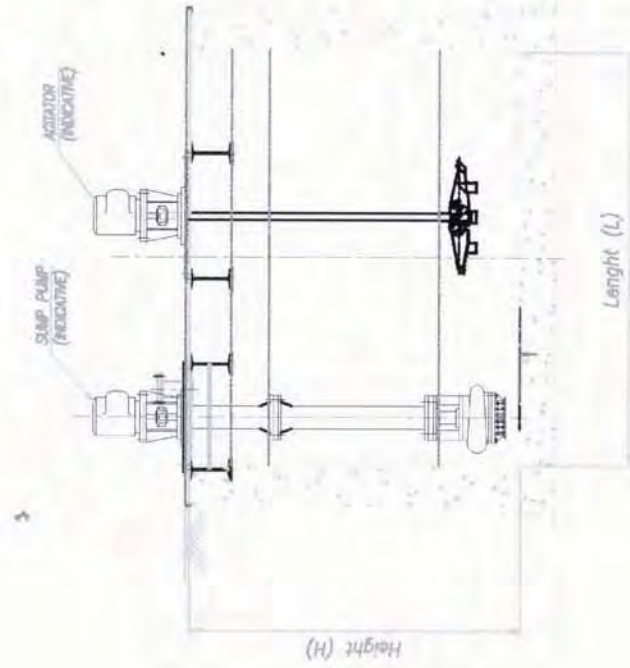
The above data is basic design data and may vary based on actual piping layout and selected vendor's recommendations.

Reference Documents

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

All dimensions are in mm

Sketch of Drain Pit (Typical)



Elevation



Plan

Note:

For dimension, please refer _____ of technical specifaion



TITLE:

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

SPECIFICATION No: PE-TS-468-167-A101

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 FGD TANKS	SPEC. NO.: PE-TS-468-167-A101
			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 Submission Date from LOI	Resubmission after incorporating comments
1	PE-V0-468-167-A001	FABRICATION DRAWING OF MISC. FGD TANK	5 weeks	Within 1 week
2	PE-V0-468-167-A002	DESIGN CALCULATION OF MISC. FGD TANKS INCLUDING ROOF STRUCTURE WITH STAAD CALCULATION	3 weeks	Within 1 week
3	PE-V0-468-167-A003	GA DRAWING OF MISC. FGD TANKS	4 weeks	Within 1 week
4	PE-V0-468-167-A004	DATASHEET & GA DRAWING OF RUBBER LINING & VINYL ESTER GLASS FLAKE FOR MISC. FGD TANKS	6 weeks	Within 1 week
5	PE-V0-468-167-A005	DATASHEET & GA DRAWING OF COMPONENTS FOR MISC. FGD TANKS	6 weeks	Within 1 week
6	PE-V0-468-167-A006	QAP OF RUBBER LINING & VINYL ESTER GLASS FLAKE FOR MISC. FGD TANKS	6 weeks	Within 1 week
7	PE-V0-468-167-A007	QAP OF COMPONENTS FOR MISC. FGD TANKS	6 weeks	Within 1 week
8	PE-V0-468-167-A008	SUB VENDOR LIST WITH INSPECTION CATEGORY FOR MISC. FGD TANKS	3 weeks	Within 1 week
9	PE-V0-468-167-A009	SURFACE PREPARATION AND LINING PROCEDURES FOR MISC. FGD TANKS	7 weeks	Within 1 week
10	PE-V0-468-167-A010	O&M MANUAL FOR RUBBER LINING & VINYL ESTER GLASS FLAKE	8 weeks	Within 1 week
11	PE-V0-468-167-A011	O&M MANUAL FOR MISC. FGD TANKS	8 weeks	Within 1 week

	TITLE:	2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATION FOR FGD TANKS	SPEC. NO.: PE-TS-468-167-A101
			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. COMPANY SEAL SIGNATURE: _____ NAME: _____ DESIGNATION: _____ COMPANY: _____ DATE: _____			



2 X 250 MW BHILAI FGD

SPECIFICATION No: PE-TS-468-167-A101

SECTION-II

**MISC. FGD TANKS
TECHNICAL SPECIFICATION**

REV. 00

Date: April, 2020

SECTION-II



2 X 250 MW BHILAI FGD

SPECIFICATION No: PE-TS-468-167-A101

**MISC. FGD TANKS
TECHNICAL SPECIFICATION**

SECTION-II

REV. 00

Date: April, 2020

**SECTION-II
SUB-SECTION-A**

STANDARD TECHNICAL SPECIFICATIONS- MECHANICAL



STANDARD TECHNICAL SPECIFICATION FOR MISCELLANEOUS TANKS

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

SECTION II

SUB-SECTION A

REVISION 00

April 2020

PAGE 1 of 8

1.0 SCOPE

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

2.0 CODES & STANDARDS

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

- I. IS-800: Code of practice for use of steel in general building construction
- II. IS-803: Code of practice for design, fabrication and erection of vertical mild steel cylindrical welded oil storage tank.
- III. IS-804: Specification for rectangular pressed steel tanks
- IV. IS-805: Code of practice for use of steel in gravity water tank.
- V. IS-816: Code of practice for metal arc welding for general construction in MS.
- VI. IS-817: Code of practice for training and testing for metal arc welder
- VII. IS-2825: Code of practice for unfired pressure vessel
- VIII. BS-2594: Specification for carbon steel welded horizontal cylindrical storage tank
- IX. BS-2654: Specification for vertical steel welded storage tanks with butt welded shells for the petroleum industry
- X. Indian Factories Act
- XI. American code for oil tanks API 650
- XII. Material Specification as per relevant IS / or approved equal
- XIII. American water works association standards (AWWA D100)

3.0 DESIGN REQUIREMENT

3.1 General Requirement

- 3.1.1 All tanks will be mild steel tanks. The tanks will be of welded construction and will be designed to withstand satisfactorily the internal forces due to the liquid which these tanks have to hold as specified and external forces due to wind and seismic forces without deformation or undue strain. The plates will be cold rolled through plate bending machines by several no. of passes to the curvature.



STANDARD TECHNICAL SPECIFICATION FOR MISCELLANEOUS TANKS

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

SECTION II

SUB-SECTION A

REVISION 00

April 2020

PAGE 2 of 8

- 3.1.2 Tank thickness shall be calculated as per IS803 latest edition. Intermediary wind girder design, Wind Design, Seismic design, anchor bolt design / selection etc. shall be done as per API 650 latest edition, latest addendum available at the time of detail engineering.
- 3.1.3 All tanks will be designed for the capacities, dimensions and working conditions as specified in this specification. The tanks will be provided with all necessary connections as specified. The design of tanks will be such as to allow easy inspection, cleaning and repair. Due consideration will be given to wind loading and adequate stiffening will be provided to prevent failure of tank due to buckling when it is empty. A **1.5 mm** corrosion allowance for shells, bottom and roofs above and beyond the required thickness / calculated thickness / nominal thickness as specified in the design code shall be provided.
- 3.1.4 Vessel seams shall be so positioned that they do not pass through nozzle connections on vessel. For vessels consisting of more than two sections, longitudinal seams shall be offset.
- 3.1.5 The inside seam should be ground smooth, suitable for application of corrosion resistant primer. If the stiffening of shell, bottom and / or roof is necessary, tanks will be stiffened from outside.
- 3.1.6 Flange faces of all nozzles shall be machined and squared with the vessel center line.
- 3.1.7 All roofs and supporting structures shall be designed to support dead load plus a uniform live load of not less than 150 kg/m² of projected area.
- 3.1.8 The tanks shall be designed to have all courses truly vertical. Adequate distance between vertical joints in adjacent courses shall be taken so that the distortion is reduced to minimum.
- 3.1.9 When removing temporary attachments from shell plates, care should be taken that parent plate is not damaged. Holes in plate work to assist in fabrication / erection should be avoided as far as possible. The location of holes and method of filling shall be indicated in the fabrication drawing. Any projection of metal shall be chipped and ground flush with the plate surface. The plate shall not be gouged or torn in process of removing lugs.
- 3.1.10 In the construction of shell, very care shall be taken to minimize distortion or lack of circularity due to welding or for any other reason.
- 3.1.11 Material of construction of all tanks shall be mild steel conforms to IS – 2062 grade – B unless otherwise specified in the specification. Material of construction for structure (angles, channels etc.) shall be IS 2062 Gr. A.

3.2 Alignment

- 3.2.1 Plates to be joined by butt-welding shall be matched accurately. Misalignment in completed vertical joints shall not exceed 10% of the plate thickness or 1.5 mm for plates of 20 mm thick and under, whichever is larger.
- 3.2.2 In completed horizontal butt joints, the upper plate shall not project beyond the face of the lower plate at any point by more than 20% of the upper plate thickness with a maximum of 3 mm for plate thickness exceeding 8 mm except that for plate thickness 8 mm and under, the maximum shall be 1.5 mm.



STANDARD TECHNICAL SPECIFICATION FOR MISCELLANEOUS TANKS

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

SECTION II

SUB-SECTION A

REVISION 00

April 2020

PAGE 3 of 8

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

3.3 WELDING

- 3.3.1 Tanks and other attachments shall be welded as per IS-816.
- 3.3.2 Welding sequence shall be so adopted that distortion due to welding shrinkage shall be minimum. Welding procedure specification shall be submitted for approval of BHEL giving details of material, welding position, sequence, type of electrode used, pre-heat & post weld requirement etc as per the code of construction. Brand name of electrodes to be used with proper classification (e.g. E 6013) shall be as per BHEL's approval.
- 3.3.3 Welding shall not be carried out when the surface is wet and during periods of rain and high winds unless the welder and the work are properly shielded which should meet the approval of the purchaser.
- 3.3.4 Inspection of all welds shall be carried out in accordance with the governing code of construction. All material used by the purchaser such as electrodes, gaskets, bolts, nuts etc. shall be conforming to relevant standards of repute and approved by the purchaser prior to use.
- 3.3.5 Each tank shall be complete with access staircase, ladder and safety cage and fittings like drain connection, overflow connection(pipe) till bottom of tank, tank inlet and outlet covers, level gauge glass, fittings with isolation cocks and protection covers, tank vent connection etc. all complete with needed accessories for the completeness of the tanks.
- 3.3.6 All openings in tank plate shall be well reinforced in approved manner by adding pad plates of adequate size and / or structural sections.

3.4 STAIRCASE / ACCESS LADDER AND HAND RAILING

- 3.4.1 All cylindrical vertical tanks shall be provided with spiral staircase and shall conform to the requirements specified in design codes / standards unless specified otherwise. All stair treads shall be 32 mm steel fabricated gratings. Each tread, if needed, shall be housed in individual steel fabricated frame which shall be adequately supported from the tank outer periphery. The staircase shall have minimum 1200 mm clear width.
- 3.4.2 Access ladder, one (1) for each horizontal cylindrical / rectangular tank shall be provided for access to the tank roof. It shall be steel fabricated having minimum 450 mm width. Ladder stringers shall be heavy steel flats or angle section. All rungs shall be minimum 20 mm diameter rods spaced at not more than 30 mm center to center. All ladders shall have steel fabricated safety cage to the approved construction. Safety cage shall be provided about 2.5 m clear height of the ladder. Access ladder's stringers shall be widely spaced at top for free access to the tank roof.
- 3.4.3 All staircase and roofs of vertical cylindrical tanks shall be provided with pipe hand railings of effective height as indicated in the relevant code / standard throughout. Handrails shall be constructed out of 32 mm medium class galvanized steel pipe conforming to IS- 1239: 1968. Handrail posts shall be arranged at spacing not greater than 1850 mm. Two (2) sets of pipes horizontal runners all along the length shall be provided. All welds joints in the handrails shall be ground flush to protect any person getting injured.



STANDARD TECHNICAL SPECIFICATION FOR MISCELLANEOUS TANKS

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

SECTION II

SUB-SECTION A

REVISION 00

April 2020

PAGE 4 of 8

Steel toe plates of 100 mm flats shall be used. Hand railing shall be fabricated and installed in an approved manner as directed by purchaser in accordance with approved drawings.

- 3.4.4 Unless otherwise specified, for all flanged connections, vendor shall furnish suitable counter flanges and necessary nuts, bolts and gaskets materials.
- 3.4.5 Unless otherwise specified, bolts and nuts shall be hexagonal head conforming to bolts and nuts shall be SA 193 & 194 respectively.
- 3.4.6 Gaskets shall be 3 mm thick full-face rubber. On completion of hydraulic test / water fill test, contractor shall replace the gaskets used during testing at his own cost.
- 3.4.7 During erection of tank, shell plates shall be suitably supported both for outside and inside to avoid buckling / collapsing of tank due to high-speed wind, gust or severe storm, if any, occurring during erection.

3.5 VERTICAL CYLINDRICAL STORAGE TANKS

- 3.5.1 The vertical cylindrical storage (non- pressure) tanks shall be of mild steel welded construction and shall be designed in accordance with codes and standards as specified. The vertical cylindrical storage tanks shall have slightly sloping bottom towards an adequately sized sump inside the tank to enable complete draining of the tank. The tank shall be designed for a wind pressure and seismic coefficient as specified.
- 3.5.2 Conical roof shall be either self-supported or supporting. The roof shall have a slope as specified in the relevant design code to ensure drainage of rainwater. Needed roof rafters and purlins adequately designed shall be provided.
- 3.5.3 All plates to be used for fabrication of tank shall be checked and all sides trimmed to make them square.
- 3.5.4 All bottom plates shall have butt weld joints to adequately support lining.
- 3.5.5 All shell course plates shall be taken during bending to prevent plate skewing. For butt weld joints, edges shall be prepared which shall be uniform and smooth throughout. To maintain needed root penetration gap at any butt weld joint, sufficient numbers of erection cleats shall be provided on all sides of outer periphery of each shell plate. Plates for tanks shall be straightened by pressing or by other non-injurious methods.
- 3.5.6 Each shell course shall be of uniform width throughout longitudinal weld in plates. Make up for the course width shall not be permitted. Shell plates in each course width shall be so arranged that all vertical joints be staggered having a minimum of 600 mm stagger. Shell thickness could be reduced in upper courses depending on design requirements but in no case the plate thickness shall be less than 6 mm.
- 3.5.7 The tank height shall be completed by the provision of top curb/ angle which shall be butt-welded to the adjacent tank plate courses. The outstanding leg of the curb angle shall be kept outside the tank periphery. All butt weld joints shall be full strength welds but for design of shell plate thickness adequate weld efficiency as recommended by applicable code(s) shall be used.

	STANDARD TECHNICAL SPECIFICATION FOR MISCELLANEOUS TANKS	SPECIFICATION NO. PE-TS-STD-167-A101	
		SECTION II	SUB-SECTION A
		REVISION 00	April 2020
		PAGE 5 of 8	

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

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

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

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

3.6 RECTANGULAR TANKS

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

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

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

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

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

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

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

	STANDARD TECHNICAL SPECIFICATION FOR MISCELLANEOUS TANKS	SPECIFICATION NO. PE-TS-STD-167-A101	
		SECTION II	SUB-SECTION A
		REVISION 00	April 2020
		PAGE 6 of 8	

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

3.9 HORIZONTAL CYLINDRICAL TANK

- 3.9.1 The horizontal cylindrical tank with dished ends shall be of mild steel welded construction and shall be designed in accordance with BS – 2594 / IS – 2825 / ASME as specified. The tank shall be designed for a wind pressure and seismic coefficient as specified. While worst of these two shall be considered, the permissible stress shall be increased as per relevant code / standard.
- 3.9.2 The shell and dished end plate thickness shall be chosen as per design requirement but in no case the dished end and shell plate thickness shall be less than 8 mm.
- 3.9.3 All seams, longitudinal as well as circumferential, shall be butt-welded. Longitudinal seams should not be situated in the lower one-third of a tank or on the top center line.
- 3.9.4 All tank shall be supplied with integral saddle support and shall be designed in accordance with BS-2594 / IS – 2825 / ASME as specified.

4.0 TESTING AND INSPECTION AT MANUFACTURER'S WORKS

4.1 General

- 4.1.1 The supplier shall provide inspection to establish and maintain quality of workmanship in his works and that of his subcontractors to ensure the mechanical accuracy of components, compliance with drawings identity and acceptability of all materials, parts and equipment. He shall conduct all tests required to ensure that the equipment and material furnished shall conform to requirements of the acceptable codes. All tests and test procedure proposed by manufacturer shall be submitted to the purchaser for their prior approval.
- 4.1.2 All materials used for manufacture of the equipment under this specification shall be of tested quality. Relevant test certificates shall be made available to the purchaser before the final shop inspection. In case the relevant correlating test certificates are not available, the supplier shall arrange to carry out the necessary tests required by codes at his own cost.
- 4.1.3 Alloy cast iron and cast steel components shall be tested for both physical and chemical properties in absence of purchaser's representatives. Test bears shall be either integral or taken from the same ladle of material as the casting they represent.
- 4.1.4 All materials including valves, instruments, pipings, flanges, counter flanges etc. shall be procured from BHEL approved manufacturer's only. Dealers are not acceptable.

4.2 TESTING AND INSPECTION FOR TANKS

- 4.2.1 The scope of testing and inspection for pressure vessel covered in this specification shall generally comprise of the following:
- Examination and approval of fabrication drawings to ensure that design, materials and fabrication details meet requirement of code and specifications. Purchaser will review these drawings for interface problems and conformity with the general arrangement drawings and accord their approval.

	STANDARD TECHNICAL SPECIFICATION FOR MISCELLANEOUS TANKS	SPECIFICATION NO. PE-TS-STD-167-A101	
		SECTION II	SUB-SECTION A
		REVISION 00	April 2020
		PAGE 7 of 8	

- II. Examination of materials of construction and identification with material test certificates.
- III. All the plates of thickness 50 mm or more shall be ultrasonically tested to ensure freedom from laminations.
- IV. Ensuring the relevant weld procedure and welder qualification tests are in accordance with stipulated code requirements.
- V. Inspection of dished end flanges and alloy steel bolting where required.
- VI. Inspection during fabrication at appropriate stages including fit ups.
- VII. For all butt welds, the root run and final run shall be subjected to dye-penetrant or magnetic particle inspection. For all fillet welds the final run shall be subjected to dye-penetrant / magnetic particle examination.
- VIII. Examination of radiographs including radiographic techniques, supervision of other non - destructive tests and heat treatment procedure as required by codes and specifications.
- IX. Examination of internal cleanliness before final closure.
- X. Dimensional examination of completed vessel including axis marking, proof marking, match marking etc.
- XI. Witnessing of hydrostatic, pneumatic or vacuum tests or special tests as required by the code and specification. In case of hydrostatic tests, the test pressure must be kept for a minimum of two hours.
- XII. Witnessing cleanliness, preservation, packing and marking.
- XIII. Stamping of vessel and issue of certificates.
- XIV. All tanks under this specification shall be tested as per the relevant design and testing code / standard. Supplier shall submit the detailed testing procedure for the tanks during detail engineering stage for BHEL / customer / consultant's approval and approved document shall be adhered by them and testing shall be done accordingly without any commercial implication.

4.2.2 NON - PRESSURE TANKS

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

- i. Identification of materials to manufacturer's test certificates.
- ii. Inspection of plate edges after edge preparation and checking curvature against templates if shell plates sent after rolling.
- iii. Checking of dimension and match marking.
- iv. **Bottom testing**

	STANDARD TECHNICAL SPECIFICATION FOR MISCELLANEOUS TANKS	SPECIFICATION NO. PE-TS-STD-167-A101	
		SECTION II	SUB-SECTION A
		REVISION 00	April 2020
		PAGE 8 of 8	

- a. After the bottom and bottom course of shell plates have been welded, the bottom shall be tested by pumping air beneath the bottom plates to a pressure just sufficient to lift them off the foundation and in any case not less than 100 mm water gauge. The pressure shall be held by construction of a temporary dam of clay or other suitable material around the tank periphery. Soap suds or other suitable material shall be applied to all joints for detection of leaks.
- b. Fuel oil may be used instead of air and soap suds to test for leaks, subject to prior agreement and approval of purchaser.
- c. Alternatively, the bottom seams may be tested by vacuum box method subject to prior agreement and approval of the purchaser. The vacuum box used shall comply with IS- 803, 1976 (figure-24)

v. Shell testing

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

vi. Roof testing

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

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

4.3 REPAIR OF LEAKS

- 4.3.1 All leaks detected during testing shall be repaired to the satisfaction of the purchaser and on completion retested for leakage as per approved procedure.
- 4.3.2 In the joints between roof plates only, pin hole leaks may be repaired by mechanical caulking. However, where there is any indication of considerable porosity, the leaks shall be sealed by laying down an additional layer of weld over the porous sections.
- 4.3.3 In all other joints, whether between shell plates or bottom plates or both, leak shall be repaired only by welding and if necessary, after first cutting out the defective part.
- 4.3.4 When the tank is filled with water for testing, defects in the shell joints shall be repaired with the water level at least 300 mm below the joint being repaired.
- 4.3.5 No welding shall be done on any tank unless all lines connecting thereto have been completely blanked off. No repairs shall be attempted on tanks while filled with oil, nor any tanks which have contained oil until the tanks have been emptied, cleaned and freed from gas in a safe manner. No repair shall be attempted on a tank which has contained oil except in a manner approved in writing by the purchaser, and in absence of the purchaser's inspector.



**2 X 250 MW BHILAI FGD
MISC. FGD TANKS
TECHNICAL SPECIFICATION**

SPECIFICATION No: PE-TS-468-167-A101

SECTION-II

REV. 00

Date: April, 2020

SECTION-II

SUB-SECTION-A

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



**2 X 250 MW BHILAI FGD
MISC. FGD TANKS
TECHNICAL SPECIFICATION**

SPECIFICATION No: PE-TS-468-167-A101

SECTION-II

REV. 00

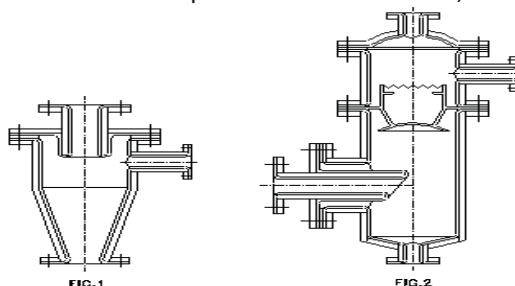
Date: April, 2020

1. INTRODUCTION:

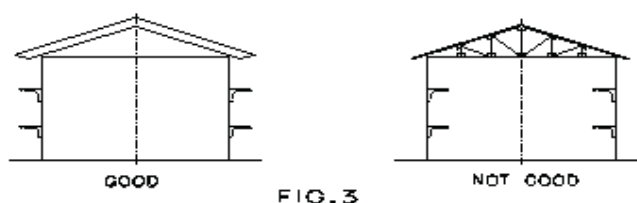
This guidance covers the minimum requirements for the design and fabrication of carbon steel vessels, equipment and pipes for rubber lining and VE Glass Flake lining.

2. GENERAL:

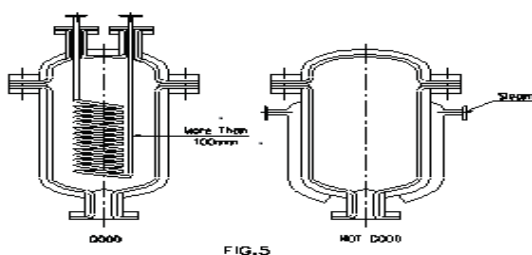
- 2-1 : Structure of steel constructions should be designed to withstand mechanical shocks under transportation and service. Particularly, hard rubber / VE Glass Flake lined vessels should be paid full attention because these vessels are liable to cause cracks when transported or installed.
- 2-2 : As the lining process is done manually, any constructions (except pipe) inaccessible by hands should be split into accessible one, as shown in Fig. 1.



- 2-3 : The parts tend to wear must be designed to be able to dismount and check or exchange easily as shown in Fig.2
- 2-4 : All lining surface should be designed as simple as possible and reinforcement must be provided on the side not to be lined as shown in Fig.3.



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





**2 X 250 MW BHILAI FGD
MISC. FGD TANKS
TECHNICAL SPECIFICATION**

SPECIFICATION No: PE-TS-468-167-A101

SECTION-II

REV. 00

Date: April, 2020

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

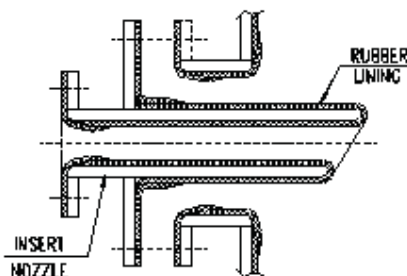


FIG.6

3. WELDING AND FINISHING:

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

- 3-1 : Welds and flush on the side to be lined shall be ground smoothly and must be free of cracks, undercuts, overlaps, pinholes and blowholes.
- 3-2 : Butt joint is preferable and overlap joint is not recommended for lining vessels. Welding must be generally made from both sides as shown in Fig. 7.

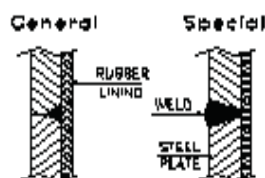


FIG.7

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

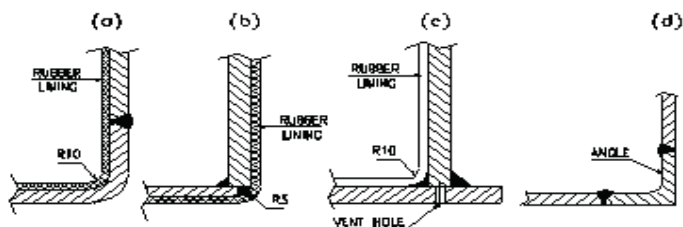


FIG.8

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



**2 X 250 MW BHILAI FGD
MISC. FGD TANKS
TECHNICAL SPECIFICATION**

SPECIFICATION No: PE-TS-468-167-A101

SECTION-II

REV. 00

Date: April, 2020

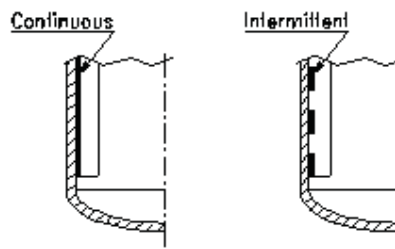


FIG. 9

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

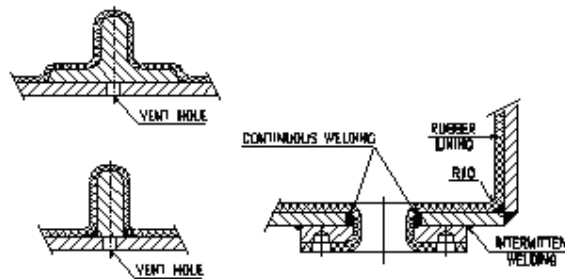


FIG. 10

4. PIPES AND FITTINGS:

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

Flat-faced flanges shall be welded on square to pipes or fittings. The weld on the front face should be continuous and ground to a smooth convex surface not less than 3 mm in radius.

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

4-1 . STRAIGHT PIPES:

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

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



**2 X 250 MW BHILAI FGD
MISC. FGD TANKS
TECHNICAL SPECIFICATION**

SPECIFICATION No: PE-TS-468-167-A101

SECTION-II

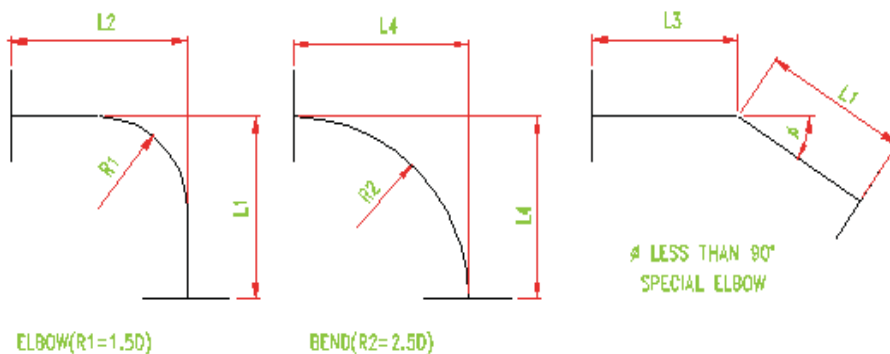
REV. 00

Date: April, 2020

4-2. STRAIGHT PIPES:

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

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



ALL DIMENSIONS IN MILLIMETRES:

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

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



**2 X 250 MW BHILAI FGD
MISC. FGD TANKS
TECHNICAL SPECIFICATION**

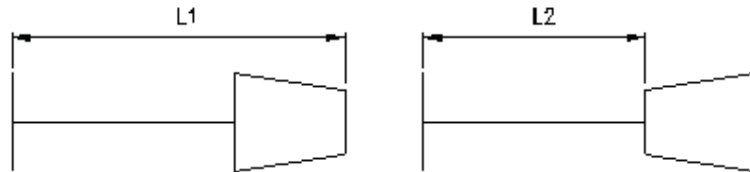
SPECIFICATION No: PE-TS-468-167-A101

SECTION-II

REV. 00

Date: April, 2020

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



REDUCING PIPES

4-3 REDUCING PIPES:

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

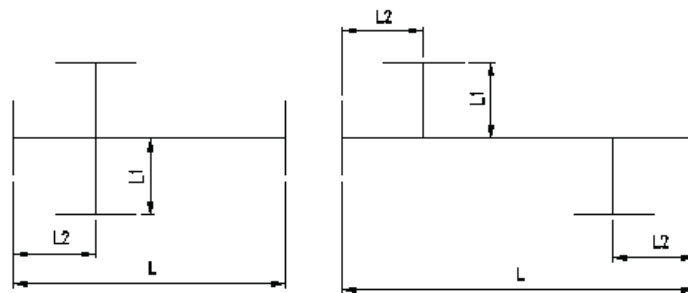
ALL DIMENSIONS IN MILLIMETERS

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

Note:

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

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





**2 X 250 MW BHILAI FGD
MISC. FGD TANKS
TECHNICAL SPECIFICATION**

SPECIFICATION No: PE-TS-468-167-A101

SECTION-II

REV. 00

Date: April, 2020

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

ALL DIMENSIONS IN MILLIMETERS

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

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

5. FLANGES AND GASKETS:

- 5-1 All branches and outlets of tank should be equipped with flange to allow the rubber lining to over flange face. Typical flanged joints are illustrated in Fig.11.
- 5-2 Mating flange of sectional tank should be square and plumb, and sections should be made to avoid distortion and when bolted together.
- 5-3 Normally, soft rubber gaskets should be interposed between lined flanges. If the flange faces have to withstand very high loads, the flanges joint shown in Fig. 11(d) should be used.

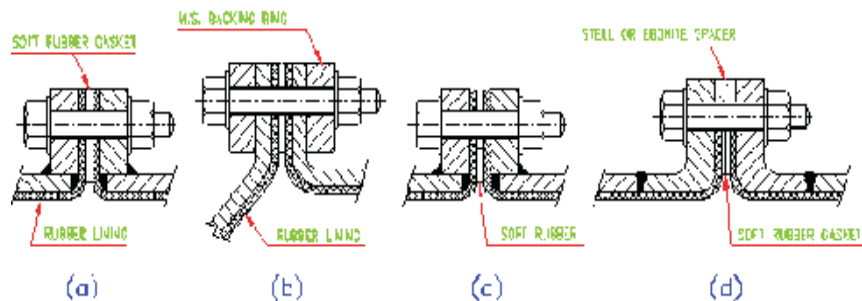


FIG.11



**2 X 250 MW BHILAI FGD
MISC. FGD TANKS
TECHNICAL SPECIFICATION**

SPECIFICATION No: PE-TS-468-167-A101

SECTION-II

REV. 00

Date: April, 2020

6. NOTES:

- 6-1 : Any surface of the base metal to be lined should not be coated with paint or oil.
- 6-2 : Any surface of the base metal to be lined should not be galvanized.
- 6-3 : Although it is possible to line on various construction materials, carbon steel is most preferable as substrate. For cast materials special care should be taken to prevent blowholes or cavities.

7. INSPECTION PROCEDURE AND STANDARD FOR LINING PIPES:

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

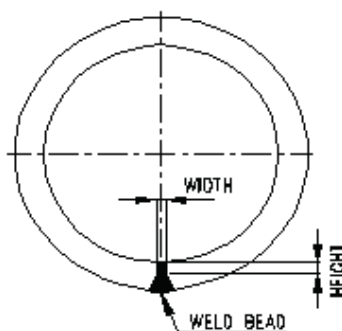
If any obstacle is detected, repairing should be requested to the fabricator of pipes.

7.1 INSPECTION OF WELD ZONE:

- a) **Visual inspection:**
Weld lines shall be free from weld cavity and spatters shall be completely removed.
Under-cut shall be 0.3 mm or less.
Appearance shall be not unsightly.
- b) **Check Curved faces at corner :**
Convex shall be 3 mm Radius at least, concave shall be 10 mm Radius at least.
- c) **Check height and width of weld bead :**

Diameter 550 mm or less :
Height - 0.1 ~ 0.2 mm
Width - 1.5 ~ 2.0 mm

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





**2 X 250 MW BHILAI FGD
MISC. FGD TANKS
TECHNICAL SPECIFICATION**

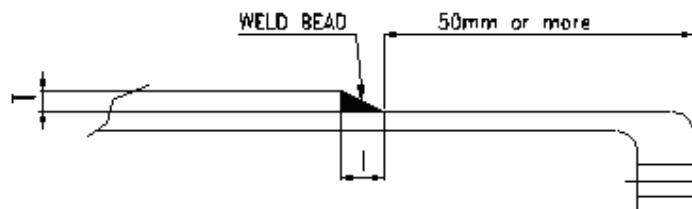
SPECIFICATION No: PE-TS-468-167-A101

SECTION-II

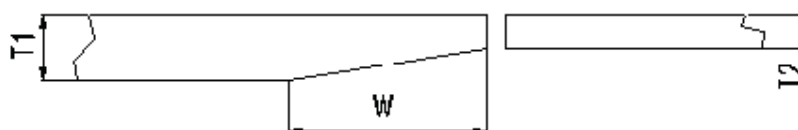
REV. 00

Date: April, 2020

d) Check finish of bead end:



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



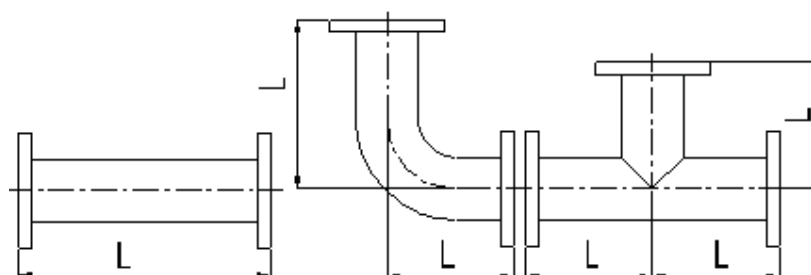
$$W = (T_1 - T_2) \times 10 \text{ mm or longer}$$

7-2 Visual inspection:

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

7-3 Dimensional inspection:

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



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

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

b) Inclination of flange:

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

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

c) misalignment of bolt holes :

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



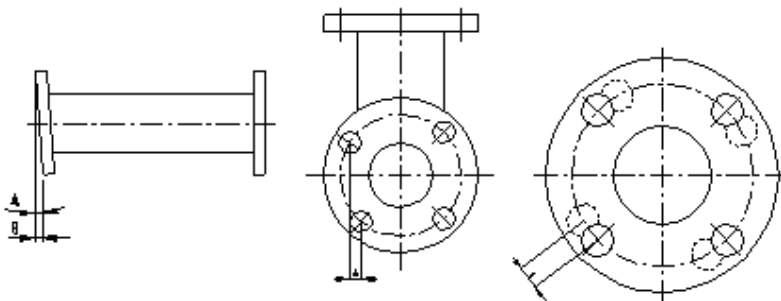
**2 X 250 MW BHILAI FGD
MISC. FGD TANKS
TECHNICAL SPECIFICATION**

SPECIFICATION No: PE-TS-468-167-A101

SECTION-II

REV. 00

Date: April, 2020



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

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

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

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

Note:

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



2 X 250 MW BHILAI FGD

SPECIFICATION No: PE-TS-468-167-A101

SECTION-II

**MISC. FGD TANKS
TECHNICAL SPECIFICATION**

REV. 00

Date: April, 2020

**SECTION-II
SUB-SECTION-B**

FORMAT FOR OPERATION AND MANITENANCE

Format for Operation & Maintenance Manual

Project name :

Project number :

Package Name :

PO reference :

Document number :

Revision number :

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

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

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



2 X 250 MW BHILAI FGD

SPECIFICATION No: PE-TS-468-167-A101

SECTION-II

**MISC. FGD TANKS
TECHNICAL SPECIFICATION**

REV. 00

Date: April, 2020

**SECTION-II
SUB-SECTION-C**

SITE STORAGE AND PRESERVATION GUIDELINES

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHNANICAL BOPs

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



PROJECT ENGINEERING MANAGEMENT, POWER SECTOR
BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

CONTENT

- 1 SCOPE OF THE DOCUMENT
- 2 PURPOSE OF STORAGE & PRESERVATION
- 3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION
 - a) GENERAL STORAGE REQUIREMENTS
 - b) GENERAL PRESERVATION REQUIREMENTS
 - c) GENERAL INSPECTION REQUIREMENTS
- 4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT
5. CONCLUSION
6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

1. SCOPE OF THE DOCUMENT

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

2. PURPOSE OF STORAGE & PRESERVATION

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

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

a) GENERAL STORAGE REQUIREMENTS

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

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

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

b) GENERAL PRESERVATION REQUIREMENTS

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

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.
11. Following preservatives/preservation methods can be used depending upon type of equipment
 - a. Rust preventive fluid (RPF)
 - b. Rust protective paints
 - c. Tarpaulin covers, in case of outdoor storage
 - d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –
 - Ingress of moisture and corrosion damages.
 - Damage to protective coating.
 - Open ends in pipes, vessels and equipment -
 - In case any open ends are noticed, same shall be capped.
2. Any damages to equipment / materials.
 - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
 - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

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

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

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



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

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





iii Open storage (O)

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

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

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



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

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

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

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

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H ₂ SO ₄)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

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

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

5. CONCLUSION

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

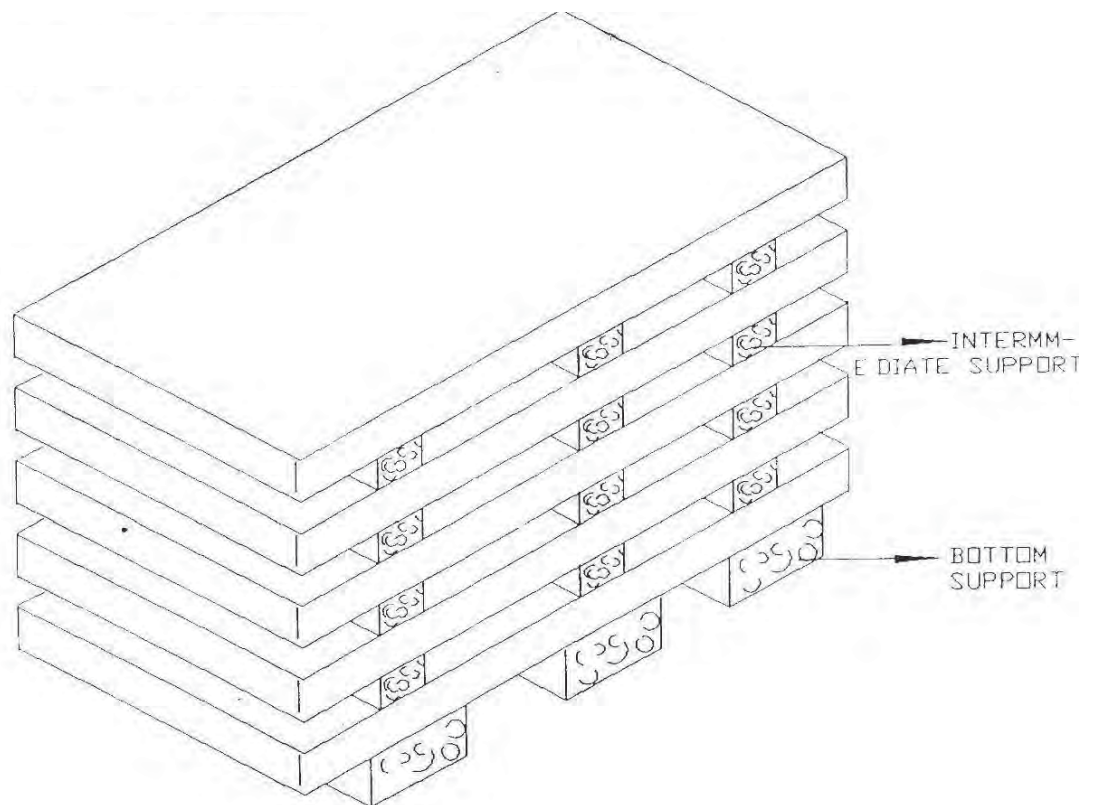


Figure – 1 – PLATE STACKING ARRANGEMENT

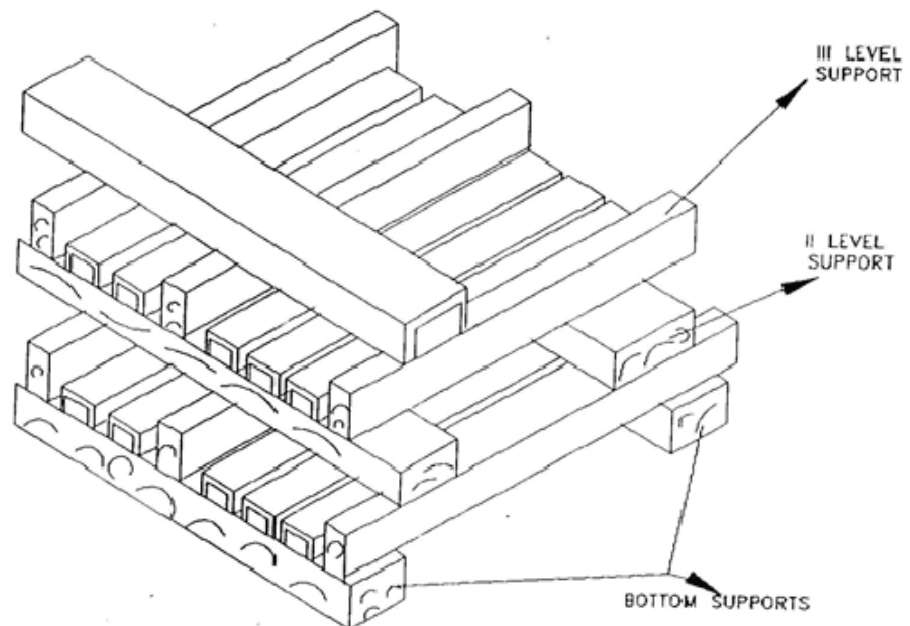


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

	2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATION FOR FGD TANKS	SPECIFICATION No: PE-TS-468-167-A101
		SECTION-III
		REV. 00
		Date: April, 2020
SECTION-III		

	2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATION FOR FGD TANKS	SPECIFICATION No: PE-TS-468-167-A101
		SECTION-III
		REV. 00
		Date: April, 2020

SECTION-III

ANNEXURE-1

LIST OF DOCUMENTS TO BE SUBMITTED WITH BID

	2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATION FOR FGD TANKS LIST OF DOCUMENTS TO BE SUBMITTED WITH BID	SPECIFICATION No: PE-TS-468-167-A101	
		SECTION : III	
		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-III)
2. Pre-bid clarification schedule as per format given under Section-III (Annexure-3), in case of any clarifications.
3. Deviation schedule as per format given under Section-III (Annexure-4), in case of any deviations by bidder.
4. Un priced format for main package (mentioning quoted against each item)
5. Un priced format for Tools and Tackles (mentioning quoted against each item)
6. Un priced format for Commissioning spare (mentioning quoted against each item)
7. List of makes of sub vendor items (refer annexure-5 of section-III)
8. FGD Tanks Schedule & GA Drawing (Typical) with Agitator Platform (refer annexure-8 of section-III)



**2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
MISC. FGD TANKS
COMPLIANCE CUM CONFIRMATION
CERTIFICATE**

SPECIFICATION No:PE-TS-468-167-A101

SECTION : III

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 MISC. FGD TANKS COMPLIANCE CUM CONFIRMATION CERTIFICATE	SPECIFICATION No:PE-TS-468-167-A101	
		SECTION : III	
		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 TECHNICAL SPECIFICATION FOR FGD TANKS	SPECIFICATION No: PE-TS-468-167-A101	
		SECTION-III	
		ANNEXURE-3	
		REV. 00	
		Date: April, 2020	

SECTION-III
ANNEXURE-3
PRE-BID CLARIFICATION SCHEDULE



2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR FGD TANKS

PRE-BID CLARIFICATION SCHEDULE

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

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

SIGNATURE: _____

NAME : _____

DESIGNATION: _____

COMPANY: _____

DATE: _____

COMPANY SEAL



2 X 250 MW BHILAI FGD
**TECHNICAL SPECIFICATION FOR
MISC. FGD TANKS**

SPECIFICATION NO. PE-TS-468-167-A101

SECTION-III

ANNEXURE-4

REV: 00

Date: April, 2020

**SECTION-III
ANNEXURE-4**

**SCHEDULE OF TECHNICAL
DEVIATION**

DEVIATION SHEET (COST OF WITHDRAWAL)									
 PROJECT:-2 X 250 MW BHILAI FGD									
PACKAGE:- MISC. FGD TANKS									
TENDER ENQUIRY REFERENCE:-									
NAME OF VENDOR:-									
SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWAL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWAL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWAL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
TECHNICAL DEVIATIONS									
COMMERCIAL DEVIATIONS									
PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE									
NAME				DESIGNATIONS		SIGN & DATE			
NOTES:									
1. For self manufactured items of bidder, cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.									
2. For directly dispatchable items, cost of withdrawal of deviation will be applicable on the basic price including taxes, duties & freight.									
3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.									
4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.									
5. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.									
6. Bidder shall furnish price copy of above format along with price bid.									
7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.									
8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.									
9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VIII of GCC will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.									
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.									
11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.									
12. Cost of withdrawal is to be given seperately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.									
13. In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.									
14. In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.									



**2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
MISC. FGD TANKS**

SPECIFICATION No: PE-TS-468-167-A101

SECTION-III

ANNEXURE-5

REV. 00

Date: April, 2020

**SECTION-III
ANNEXURE-5**

LIST OF MAKES OF ITEMS



2 X 250 MW BHILAI FGD

MISC. FGD TANKS
TECHNICAL SPECIFICATION

SPECIFICATION NO. PE-TS-468-167-A101

SECTION : III

ANNEXURE :5

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
MISC. FGD TANKS**

SPECIFICATION No: PE-TS-468-167-A101

SECTION-III

ANNEXURE-6

REV. 00

Date: April, 2020

**SECTION-III
ANNEXURE-6**

SPECIAL TOOLS & TACKLES

	2 X 250 MW BHILAI FGD TECHNICAL SPECIFICATION FOR MISC. FGD TANKS	SPECIFICATION NO. PE-TS-468-167-A101	
		SECTION : III	
		ANNEXURE-6	
		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 Tanks units. A list of such tools and tackles shall be submitted along with the offer.



**2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
MISC. FGD TANKS**

SPECIFICATION No: PE-TS-468-167-A101

SECTION : III

ANNEXURE-7

REV 00

Date: April, 2020

**SECTION: III
ANNEXURE-7**

LIST OF COMMISSIONING SPARES

SECTION- III, ANNEXURE-7

2 X 250 MW BHILAI FGD- MISC. FGD TANKS PACKAGE
LIST OF COMMISSIONING SPARES (Required for Commissioning of Misc. FGD Tanks
Break up price for COMMISSIONING SPARES

Sl. no	Description	Qty.	Unit	Unit price	Total Ex- Works Prices duly packed	ED	CST	FREIGHT Inclusive Service Tax	Total price FOR SITE
1	CAF Gasket of each size	2 nos.							
2	Nuts, bolts & washers of each size (nos. of bolts, nuts & washers as required for each nozzle) as per approved Drg.	1 lot							
3	Any other item required for successful commissioning of the tanks including rubber lining & VE Glass Flake lining (to be specified clearly by bidder)	1 lot							
NOTE -									
1. The items indicated in the above list are minimum. Any other spares if required shall be included by bidder in the above list.									
2. Bidder shall furnish unit price of commissioning spares in above format alongwith the Bid. Any part even though not mentioned in list furnished but required at later date shall be supplied free of cost.									
3. Bidder to note that the items indicated in the above list shall be provided prior to commissioning of the Misc FGD Tanks. Further, items indicated in the list shall be supplied over and above the consummables that is supplied along with the Misc FGD Tanks prior to start up.									



TITLE:

**2 X 250 MW BHILAI FGD
TECHNICAL SPECIFICATION FOR
MISC. FGD TANKS**

SPECIFICATION No: PE-TS-468-167-A101

SECTION-III

REV. 00

Date: April, 2020

**SECTION-III
ANNEXURE-8**

**FGD TANKS SCHEDULE
&
GA DRAWING (TYPICAL) WITH AGITATOR
PLATFORM**

TANK SCHEDULE (Signed and Stamped copy to be submitted with the offer by Bidder)													
Sl.no.	Description	Primary Hydrocyclone feed tank	Filtrate water tank	Secondary Hydrocyclone feed tank	Waste water Tank	Limestone Slurry Storage tank	Auxiliary Absorbent Tank	Process Water tanks	Belt wash tank	Cake wash tank	Absorber Area Drain Pit	Gypsum Dewatering Area Drain Pit	LIMESTONE AREA DRAIN PIT
1	Tank Sl No.	1	2	3	4	5	6	7	8	9	10	11	12
2	Type of agitator	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Marine Propeller – Horizontal Type (Side Entry).	Not applicable	Not applicable	Not applicable	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)
3	Medium to be handled	Gypsum slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Limestone slurry	Gypsum slurry	Process Water	Process/Clarified Water	Process/Clarified Water	Gypsum slurry	Gypsum slurry	Limestone slurry
4	Duty	Continuous	Continuous	Continuous	Continuous	Continuous	Intermittent-Whenever FGD is under maintenance	Not applicable	Not applicable	Not applicable	Intermittent	Intermittent	Intermittent
5	Agitator Location	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Not applicable	Not applicable	Not applicable	Outdoor	Outdoor	Outdoor
6	Operation	Continuous	Continuous	Continuous	Continuous	Continuous	Intermittent-Whenever FGD is under maintenance	Not applicable	Not applicable	Not applicable	Intermittent	Intermittent	Intermittent
7	Pipe Material Specification												
a)	150 NB & below	SAL06 Gr.B (IIR)	SAL06 Gr.B (IIR)	SAL06 Gr.B (IIR)	SAL06 Gr.B (IIR)	SAL06 Gr.B (IIR)	SAL06 Gr.B (IIR)	SAL06 Gr.B (IIR)	SAL06 Gr.B (IIR)	SAL06 Gr.B (IIR)	SAL06 Gr.B (IIR)	SAL06 Gr.B (IIR)	SAL06 Gr.B (IIR)
b)	Above 150 NB	IS-3582 (IIR)	IS-3582 (IIR)	IS-3582 (IIR)	IS-3582 (IIR)	IS-3582 (IIR)	IS-3582 (IIR)	IS-3582 (IIR)	IS-3582 (IIR)	IS-3582 (IIR)	IS-3582 (IIR)	IS-3582 (IIR)	IS-3582 (IIR)
8	Tank details												
a)	Tank Shape	Vertical cylindrical fixed cone roof	Vertical cylindrical fixed cone roof	Vertical cylindrical fixed cone roof	Vertical cylindrical fixed cone roof	Vertical cylindrical fixed cone roof	Vertical cylindrical fixed cone roof	Vertical cylindrical fixed cone roof	Vertical cylindrical fixed cone roof	Vertical cylindrical fixed cone roof	Rectangular	Rectangular	Rectangular
c)	Tank name	Primary Hydrocyclone feed tank	Filtrate water tank	Secondary Hydrocyclone feed tank	Waste water Tank	Limestone Slurry Storage tank	Auxiliary Absorbent Tank	Process water tanks	Belt wash tank	Cake wash tank	Absorber Area Drain Pit	Gypsum Dewatering Area Drain Pit	Limestone Area Drain Pit
d)	Tank Quantity (in No.)	1	1	1	1	2	1	2	2	2	2	1	1
e)	Capacity (Hold Volume)	88.40	43.98	50.30	118.80	604.40	746.13	63.62	17.67	17.67	56.00	56.00	56.00
f)	Capacity (Effective)	60.90	28.90	32.67	90.30	515.00	730.40	36.58	7.77	7.77	27.20	27.20	27.20
	Dimension (in m)												
a)	Diameter	5.0	4.0	4.0	5.5	9.0	10.0	4.5	3.0	3.0	-	-	-
b)	Length	-	-	-	-	-	-	-	-	-	4	4	4
h)	Breadth	-	-	-	-	-	-	-	-	-	4	4	4
j)	Height	5.0	4.0	4.5	5.5	10.0	10.0	4.5	3.0	3.0	4	4	4
2.7	Minimum liquid level in the tank	1.0	1.0	1.0	1.0	1.0	1.0	1.3	1.0	1.0	1.4	1.4	1.4
2.8	Normal liquid level in the tank	4.3	3.3	3.8	4.8	9.3	9.3	3.8	2.3	2.3	3.3	3.3	3.3
2.9	Maximum liquid level in the tank	4.5	3.5	4	5	9.5	9.5	4.0	2.5	2.5	3.5	3.5	3.5
	Quantity of Agitator per tank	1	1	1	1	1	3 (horizontally mounted in One tank)	Not applicable	Not applicable	Not applicable	1	1	1
10	Total quantity of agitators (for three units)	1	1	1	1	2	3 (horizontally mounted in One tank)	Not applicable	Not applicable	Not applicable	2	1	1
11 (i)	Slurry Analysis												
a)	Slurry to be handled	Gypsum slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Limestone slurry	Gypsum slurry	Water	Water	Water	Gypsum slurry	Gypsum slurry	Limestone slurry
b)	Maximum solid particle size	200 mesh (74 µ)	6-7 mm	200 mesh (74 µ)	200 mesh (74 µ)	200 mesh (74 µ)	200 mesh (74 µ)	-	-	-	6-7 mm	6-7 mm	6-7 mm
c)	Normal solid particle size, d50	325 mesh (44 µ)	6-7 mm	325 mesh (44 µ)	325 mesh (44 µ)	325 mesh (44 µ)	325 mesh (44 µ)	-	-	-	6-7 mm	6-7 mm	6-7 mm
d)	Solid to be handled	Gypsum along with limestone & other impurities	Gypsum along with limestone & other impurities	Gypsum along with limestone & other impurities	Gypsum along with limestone & other impurities	Limestone + impurities	Gypsum along with Limestone & other impurities	-	-	-	Gypsum along with limestone & other impurities	Gypsum along with limestone & other impurities	Limestone + impurities
e)	Chloride concentration	max 25000 ppm	max 25000 ppm	max 25000 ppm	max 25000 ppm	max 1000 ppm	max 25000 ppm	-	-	-	max 25000 ppm	max 25000 ppm	max 1000 ppm
f)	Hardness of particle	5-7 mohs scale	5-7 mohs scale	5-7 mohs scale	5-7 mohs scale	5-7 mohs scale	5-7 mohs scale	-	-	-	5-7 mohs scale	5-7 mohs scale	5-7 mohs scale
g)	Slurry concentration, wt%	30 wt%	11%	16.60%	3%	30 wt%	30%	-	-	-	30%	30%	30 wt%
h)	Sp. Gravity of slurry	1.213	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(wtg)	2.32(wtg)	2.32(wtg)	2.32(wtg)	2.32(wtg)	2.32(wtg)	-	-	-	2.32(wtg)	2.32(wtg)	2.32(wtg)
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

	I)	SiO ₂ Content	4 to 6 g/l Normal -62 deg C; Design-70 deg C.	4 to 6 g/l Normal -62 deg C; Design-70 deg C.	4 to 6 g/l Normal -62 deg C; Design-70 deg C.	4 to 6 g/l Normal -58 deg C; Design- 70 deg C.	-	-	-	4 to 6 g/l Normal -42 deg C; Design-70 deg C.	4 to 6 g/l Normal -42 deg C; Design-70 deg C.	4 to 6 g/l Normal -45 deg C; Design-55 deg C.
Process water Analysis												
a)	Calcium as CaCO3	-	-	-	-	-	-	-	-	-	-	-
b)	Magnesium as CaCO3	-	-	-	-	-	38	38	-	-	-	-
c)	Chlorides as CaCO3	-	-	-	-	22	22	22	-	-	-	-
d)	Sulphate as CaCO3	-	-	-	-	20	20	20	-	-	-	-
e)	Alkalinity as CaCO3	-	-	-	-	17	17	17	-	-	-	-
f)	Total Iron as Fe	-	-	-	-	54	54	54	-	-	-	-
g)	Total Silica as SiO2	-	-	-	-	0.1	0.1	0.1	-	-	-	-
h)	pH	-	-	-	-	7	7	7	-	-	-	-
i)	Turbidity as NTU	-	-	-	-	7.5	7.5	7.5	-	-	-	-
Inside Lining of tank (Refer Note-3)												
12												
a)	Lining specification	4MM thick of best quality bromine butyl rubber lining with hardness 55+/5 (Shore A hardness)	3MM thick Vinyl Ester based flake glass lining	3MM thick Vinyl Ester based flake glass lining	4MM thick of best quality brominated rubber lining with hardness 55+/5 (Shore A hardness)	4MM thick of best quality bromine butyl rubber lining with hardness 55+/5 (Shore A hardness)	Epoxy lining minimum three coats of 150 microns thickness	Epoxy lining minimum three coats of 150 microns thickness	Epoxy lining minimum three coats of 150 microns thickness	3MM thick Vinyl Ester based flake glass lining	3MM thick Vinyl Ester based flake glass lining	3MM thick Vinyl Ester based flake glass lining
13	MATERIAL SPECIFICATION											
a)	Shell, Roff, Baffle and Baffle Plate	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	NA	NA	NA
b)	Structures	IS:2062 E250 GRADE A/B/R	IS:2062 E250 GRADE A/B/R	IS:2062 E250 GRADE A/B/R	IS:2062 E250 GRADE A/B/R	IS:2062 E250 GRADE A/B/R	A/B/R	IS:2062 E250 GRADE A/B/R	IS:2062 E250 GRADE A/B/R	IS:2062 E250 GRADE A/B/R	IS:2062 E250 GRADE A/B/R	IS:2062 E250 GRADE A/B/R
c)	Stairways & Platforms	IS:2062 E250 GRADE A/B/R	IS:2062 E250 GRADE A/B/R	IS:2062 E250 GRADE A/B/R	IS:2062 E250 GRADE A/B/R	IS:2062 E250 GRADE A/B/R	A/B/R	IS:2062 E250 GRADE A/B/R	IS:2062 E250 GRADE A/B/R	NA	NA	NA
d)	Manhole	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	A/B/R	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	NA	NA	NA
e)	Nozzle	A106 Gr.B	A106 Gr.B	A106 Gr.B	A106 Gr.B	A106 Gr.B	A106 Gr.B	A106 Gr.B	A106 Gr.B	NA	NA	NA
f)	Nozzle Flanges	DN25 - DN600: IS:2062 Gr.B (plate) SO FF ASME B 16.5 Cl.150	DN25 - DN600: IS:2062 Gr.B (plate) SO FF ASME B 16.5 Cl.150	DN25 - DN600: IS:2062 Gr.B (plate) SO FF ASME B 16.5 Cl.150	DN25 - DN600: IS:2062 Gr.B (plate) SO FF ASME B 16.5 Cl.150	DN25 - DN600: IS:2062 Gr.B (plate) SO FF ASME B 16.5 Cl.150	DN25 - DN600: IS:2062 Gr.B (plate) SO FF ASME B 16.5 Cl.150	DN25 - DN600: IS:2062 Gr.B (plate) SO FF ASME B 16.5 Cl.150	DN25 - DN600: IS:2062 Gr.B (plate) SO FF ASME B 16.5 Cl.150	NA	NA	NA
g)	Nozzle Reinforcement	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	NA	NA	NA
h)	Nozzle Nicks	IS:1239	IS:1239	IS:1239	IS:1239	IS:1239	IS:1239	IS:1239	IS:1239	NA	NA	NA
i)	Hand Railing	IS:1239 (MEDIUM), GALVANIZED	IS:1239 (MEDIUM), GALVANIZED	IS:1239 (MEDIUM), GALVANIZED	IS:1239 (MEDIUM), GALVANIZED	IS:1239 (MEDIUM), GALVANIZED	GALVANIZED	IS:1239 (MEDIUM), GALVANIZED	IS:1239 (MEDIUM), GALVANIZED	IS:1239 (MEDIUM), GALVANIZED	IS:1239 (MEDIUM), GALVANIZED	IS:1239 (MEDIUM), GALVANIZED
j)	Gaskets	BUTYL RUBBER	BUTYL RUBBER	BUTYL RUBBER	BUTYL RUBBER	BUTYL RUBBER	BUTYL RUBBER	BUTYL RUBBER	BUTYL RUBBER	SA 193 GR B7 & SA 194 GR 2H	SA 193 GR B7 & SA 194 GR 2H	SA 193 GR B7 & SA 194 GR 2H
k)	Bolts & Nuts	SA 193 GR B7 & SA 194 GR 2H	SA 193 GR B7 & SA 194 GR 2H	SA 193 GR B7 & SA 194 GR 2H	SA 193 GR B7 & SA 194 GR 2H	SA 193 GR B7 & SA 194 GR 2H	SA 193 GR B7 & SA 194 GR 2H	SA 193 GR B7 & SA 194 GR 2H	SA 193 GR B7 & SA 194 GR 2H	SA 193 GR B7 & SA 194 GR 2H	SA 193 GR B7 & SA 194 GR 2H	SA 193 GR B7 & SA 194 GR 2H
l)	Fittings	DN25 - DN50: SW A234-WPB ASME-B16.11	DN25 - DN50: SW A234-WPB ASME-B16.11	DN25 - DN50: SW A234-WPB ASME-B16.11	DN25 - DN50: SW A234-WPB ASME-B16.11	DN25 - DN50: SW A234-WPB ASME-B16.11	DN25 - DN50: SW A234-WPB ASME-B16.11	DN25 - DN50: SW A234-WPB ASME-B16.11	DN25 - DN50: SW A234-WPB ASME-B16.11	DN25 - DN50: SW A234-WPB ASME-B16.11	DN25 - DN50: SW A234-WPB ASME-B16.11	DN25 - DN50: SW A234-WPB ASME-B16.11
m)	Earthling Lug	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR	IS:2062 E250 GRADE BR
n)	Anchor Bolt	IS:1367 PART 3, CLASS 4.4	IS:1367 PART 3, CLASS 4.4	IS:1367 PART 3, CLASS 4.4	IS:1367 PART 3, CLASS 4.4	IS:1367 PART 3, CLASS 4.4	IS:1367 PART 3, CLASS 4.4	IS:1367 PART 3, CLASS 4.4	IS:1367 PART 3, CLASS 4.4	IS:1367 PART 3, CLASS 4.4	IS:1367 PART 3, CLASS 4.4	IS:1367 PART 3, CLASS 4.4
o)	Faste-ners used in wetted condition	ALLOY 926 or BETTER MATERIAL	ALLOY 926 or BETTER MATERIAL	ALLOY 926 or BETTER MATERIAL	ALLOY 926 or BETTER MATERIAL	ALLOY 926 or BETTER MATERIAL	ALLOY 926 or BETTER MATERIAL	ALLOY 926 or BETTER MATERIAL	ALLOY 926 or BETTER MATERIAL	ALLOY 926 or BETTER MATERIAL	ALLOY 926 or BETTER MATERIAL	ALLOY 926 or BETTER MATERIAL
DESIGN DATA												
a)	Design Code	IS-803 1976 (REAFFIRMED 2013) or latest	IS-803 1976 (REAFFIRMED 2013) or latest	IS-803 1976 (REAFFIRMED 2013) or latest	IS-803 1976 (REAFFIRMED 2013) or latest	IS-803 1976 (REAFFIRMED 2013) or latest	IS-803 1976 (REAFFIRMED 2013) or latest	IS-803 1976 (REAFFIRMED 2013) or latest	IS-803 1976 (REAFFIRMED 2013) or latest	NA	NA	NA
b)	Roof Slope	5°	5°	5°	5°	5°	5°	5°	5°	NA	NA	NA
c)	Design Pressure	Atmospheric	Atmospheric	Atmospheric	Atmospheric	Atmospheric	Atmospheric	Atmospheric	Atmospheric	NA	NA	NA
d)	Operating Pressure	Atmospheric	Atmospheric	Atmospheric	Atmospheric	Atmospheric	Atmospheric	Atmospheric	Atmospheric	NA	NA	NA
e)	Hydro Testing	Water filled head upto overflow nozzle	Water filled head upto overflow nozzle	Water filled head upto overflow nozzle	Water filled head upto overflow nozzle	Water filled head upto overflow nozzle	Water filled head upto overflow nozzle	Water filled head upto overflow nozzle	Water filled head upto overflow nozzle	NA	NA	NA
f)	Joint Efficiency	As per IS	As per IS	As per IS	As per IS	As per IS	As per IS	As per IS	As per IS	NA	NA	NA
g)	Radiography	As per IS	As per IS	As per IS	As per IS	As per IS	As per IS	As per IS	As per IS	NA	NA	NA

PROJETCT: 2 X 250 MW BHILAI FGD

ANNEXURE- 9 (NOZZLE SCHEDULE)

1.PRIMARY HYDRO CYCLONE FEED TANK				
S.N.	NOZZLE MARK	SIZE (NB)	QTY (NOS)	SERVICE
1	N1 A/B	80	2	INLET TO TANK ON ROOF
2	N2	125	1	INLET TO TANK ON ROOF
3	A1	300	1	AGITATOR NOZZLE ON ROOF
4	MH1/MH2	800	2	MANHOLE ON SHELL AND ROOF
5	N3	250	1	TANK OVERFLOW
6	LT-1/LT-2	80	2	LEVEL TRANSMITTER ON ROOF
7	V1	80	1	VENT ON ROOF
8	N4	125	1	TANK DRAIN TO OVERFLOW
8	N6	125	1	TANK DRAIN
9	N5 A/B	150	2	PUMP SUCTION (OUTLET)
2.FILTERATE WATER TANK				
S.N.	NOZZLE MARK	SIZE (NB)	QTY (NOS)	SERVICE
1	N1 A/B/C/D	150	4	INLET TO TANK ON ROOF
2	N2 A/B	100	2	INLET TO TANK ON ROOF
3	N3	100	1	INLET TO TANK ON ROOF
4	N4	50	1	INLET TO TANK ON ROOF
5	N5	150	1	INLET TO TANK ON ROOF
6	A1	300	1	AGITATOR NOZZLE ON ROOF
7	MH1/MH2	800	2	MANHOLE ON SHELL AND ROOF
8	N6	200	1	TANK OVERFLOW
9	LT-1/LT-2	80	2	LEVEL TRANSMITTER ON ROOF
10	V1	80	1	VENT ON ROOF
11	N7	100	1	TANK DRAIN TO OVERFLOW
12	N8	100	1	TANK DRAIN
13	N9 A/B	150	2	PUMP SUCTION (OUTLET)
3.SECONDARY HYDRO CYCLONE FEED TANK				
S.N.	NOZZLE MARK	SIZE (NB)	QTY (NOS)	SERVICE
1	N1 A/B	200	2	INLET TO TANK ON ROOF
2	N2	100	1	INLET TO TANK ON ROOF
3	A1	300	1	AGITATOR NOZZLE ON ROOF
4	MH1/MH2	800	2	MANHOLE ON SHELL AND ROOF
5	N3	200	1	TANK OVERFLOW
6	LT-1/LT-2	80	2	LEVEL TRANSMITTER ON ROOF
7	N4	100	1	TANK DRAIN TO OVERFLOW
8	N5	100	1	TANK DRAIN
9	N6 A/B	125	2	PUMP SUCTION (OUTLET)
10	V1	80	1	VENT ON ROOF

4. WASTE WATER TANK				
S.N.	NOZZLE MARK	SIZE (NB)	QTY (NOS)	SERVICE
1	N1 A/B	150	2	INLET TO TANK ON ROOF
2	N2	50	1	INLET TO TANK ON ROOF
3	N3	50	1	INLET TO TANK ON ROOF
4	A1	350	1	AGITATOR NOZZLE ON ROOF
5	MH1/MH2	800	2	MANHOLE ON SHELL AND ROOF
6	N4	200	1	TANK OVERFLOW
7	LT-1/LT-2	80	2	LEVEL TRANSMITTER ON ROOF
8	AT-1/AT-2	80	2	ANALYSER TRANSMITTER ON ROOF
9	V1	80	1	VENT ON ROOF
10	N5	150	1	TANK DRAIN TO OVERFLOW
11	N6	100	1	TANK DRAIN
12	N7 A/B	100	2	PUMP SUCTION (OUTLET)
5. LIMESTONE SLURRY STORAGE TANKS - 2 NOS				
S.N.	NOZZLE MARK	SIZE (NB)	QTY (NOS)	SERVICE
1	N1 A/B	150	2	INLET TO TANK ON ROOF
2	N2 A/B	80	2	INLET TO TANK ON ROOF
3	A1	450	1	AGITATOR NOZZLE ON ROOF
4	MH1/MH2	800	2	MANHOLE ON SHELL AND ROOF
5	N3	200	1	TANK OVERFLOW
6	LT-1/LT-2	80	2	LEVEL TRANSMITTER ON ROOF
7	DT-1/DT-2	80	2	DENSITY TRANSMITTER ON ROOF
8	V1	80	1	VENT ON ROOF
9	N4	200	1	TANK DRAIN TO OVERFLOW
10	N5	100	1	TANK DRAIN
11	N6 A/B	100	2	PUMP SUCTION (OUTLET)
6. AUXILIARY ABSORBENT TANK				
S.N.	NOZZLE MARK	SIZE (NB)	QTY (NOS)	SERVICE
1	N1 A/B	250	2	INLET TO TANK ON ROOF
2	N2 A/B/C/D	200	4	INLET TO TANK ON ROOF
3	A1 / A2 / A3	300	3	AGITATOR NOZZLE ON SHELL
4	MH1/MH2	800	2	MANHOLE ON SHELL AND ROOF
5	N3	250	1	TANK OVERFLOW
6	LT-1	80	1	LEVEL TRANSMITTER ON ROOF
7	V1	80	1	VENT ON ROOF
8	N54	200	1	TANK DRAIN
9	N5 A/B	150	2	PUMP SUCTION (OUTLET)

7. PROCESS WATER TANKS - 2 NOS				
S.N.	NOZZLE MARK	SIZE (NB)	QTY (NOS)	SERVICE
1	N1	250	1	INLET TO TANK ON ROOF
2	N2 A/B/C/D	50	4	INLET TO TANK ON ROOF
3	N3 A/B/C/D	80	4	INLET TO TANK ON ROOF
4	MH1/MH2	800	2	MANHOLE ON SHELL AND ROOF
5	N4	250	1	TANK OVERFLOW
6	LT-1/LT-2	80	2	LEVEL TRANSMITTER ON ROOF
7	N5	80	1	VENT ON ROOF
8	N6	125	1	TANK DRAIN
9	N7	250	1	PUMP SUCTION (OUTLET)
10	N8	350	1	PUMP SUCTION (OUTLET)
8. BELT FILTER WASH TANKS - 2 NOS				
S.N.	NOZZLE MARK	SIZE (NB)	QTY (NOS)	SERVICE
1	N1	50	1	INLET TO TANK ON ROOF
2	N2	32	1	INLET TO TANK ON ROOF
3	MH1/MH2	800	2	MANHOLE ON SHELL AND ROOF
4	N3	80	1	TANK OVERFLOW
5	LT-1/LT-2	80	2	LEVEL TRANSMITTER ON ROOF
6	V1	50	1	VENT ON ROOF
7	N4	80	1	TANK DRAIN
8	N5 A/B	50	2	PUMP SUCTION (OUTLET)
9. CAKE WASH (CLARIFIED WATER) TANKS - 2 NOS				
S.N.	NOZZLE MARK	SIZE (NB)	QTY (NOS)	SERVICE
1	N1	150	1	INLET TO TANK ON ROOF
2	N2 A/B	50	1	INLET TO TANK ON ROOF
3	MH1/MH2	800	2	MANHOLE ON SHELL AND ROOF
4	N3	100	1	TANK OVERFLOW
5	LT-1/LT-2	80	2	LEVEL TRANSMITTER ON ROOF
6	V1	50	1	VENT ON ROOF
7	N4	80	1	TANK DRAIN
8	N5 A/B	100	2	PUMP SUCTION (OUTLET)
Notes				
1: The above shown sizes and number of nozzles are indicative and for estimation purpose only. Final number and sizes of nozzles shall be furnished during detailed engineering.				